TECHNICAL REPORT

Piloting a process for Emerging Risks Identification: Lessons learnt and next steps[1]

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ABSTRACT

A process for ERI was trialled and further developed between 2010-2012 by the Emerging Risks unit which has the responsibility of coordinating EFSA's activities to establish a capacity for emerging risks identification (ERI). This included the implementation of an operational process for ERI, the assessment of selected data sources, the testing of tools for collecting information, the consolidation of knowledge networks for sharing information, and the development of a methodological framework. Using an expert judgment approach, specific issues were identified for follow-up activities including 4 outsourced projects (*i.e.* impact of climate change on aflatoxin emergence in cereal crops, omics technologies in risk assessment, a European-wide survey on energy drink consumption, and developing approaches for assessing human health risks from exposure to multiple chemical residues), 3 internal task forces (*i.e.* bee health, emerging tools and methods for hazard assessment, and chemical mixtures), and 2 reports on trade and food prices. These follow-up activities will contribute to the determination of whether the issues identified are indeed emerging risks. The issues prioritised were identified mainly from the scientific literature and expert networks. Overall, our experience shows that ERI requires a high level of expertise due to major data gaps and uncertainties in the evaluation process. Effective networking has proven to be essential for exchanging methods, data and evaluations of emerging risks. The system piloted has shown some potential for the identification of issues that may give rise to emerging risks, and useful knowledge has been gained in gathering and filtering large amounts of information, and building knowledge networks on emerging risks. Next steps include the establishment of a standing working group of the Scientific Committee on emerging risks, the reinforcement of the engagement with Member States and Stakeholders, the fine tuning of the methodological framework, and the completion of the projects on the issues identified.

KEY WORDS

Emerging risks, emerging issues, expert judgment, network, stakeholders;

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SUMMARY

The Emerging Risks (EMRISK) unit has the responsibility of coordinating EFSA's activities to establish a capacity for emerging risks identification (ERI). This should provide an opportunity for risk assessors to undertake further investigations leading possibly to a full risk assessment, and for risk managers to subsequently potentially consider putting in place appropriate prevention or mitigation measures.

A process for ERI was trialled and further developed between Feb 2010 and May 2012. This includes (i) the implementation of an operational process for ERI, (ii) the assessment of selected sources of information, (iii) the establishment and testing of tools for the collection and filtering of relevant information, (iv) the consolidation of knowledge networks for sharing information, and (v) the further development of a methodological framework.

(i) More than 2200 issues, mainly from rapid alert system for food and feed (RASFF) and the scientific literature, were evaluated using an expert judgment approach. Specific issues were identified, for which follow-up activities have been initiated. These include 4 outsourced projects (*i.e.* a study on the emergence of aflatoxins in cereal crops in the EU due to climate change, a European-wide survey to gather consumption data on energy drinks focussed on young populations, a study on the future impact of omics technologies in food and feed safety risk assessment and ERI, and a project to develop approaches for assessing human health risks from exposure to multiple chemical residues), 3 internal task forces (*i.e.* on the bee health and weakening of honey bee colonies, emerging tools and methods for hazard assessment, and chemical mixtures), and 2 reports on the fluctuations in trade volumes and food prices as drivers of emerging risks. The information from these follow-up actions is being produced or processed in order to contribute to the determination of whether the issues identified are indeed emerging risks.

(ii) In this pilot phase, the usefulness, in terms of ERI, of five principle sources of information were assessed, *i.e.* the RASFF, the media, the scientific literature and trade and price data. Issues prioritised for action were identified mainly from the scientific literature, whereas the RASFF and trade did not seem to readily fit the purpose of ERI. Media monitoring appeared to have some potential in specific areas such as plant health, animal health and GMO. In order to collect and analyse trade and pricing data for the identification of drivers of emerging risks, expert consultations would be pivotal for the final interpretation of the results with respect to ERI. Knowledge networks of experts appeared to be the most profitable source of information for ERI.

(iii) A working group (WG) on data collection for ERI proposed a procedure to identify, assess, rank and prioritize data sources. In order to identify useful sources of information, however, clear targeted issues/topics should be first identified, as a systematic screening of data sources appreared to be unfeasible with the available resources. IT tools were developed and tested to support data collection. Whilst IT-tools could provide large amounts of information in a short time, they presented analysts with the additional problem of being overwhelmed by data that needed to be carefully screened and interpreted by skilled practitioners. In order to harmonise and standardise data collection and to facilitate information exchange among the different players involved in ERI, a semi-structured briefing note template and the EMRISK Monitoring Database were developed. This database includes essential information on all the issues evaluated and the decisions taken on follow-up actions. The use of templates and the maintenance of the EMRISK monitoring database appeared to be a valid support for the development of a standardised procedure for ERI, including *ad hoc* reporting and sharing of information.

(iv) Effective networking was identified as being essential for exchanging experience, methods, data and evaluations of emerging risks. To this end, the Emerging Risks Exchange Network (EREN) and the Stakeholder Consultative Group on Emerging Risks (StaCG-ER) were operated. In their first year of operation, the emphasis was on describing existing systems and methodologies used to identify emerging risks. It is proposed to reinforce the role and membership of EREN with selected EU-agencies and with international authorities and organisations, and to encourage greater stakeholder engagement and data exchange with StaCG-ER.

(v) A WG on methodology for ERI assessed the effectiveness of the procedure under development at EFSA, and proposed a revised simplified framework and several recommendations for improvement.

Overall, our experience shows that collecting useful information on emerging risks requires a high level of expertise due to the data gaps, and broad knowledge of all ongoing EFSA activities to avoid duplication of work. It is, thus, proposed to establish a standing WG, including experts from the EFSA Scientific Committe and Panels, to work closely with the EMRISK unit.

Building on this hands-on experience, the system is starting to show the potential for the identification of issues that may give rise to emerging risks. In particular, useful knowledge has been gained in gathering, evaluating and filtering large amounts of information related to emerging risks and building knowledge networks on emerging risks. From this, a simplified and updated process will be implemented during the next three years.

Next steps include the establishment of a standing WG of the Scientific Committee to support EFSA activities on ERI, the reinforced engagement with the Member States Network and the Stakeholder Consultative Group, the fine tuning of the revised methodological framework, and the completion of the projects on the issues identified.

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BACKGROUND AS PROVIDED BY EFSA

The successful identification of risks at their early inception (emerging risks) is at the heart of public health and environmental protection. According to EFSA's Founding Regulation[3], the Authority is required to *"undertake action to identify and characterise emerging risks"* in the field of food and feed safety. In 2007, the EFSA established, for this purpose, a dedicated unit on emerging risks. Improved identification of emerging risks may become a major preventive instrument at the disposal of the Member States and the Community[4].

The EFSA Emerging Risks (EMRISK) unit is responsible for supporting the development, establishment and operation of structures for the collection and evaluation of information with a view to identifying emerging risks in the fields of food and feed safety, and animal and plant health. To achieve this objective, the EMRISK unit and the EFSA Scientific Committee (SC) have carried out, over recent years, extensive expert consultations and a testing phase to develop a more transparent and practicable approach (EFSA (European Food Safety Authority), 2007, 2009b, 2010c; Kocharov, 2010; VWA et al., 2006).

The considerable experience gained by EFSA in these activities is already providing evidence of the potential of this pro-active approach in the identification of issues and future scenarios that may give rise to emerging risks. In particular, useful knowledge has been gained in gathering and evaluating information in different areas, and building knowledge networks on emerging risks, with Members States, Stakeholders, and EFSA's units and panels.

This technical report on emerging risks aims at taking stock of the knowledge acquired, presenting the results obtained and the lessons learnt, in order to pave the way for the further development of the EFSA strategy and activities on emerging risk identification.

TERMS OF REFERENCE AS PROVIDED BY EFSA

Thus, the EMRISK unit is requested to coordinate the drafting of a technical report on emerging risks. The report should include:

1) An update on the development of methods and processes for the identification of emerging risks in the area of EFSA's remit;
2) A summary of the activities carried out by EFSA to identify emerging risks;
3) A description of the issues identified;
4) A description of the outcomes and follow-up actions put in place;
5) Recommendations for further developing the emerging risk identification process.

[3] Article 23(f) Reg. 178/2002/EC
[4] Recital 50, Reg. 178/2002/EC

1. INTRODUCTION

The successful identification of risks at their early inception is at the heart of public health and environmental protection. According to EFSA's Founding Regulation[5], the Authority is required to "*undertake action to identify and characterise emerging risks*"[6] and "*to establish a system of networks of organisations*"[7] in the field of food and feed safety emerging risks. More recently, the development of an integrated and focused capability to identify and evaluate emerging risks has also been indicated as a key objective of the EFSA's Science Strategy (EFSA (European Food Safety Authority), 2012a).

Such a pro-active approach should provide an opportunity for risk assessors to undertake further investigations possibly leading to a full risk assessment to support risk managers to put in place prevention and mitigation measures. It is not surprising, therefore, that in addition to EFSA the task of emerging risks identification (ERI) has been assigned to a number of different bodies in the EU and in third countries (European Centre for Disease Prevention and Control (ECDC), 2011; European Environment Agency, 2011; International Risk Governance Council, 2009; JRC IPTS Team Working in European Foresight, 2010; Kocharov, 2010; OECD, 2003). EFSA aims to establish a transparent methodology, a data monitoring capacity, and networking structures to identify emerging risks in a timely fashion and to communicate these to the risk managers. Therefore, an effective risk management response is the ultimate goal of ERI.

The Emerging Risks (EMRISK) unit plays a key role in the coordination of EFSA's activities to develop a capacity for ERI. This includes the development of a transparent methodological framework, the establishment of structures for the collection and evaluation of relevant information, and knowledge networks for the sharing information. To achieve these objectives, the EMRISK unit and the EFSA Scientific Committee (SC) have carried out, over recent years, extensive expert consultations and a testing phase to develop a transparent and practicable approach (EFSA (European Food Safety Authority), 2007, 2009b, 2010c; Kocharov, 2010; VWA et al., 2006). Following the adoption of an operational definition of "*emerging risk*" by EFSA in 2007, *ad hoc* Working Groups (WG), along with a Network of Member States on emerging risks, have been convened to start discussing and testing data collection and evaluation approaches in such a framework (Altieri et al., 2011; EFSA (European Food Safety Authority), 2009b, 2010c; Havelaar et al., 2010; Kocharov, 2010; VWA et al., 2006).

Whilst in EFSA the task of ERI is formally assigned to the EMRISK unit, ERI in the food and feed chain is a responsibility of EFSA as a whole. In fact, there are several other units in EFSA carrying out relevant activities on emerging risks. The SAS unit, for example, contributes to the development of tools for ERI in the animal and plant health field, and several other units address emerging risks with self tasking mandates (EFSA (European Food Safety Authority), 2010a, 2010d, 2010e, 2010g).

The considerable experience gained by EFSA in these activities is already providing evidence of the potential of this pro-active approach in the identification of issues and future scenarios that may give rise to emerging risks. Useful knowledge has been gained in gathering, evaluating large amounts of information, and building knowledge networks on emerging risks, including Members States, Stakeholders, as well as EFSA's science units and their associated panels.

This technical report on emerging risks takes stock of the knowledge acquired between Feb 2010 and May 2012, presenting the results obtained and the lessons learnt. This experience will allow paving the way for the further development of the EFSA strategy and activities on ERI. In particular, the report includes a detailed account of the developments in the EFSA's strategy and methodology for ERI, the results obtained in terms of issues identified and follow-up actions, the data sources utilised, the knowledge networks established, as well as indications on next steps and future direction of EFSA's work in this area.

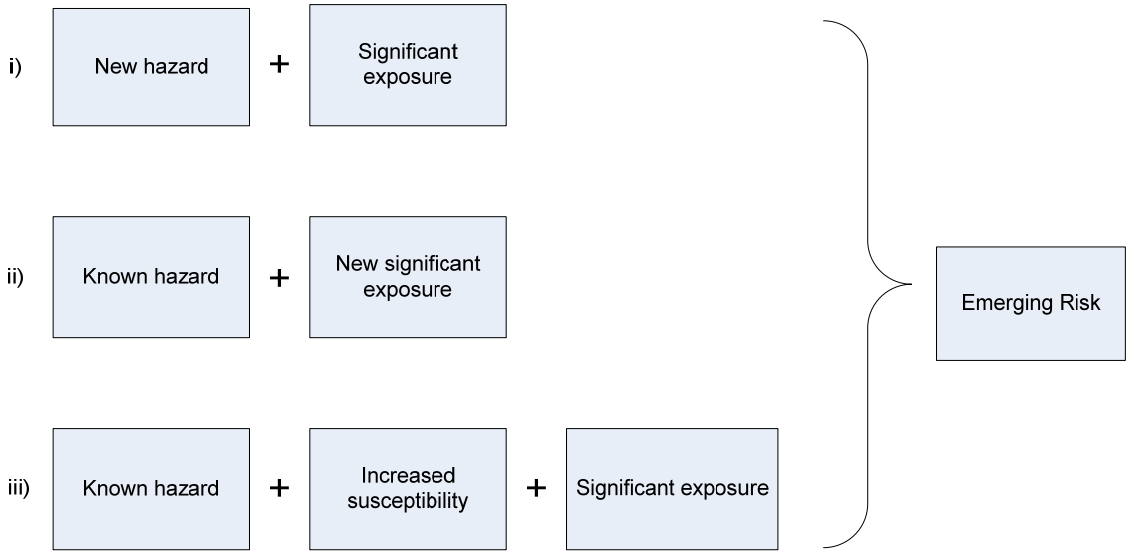
[5] Reg. 178/2002/EC
[6] Article 23(f) Reg. 178/2002/EC
[7] Art. 23(g) Reg. 178/2002/EC

Emerging risks, emerging issues and their identification

As no definition of "*emerging risk*" is provided by EC Regulation 178/2002, an operational definition has been developed, with reference to the food/feed chain, by the EFSA's SC and adopted by EFSA in 2007 (EFSA (European Food Safety Authority), 2007). According to such a definition "*an emerging risk to human, animal and/or plant health is understood as a risk resulting from a newly identified hazard to which a significant exposure may occur or from an unexpected new or increased significant exposure and/or susceptibility to a known hazard"*. Work aimed at further clarifying the many implications of this definition within the framework of EFSA's mission has continued throughout the work and activities of the EMRISK unit.

The above definition addresses: (i) newly identified hazards (*i.e.* previously nonexisting or not known) for which a significant exposure may occur; (ii) re-emerging hazards (*i.e.* hazards already characterised) for which an unexpected or increased exposure may occur; and (iii) increased susceptibility to known hazards for humans, animals or plants (Figure 1).

Figure 1. EFSA's definition of emerging risk.



In the above definition, the term "*new*" points to new or recent scientific evidence published on newly identified hazards, or hazards not regulated in the EU and/or hazards not yet addressed by EFSA. Also of consideration is new information that would lead to a significant re-evaluation of a previously characterised hazard. The term "*identified*" can be interpreted in different ways depending on the type and amount of supporting evidence considered necessary, with the general understanding that, in order to limit possible "false positive" results (*i.e.* wrongly identifying an issue as an emerging risk), ERI should be based as much as possible on solid, although preliminary, evidence and not exclusively on theoretical speculations. On the other hand, the data available for ERI are typically much more scant than those needed for risk assessment. The term "*significant*", in this context, is used in the sense of "*meaningful"* or "*relevant"* and not in the sense of "*statistically significant*" (*i.e.* unlikely to have occurred by chance). The evaluation of exposure is an additional important dimension of this definition. In fact, exposure of human beings, animals and/or plants must be present or envisaged for the definition of emerging risk to be met. One potential hurdle in the case of emerging risks is that information to estimate exposure to a previously unknown hazard is often not available as such data is often only gathered or produced once a hazard has been identified. To this end, *ad hoc* investigations may be required, possibly in collaboration with Member States, before deciding on whether an emerging risk has been identified.

With reference to sharing information among players involved in ERI, it has been noted that statutory responsibilities in the founding regulation in transmitting information on "*emerging risks*" could lead to tensions within any network and potentially limit the exchange of information (EFSA (European Food Safety Authority), 2011c). In light of this, and considering that information collected at the early stages of any ERI process is typically preliminary, incomplete and so with significant uncertainty attached to it, it has been suggested to differentiate between "*emerging issues*" and "*emerging risks*" (Table 1) (EFSA (European Food Safety Authority), 2011c; Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), 2009). In this context, an "*emerging issue*" can be defined as one that has very recently been identified and merits further investigation, and for which the information collected is still too limited to be able to assess whether it meets the requirements of an emerging risk. Thus, emerging issues are identified at the beginning of the ERI process as subjects that merit further investigation and additional data collection. Emerging issues can include specific issues (*e.g.* a specific chemical substance or pathogen, or a specific genetically susceptible group of the population), as well as general issues such as drivers of change or megatrends (*e.g.* climate change) (EFSA (European Food Safety Authority), 2011c, 2012b). Thus, the main difference between ERI from classical risks assessment is that ERI is based on very limited and preliminary information with a high degree of uncertainty.

Table 1. Characteristics of "emerging issues" and "emerging risks".

Emerging issue	**Emerging risk**
• Compliant with the EFSA's definition of emerging risks; • Identified at the beginning of the ERI process, as an issue that merits further investigation; • Emerging issues can include specific issues (*e.g.* a specific chemical substance or pathogen, or a specific genetically susceptible group of the population), as well as general issues such as drivers of change or megatrends (*e.g.* climate change); • Information collected is limited and preliminary; • Additional data collection and in depth evaluation is needed to be able to assess whether it is an emerging risks;	• Compliant with the EFSA's definition of emerging risks; • Identified at the end of the ERI process; • Emerging risks can include specific issues (*e.g.* a specific chemical substance or pathogen, or a specific genetically susceptible group of the population), as well as general issues such as drivers of change or megatrends (*e.g.* climate change); • Information collected should be sufficient to address, at least, the essential evaluation criteria (see definition of emerging risk); • Follow-up actions are identified, *e.g.* self-tasking mandate;

Early warning systems and Emerging Risk Identification systems

It is important to clarify that ERI is distinct from the detection of known risks leading to emergency (or crisis) conditions. The latter generally result from a lack of compliance with existing regulations and are dealt with through established Commission procedures[8]. It is, therefore, useful to differentiate between an "*early warning system*" and an "*ERI system*" (Marvin et al., 2009). These two systems have, generally, different aims and are based on different tools and principles. Early warning systems are typically reactive systems designed to collect, analyse and interpret data from hazard or disease surveillance programs after they have occurred. These systems have demonstrated their usefulness in crisis situations to support decision makers in implementing control and mitigations measures.

ERI systems, on the other hand, aim specifically at identifying risks pro-actively before they have any impact or at an early stage of development. The ERI approach should have, therefore, a more predictive and anticipatory nature. ERI systems are usually based on an interdisciplinary "intelligence" approach that is based on the collection, analysis and evaluation of evidence directly and indirectly related to the domain of interest (*e.g.* monitoring of the scientific literature, expert consultations, and identification of drivers of change, megatrends, and future scenarios). This is a key issue to take into account when establishing an operational ERI in order to select appropriate sources of information and allocate resources.

Whilst not specifically designed for ERI, in certain cases early warning systems can be useful in the detection of emerging risks. An example is the melamine incident where cases hospitalised for kidney failure were reported before the detection of the melamine contamination (EFSA (European Food Safety Authority), 2008). In fact, emerging risks can appear or be discovered suddenly (*e.g.* the melamine incident), or can arise gradually over time (*e.g.* effects of climate change on the geographical distribution of foodborne pathogens or contaminants, such as aflatoxins)(Costello et al., 2009; EFSA (European Food Safety Authority), 2011f; Mottram et al., 2002). Moreover, food frauds and bioterrorism attacks when related to new hazards, increased exposure to a known hazard, and new susceptible groups can also present themselves as emerging risks (EFSA (European Food Safety Authority), 2008). Although these tend to be treated as risk management issues, rather than risk assessment concerns.

Finally, the speed of development of an emerging risk and its potential impact affect the approach needed to deal with the response following its identification. Slowly developing emerging risks typically offer opportunities for a more extensive data generation and time for putting in place control and prevention measures by risk managers. Conversely, rapidly developing or suddenly detected risks with an immediate impact require a much faster and focused approach, including crisis response.

[8] Corrigendum to Commission Decision 2004/478/EC of 29 April 2004 concerning the adoption of a general plan for food/feed crisis management. OJ L 212/60, 12.6.2004, p. 60-68.

2. METHODS

2.1. EFSA procedure for Emerging Risk Identification piloted between 2010-2012

The EMRISK unit is responsible for the coordination of the entire ERI process. The unit comprises a multidisciplinary team of 6 scientific officers with expertise in microbiology, animal health, ecology, toxicology, food chemistry, and epidemiology. Briefly, the unit screened selected sources of information and identified specific emerging issues. Emerging issues were identified by EMRISK through a series of evaluations performed in round table discussions within the unit, followed by an evaluation involving a group of EFSA scientific staff. The issues identified were then submitted to the Panels and the SC, who eventually had to declare whether an emerging risk was identified. Representatives from Member States food safety institutions and Stakeholders were consulted along the process on specific issues.

The procedure described in the following paragraphs was piloted in the period between Feb 2010 and May 2012, and reviewed with the support of an *ad hoc* WG of external experts (EFSA (European Food Safety Authority), 2012b). With reference to terminology, at the beginning of the ERI process when only preliminary information is available we deal with "*emerging issues*", whereas at the end of the process after data collection and more in depth evaluation we deal with "*emerging risks*". The procedure implemented and piloted by EFSA for ERI included the 5 following steps summarised below.

- *Step 1: Identification of data sources*

Different types of data sources were identified by the EMRISK unit as potentially useful sources of information for ERI (EFSA (European Food Safety Authority), 2011b). Five principle sources have been prioritised, namely the RASFF, the media, the scientific literature, and trade and price data. Some of the data sources were assigned by mandate to the EMRISK unit (*e.g.* the RASFF), whereas others were selected on the basis of the individual expertise present in the unit (*e.g.* scientific journals dealing specifically with food safety and emerging risks). A detailed description of these sources of information was provided in a previous report (EFSA (European Food Safety Authority), 2010c).

- *Step 2: Data collection and pre-filtering performed by EMRISK Scientific Officers*

The sources of information identified in step 1 are monitored by EMRISK scientific officers, taking into account, where possible, individual areas of expertise. The frequency of monitoring depends on the frequency that the information source was updated (*e.g.* daily for the RASFF). Information about major foodborne outbreaks or incidents, new and emerging food-related hazards, new animal and human infectious diseases potentially related to food occurring worldwide were considered. Each scientific officer is responsible for identifying new and emerging food/feed-related hazards, including human infectious diseases and chemical contaminations (*i.e.* pre-filtering). The emerging issues identified were pre-filtered on the basis of the expert judgment of each officer using a set of agreed evaluation criteria (see paragraph 2.2).

- *Step 3: First data filtering and evaluation performed by the EMRISK unit*

The emerging issues identified in step 2 as deserving further consideration were subject to further filtering through round table discussions performed by the EMRISK unit, usually on a monthly basis. The evaluation of the emerging issues identified was based on expert judgment, using the same set of evaluation criteria of step 2. The difference between step 2 and step 3 was that in step 3 the emerging issues were evaluated by the whole unit through general discussions. For each emerging issue evaluated, a follow-up decision was taken by the whole unit: for example, (i) "no action" (*i.e.* the issue is dismissed as it is clearly not indicative of an emerging risk); (ii) "collect more information" (*i.e.*

more information needed for assessing the relevance of the emerging issue); or (iii) "to ERIC" (*i.e.* the emerging issue identified was judged sufficiently relevant for further data collection and evaluation); or "to other units for information", which typically occurred for issues which could be of interest, but did not fall within the definition of emerging risks.

- *Step 4: Second data filtering and evaluation performed by the Emerging Risks Internal Collaboration group (ERIC)*

In order to support the EMRISK unit in the ERI process, EFSA established an internal group, ERIC (see paragraph 2.4.1). ERIC comprised a multidisciplinary team of EFSA's scientific staff drawn from all scientific units and the EFSA Communications Directorate. ERIC was mandated to evaluate the emerging issues identified by the EMRISK unit in step 3 with the aim of: (i) identifying the most relevant issues to be submitted to the Panels and the SC for their evaluation as emerging risks; (ii) dismissing irrelevant issues; or (iii) requesting additional information or analysis. As from the closure of ERIC's mandate in May 2011, the Member States Network on emerging risks has provided support for the screening and evaluation of emerging issues (see paragraph 2.4.2).

- *Step 5: Third data filtering and evaluation performed by the Scientific Committee and Panels*

The final filter envisaged in the tested ERI procedure consisted of transferring the emerging issues identified to the competent Panel(s) or to the SC. In fact, the competent Panels or the SC had the responsibility to finally declare whether an emerging risk was identified, and to recommend to the EFSA Executive Director what action could be taken. Actions could include, for example, "EFSA self-tasking for full risk assessment", "further data gathering", "keep monitoring", or generate "research proposals".

2.2. Prioritization of relevant issues

At each step of the ERI process, in order to select and prioritise relevant issues, a qualitative evaluation was carried out based on the expert judgment of scientific officers and a set of agreed evaluation criteria. The criteria used were elaborated on the basis of the ones used by the EC's Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) and re-adapted to EFSA's needs, taking into consideration the EFSA definition of emerging risk (EFSA (European Food Safety Authority), 2007). Namely, the evaluation criteria considered include:

- Novelty (*i.e.* does the signal conform to EFSA's definition of emerging risk? *i.e.* new hazard, new/increased exposure, increased susceptibility, also taking into consideration of whether the source, or route of contamination/exposure is new or whether there is significant new information on the hazard);
- Soundness (*i.e.* reliability of sources of information and consistency of the information from different "independent" sources, *e.g.* peer-reviewed journals or the media);
- Imminence (*i.e.* how soon it is estimated that the potential health risk will manifest, *e.g.* days, months, years, or already present in the food chain);
- Scale (*i.e.* number of people and Member States potentially exposed to this potential hazard, possibly taking into account trade and consumption patterns);
- Severity (*i.e.* morbidity and/or mortality of the exposed population, taking into account vulnerable sub-groups of the population);
- In addition, risk management issues generally resulting from a lack of compliance with existing regulations should be excluded.

The evaluation of each criterion was done in a qualitative manner, as a rigid scoring framework did not seem appropriate because, by definition, information about emerging risks is inevitably limited and scattered, and hazards may not be sufficiently characterised. In specific cases, a "fast track" procedure was used to prioritise issues identified by the EFSA management or advisory bodies (*e.g.* energy drinks). For these issues specific follow-up projects have been initiated without running the information through the whole screening procedure.

Monitoring activities were focused on areas of expertise of scientific officers of the EMRISK unit, giving lower priority to highly regulated areas for which specific legislation or ongoing EFSA activities already exist, including for example antibiotic resistance, feed and food additives, food contact materials, and pesticide residues.

2.3. Sources of information and data collection

As previously described in detail, scientific officers of the EMRISK unit screened and reviewed a range of sources of information, including mainly reports from the RASFF, outputs from a media monitoring system, and selected scientific journals (EFSA (European Food Safety Authority), 2010c). The efficiency of the data collection procedure was regularly assessed over the pilot period and selected tools for data collection were fine tuned and tested.

2.3.1. Rapid alert system for food and feed (RASFF)

The RASFF was the major source of information, especially at the early stages of deployment of the ERI procedure. The RASFF was initially monitored manually and systematically. IT tools were developed to automate, at least in part, the monitoring activities of this source of information. This source of information was thoroughly assessed and evaluated in terms of utility in ERI in a previous report (see paragraph 3.3) (EFSA (European Food Safety Authority), 2010f).

2.3.2. Scientific literature

As previously reported (EFSA (European Food Safety Authority), 2010c), about 30 scientific journals were prioritized for monitoring as journals dealing specifically with food safety and emerging risks, or authoritative journals of more general interest dealing with microbiology, animal, environmental or public health issues. The screening of the scientific literature was tested in the piloting period, and a more focussed approach was implemented to identify relevant articles more efficiently assigning to each scientific officer of the EMRISK unit specific areas to be monitored according to their individual expertise.

2.3.3. Media monitoring

In order to facilitate the collection of information from the media, over the recent years EFSA has collaborated with the Joint Research Centre (JRC) to explore the potential use and relevance of MediSys for detecting alerts in the areas of food and feed safety (EFSA (European Food Safety Authority), 2009a). MediSys, a web-monitoring system application developed by JRC, has a wide media and language coverage with thousands of news articles screened from news sites in many different languages. MediSys went online in August 2004 and has been continuously extended. Over the last two years, the JRC and EFSA have extended the threat detection system of MediSys to food and feed hazards (Linge and Belyaeva, 2011). The media coverage of Medisys has been extended by 300 additional sources. Over 200 filters for common food and feed hazards have been added covering additives and supplements, animal health, biological hazards, contaminants, feed, food contact material, GMO, nutrition and allergens, pesticides and plant health. EFSA has now a dedicated MediSys site which allows all EFSA staff to screen news articles for the new filters. A preliminary assessment of the filters related to animal health, plant health, pesticides, GMOs, biological hazards has been conducted to make further recommendations on the implementation of these alerts. This analysis is currently underway and new developments are underway in the area of GMOs with the support of RIKILT - Institute of Food Safety and the JRC.

2.3.4. Trade data

International trade and especially EU imports have been identified as potential indicators for the detection of emerging risks within EFSA's mandate. Comext is the Eurostat reference database for external trade. It contains both recent and historical data from the EU Member States and also statistics for a number of third countries. It allows the identification of volumes of imports into the EU of specified food categories, identifying both the country of origin and the destination country. The database is accessible to the public through Eurostat's web page[9].

The United Nations Commodity Trade Statistics Database (UN Comtrade) contains import and export statistics reported by close to 200 countries or areas. It concerns annual trade data from 1962 to the most recent year. UN Comtrade is available to the general public via the internet.

The EMRISK unit has explore the potential use of trade information for ERI (EFSA (European Food Safety Authority), 2010b).

2.3.5. Price data

With a view to identifying drivers of emerging issues in the food and feed chain, the EMRISK unit explored the use of price data (Appendix A). Freely available sources of food pricing data and market analyses prepared by European and international bodies that could be used to forecast the economic environment influencing the food chain have been assessed .

2.3.6. Other data sources

Between 2010-2011, the EMRISK unit established and coordinated a WG on data collection for ERI related to food and feed (DACO-WG) to support EFSA in the deployment of a structured data collection system focused on emerging risks (EFSA (European Food Safety Authority), 2011b). The WG consisted of a multi-disciplinary team of 15 experts having expertise in different areas related to food and feed safety. The main tasks of this WG were to support EMRISK in defining a list of data sources and suitable strategies and tools to gather relevant information related to indicators of emerging risks as pre-defined by the EFSA Scientific Cooperation (ESCO)-WG on Emerging Risks (EFSA (European Food Safety Authority), 2009b).

In this context, the WG proposed a procedure to identify and prioritize data sources, using a two-step process based on the National Intelligence Model and the Dataquest approach. This procedure consists of an initial classification of the identified data sources, followed by a monitoring period of the pre-selected data sources and a consecutive and more detailed quality assessment of the relevant data sources for ranking and prioritization purposes. For this assessment, the WG defined text descriptors and quality parameters (*e.g.* data type as previously indicated (EFSA (European Food Safety Authority), 2011c)). Then, as a pilot study, the WG proposed data sources selected on the basis of their expert knowledge in the chemical, biological and nutritional areas, including research projects in the food area from the EU framework programme (*e.g.* FP6 and FP7).

The assessment of the various data sources complied by the WG highlighted the need for a closer collaboration with relevant research projects, experts and stakeholders. Among the 165 EU FP projects screened by the WG, 145 could be tentatively linked to the eleven ESCO indicators by screening titles and abstracts, but only 23 projects were further selected when specific knowledge of the projects was applied. In addition to the FP projects, the WG proposed data sources related to the biological, chemical and nutritional ESCO indicators as a case-study. The majority of these data sources were indicator-specific (n=126) while a relatively still high proportion of these data were linked to more

[9] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

than one indicator (n=62). The description and qualitative assessment of these data sources showed that the ones related to the ESCO indicators 5 (*i.e.* emergence of increased resistance to antimicrobials and plant protection products) and 10 (*i.e.* unexpected increased susceptibility of (sub)populations to known contaminants and other hazardous substances not regulated in the food/feed chain), and to a lesser extent to the indicators 2 (*i.e.* unexpected detection in food or feed of a potentially toxic/radioactive chemical), 4 (*i.e.* emergence of a new or exotic biological agent pathogenic to animals) and 9 (*i.e.* unexpected evidence of increased exposure of specified animal (sub)populations to particular hazardous chemical/biological/radioactive contaminants and other agents through food) were not well represented, which pinpointed areas where additional sources could be gathered. The assessment of the FP projects also highlighted the lack of coverage for the ESCO indicator 5 (*i.e.* emergence of increased resistance to antimicrobials and plant protection products), which may be related to the lack of expertise within the WG in this scientific domain. Overall, the descriptors used for the assessment of the data sources showed that some data types were over- (*e.g.* research, national and international official data) or under- (*e.g.* stakeholders, consumption patterns, trade and national scientific committees) represented, that both the geographic and period coverage were relatively good (*i.e.* 50% of the data sources had a world-wide coverage and 80% were collated over periods greater than one year), that most data sources were accessible (13% were accessible at financial cost and 2% were not accessible), predominantly described in English (2% used alternative languages), contained processed data (84%) of sufficient or mixed comparability (76%), but that metadata was not often available (44% with unavailable metadata).

Finally, the WG was able to provide useful inputs for the general ERI strategy. Such a strategy should encompass, firstly, the selection of priority areas and, secondly, the identification of appropriate associated data sources. Close collaboration with relevant research projects, experts and stakeholders is a major condition for a successful data collection on emerging risks.

2.3.7. Storing and exchanging information: "EMRISK Database" and "Briefing notes"

In order to harmonise and standardise the evaluation and prioritisation of the issues screened, and to facilitate information exchange among the different players involved in ERI, the EMRISK unit developed in collaboration with its WGs and Network on emerging risks a semi-structured briefing note template (Appendix B). The briefing note included all the information needed for the evaluation and prioritization of the issues identified.

Information compiled in the briefing notes were then transferred and stored in the EMRISK Monitoring database. This database included essential information on all the issues evaluated and the decisions taken on follow-up actions. Essential information included a short description of the issue identified, the type of hazard, the source of information, the decisions taken, and the feedback received after the evaluation from the Panels, the SC, the Network of Member States and the Stakeholders. Information screened by the individual scientific officers not selected further consideration were not recorded in the database due to prioritisation on the use of the resources available.

2.4. Networking activity

ERI is a process involving the gathering and evaluation of large amounts of information from different sources, including wide expert consultations. Over the recent years it became apparent that EFSA needed networking structures to identify and share information on emerging risks (EFSA (European Food Safety Authority), 2011c). For this purpose, it was suggested that EFSA should fully benefit from the existing knowledge networks already available, and establish multilateral agreements with Member States and inter-governmental agencies to share information (EFSA (European Food Safety Authority), 2012b).

Within the general framework of ERI, over the last two years the EMRISK unit established and further developed different knowledge networks aimed at supporting EFSA in ERI. This included an internal multidisciplinary task force of scientific staff members (*i.e.* ERIC), a Network on Emerging Risks of Member States (*i.e.* EREN), and the Stakeholders Consultative Group on Emerging Risks (StaCG-ER). As ERI is a task assigned to a number of different bodies in the EU and in third countries, interactions with other relevant EU-agencies (*e.g.* ECHA and JRC) and, where possible, international authorities and organisations (*e.g.* WHO and FAO) were started.

The following paragraphs include an update on the composition of these groups and Network and their specific role in the ERI procedure.

2.4.1. The Emerging Risks Internal Collaboration group (ERIC)

Between Feb 2010 and May 2011, EFSA explored and tested for the first time the usefulness of an internal multidisciplinary task force of staff members with relevant expertise to support in ERI.

ERIC carried out evaluations of the signals identified by the EMRISK unit, with the aim of identifying issues to be submitted to the Panels and the SC, and to prioritise issues for follow-up actions (*e.g.* self tasking mandate or data collection). The group was also tasked with bringing forward emerging issues identified by the Panels.

The evaluation of the relevance of the issues presented by the EMRISK unit was performed through round table discussions using an expert judgment approach and a set of agreed evaluation criteria (see paragraph 2.2). As from the closure of ERIC mandate in May 2011, EREN provided support for the screening and evaluation of emerging issues. More than 120 issues identified by the EMRISK unit were evaluated by ERIC and EREN. On the basis of these evaluations, selected issues were prioritised by the EMRISK unit and follow-up actions started accordingly (see section on results).

2.4.2. Emerging Risks Exchange Network (EREN)

EFSA promoted the networking of organisations of Member States active in the field of ERI and the EC, mainly to facilitate the exchange of information and expertise in this new discipline and the coordination of activities.

For this purpose, the EMRISK unit established EREN, which in its first year of operation constituted the principal body for exchanging information on emerging risks to food and feed safety between EFSA and the Member States (EFSA (European Food Safety Authority), 2011a). The exchange on emerging risks comprised exchange of information on emerging food safety risks observed or anticipated by network members and on any related ERI activity of network members. In accordance with EFSA's commitment to share data with EREN delegates, the issues originating from the EMRISK unit monitoring activities were shared with the network, and EREN members were requested to provide additional information or feedback on the relevance of those issues, on the basis of their expert knowledge and on the data they were able to collect at the national level. As from the closure of ERIC mandate on in May 2011, EREN, provided support for the screening and evaluation of emerging issues.

2.4.3. Stakeholder consultative Group on Emerging Risks (StaCG-ER)

Whilst the EFSA scientific staff and national institutions are of key importance to such a comprehensive network, an important source of both data and methodologies is represented by the stakeholders. For openness and transparency, but also for information and data sharing, communication and dialogue on issues pertaining to emerging risk, stakeholders' engagement is essential. EFSA has established StaCG-ER in order to start sharing information on issues pertaining to emerging risks (EFSA (European Food Safety Authority), 2011e).

In its first year of activity, the group exchanged information on the different methods used for ERI. Emerging risks is an essential part of the daily activities in food and feed sector organisations and is undertaken through regular monitoring of various data sources combined with information received through organisations' networks. A common approach among stakeholders is the use of expert groups to discuss the relevance and importance of signals of potential emerging risks. The group emphasised the need for a multidisciplinary approach to be reflected in the choice of members of such groups. Whilst data sources vary according to the scope of each organisation and therefore are sector specific, the general approaches used were highlighted. Potential drivers of emerging risks have also been discussed, which may, individually and/or in combination, affect the way that potential risks develop in the food and feed chain. In order to strengthen the capability to identify emerging risks of public health importance, a multidisciplinary and multi-stakeholder approach appears to be essential for both vision and interpretation, as is a means for sharing information and accumulated knowledge. Therefore, the development of a common language with shared definitions, terminology, and methodology was found to be necessary. The group highlighted that a system needs to be developed or deployed to assist in the interpretation and impact assessment of newly reported issues and signals of change which may have an impact on public health through exposure through food.

Building on the experience gained in the first year of activity and in order to continue exchanging information in a constructive way with stakeholders, the mandate of the StaCG-ER has been recently renewed for 2012-2013. In this second mandate the focus of the work will be on both signals of specific emerging risks identified by the stakeholders and on data exchange rather than on methodologies used for ERI.

3. RESULTS

Between Feb 2010 and May 2012, the EMRISK unit evaluated more than 2200 signals identified from different data sources. Table 2 gives the distribution of the issues evaluated by type of sources of information. More than 90% of the issues derived from the RASFF, whereas the scientific literature originated approximately 150 issues (about 7% of the total). The media, Promed, and EFSA's networking (*i.e.* Advisory Forum, EFSA's Units, EREN) generated 60 issues, about 3% of the total.

Out of the 2200 issues evaluated, the EMRISK unit prioritised 124 (about 6% of the total) issues for ERIC (Figure 2). For selected issues, briefing notes were prepared by the EMRISK unit to describe them in more detail. The purpose of the briefing notes was to present information collected on priority emerging issues identified in order to allow a more in depth evaluation of the relevance of the issue. These included a wide range of subjects, ranging from specific biological hazards and chemical contaminants, to antibiotic resistance issues, as well as drivers of change. Seventeen issues were prioritised for the consideration of the Panels and the SC, or for more immediate follow-up actions.

With reference to the usefulness of the different sources of information, the RASFF generated the vast majority of the issues evaluated. However, none lead to follow-up actions. Conversely, more than 75% of the issues submitted to the Panels and SC or prioritised for action were initially identified through the scientific literature or EFSA networking.

In order to interpret the efficiency of the different sources of information in terms of ability to identify issues that merited further investigation, it should be noted that the amount of time and resources dedicated to the monitoring was not the same across the different sources of information. Especially at the beginning of the piloting and up to the first half of 2011, the majority of the monitoring resources were dedicated to the RASFF, and only a minor part to the scientific literature. The integration of the EFSA networking into the early stages of the ERI process is much more recent (*i.e.* was not active throughout the whole of this time period).

Table 2. Distribution of issues by source of information[a] evaluated by the EMRISK unit, ERIC or EREN, submitted to the Panels or Scientific Committee, or prioritised for further action (Feb 2010 – May 2012).

Source of information	Issues evaluated by the EMRISK unit	Issues evaluated by ERIC/EREN	Issues prioritised for Panels/SC, or follow-up actions
	Freq.(%)	Freq (*%*)	Freq (%)
RASFF[b]	2043 (*90.8*)	40 (*32.3*)	1 (*5.9*)
Scientific Literature	148 (*6.6*)	66 (*53.2*)	13 (*76.5*)
Media	27 (*1.2*)	7 (*5.6*)	0 (*0*)
Promed	19 (*0.8*)	5 (*4.0*)	1 (*5.9*)
EFSA networking[c]	7 (*0.3*)	6 (*4.8*)	2 (*11.8*)
Others[d]	7 (*0.3*)	0 (*0*)	0 (*0*)
Total	**2251 (100)**	**124 (100)**	**17 (100)**

[a] The same information could come from different sources. The source of information firstly captured by the EMRISK unit has been reported.
[b] The real number of notifications evaluated is higher as for several recurrent issues (*e.g.* aflatoxins, pesticides, colorants) notifications were evaluated as clusters and counted once.
[c] EFSA networking include Advisory forum (2), EFSA Units (3), and EREN (2).
[d] Others (other non-EU organisations 4, OECD 1, International Food Chemical Safety Liaison Group 1, trade 1).

3.1. Issues identified and evaluated

Figure 2 lists the issues identified by EMRISK and evaluated with ERIC (EREN from May 2011) between Feb 2010 and May 2012. The vast majority of the issues presented in the table, after more data collection and evaluation, were dismissed as not satisfying the evaluation criteria (*e.g.* EFSA definition of emerging risk, or issue related to lack of compliance with existing regulations). For the issues dismissed at this stage of the process, no further detail is provided in this report. Those issues that were subsequently submitted to the Panels and SC or prioritised for follow-up actions are highlighted in the figure. These include general topics such as drivers of change, as well as specific chemical, biological, animal and plant health, and GMO issues. The following paragraphs describe the issues identified and prioritised for follow-up actions during this pilot phase.

3.1.1. Drivers

More than 20 drivers of change with a potential impact on food safety in the mid or long term perspective were identified and evaluated. The drivers prioritised for follow-up actions include climate change, changing food consumption behaviours, globalisation and new technologies. Within each of these areas specific examples were identified:

Climate change. Aflatoxin contamination in maize is of worldwide importance, and *Aspergillus flavus* and *parasiticus* are the principal known fungi responsible for aflatoxin production. The EMRISK unit, with the support of a an outsourced project has investigated possible future scenarios on the emergence of aflatoxins in cereal crops in the EU due to climate change (Battilani et al., 2012). A review of the scientific literature on the ecological parameters influencing the development of *A. flavus* and *A. parasiticus* on maize and maize kernel in field conditions was conducted, and a model was developed to predict the risk of Aflatoxin B1 contamination due to *A. flavus* in maize at harvest and further adapted to wheat and rice as host crops. The JRC provided a database with mean daily temperatures during emergence, flowering and harvesting of maize, wheat and rice. Meteorological data (temperature, relative humidity and rain) obtained from the LARS weather generator were used as input for the modelling of crop phenology and *A. flavus* behaviour. The output was designed over the European territory and generated projections over the next 100 years, in three different climate scenarios (present, +2°C and +5°C scenarios). Predictions showed a reduction in season length and an advance in flowering and harvest dates leading to an enlargement of the crop growing areas towards north EU, mainly for maize and rice, because earlier ripening could occur in these areas. The risk of *A. flavus* contamination was expected to increase in maize, both in the +2°C and +5°C scenarios, to be very low in wheat and to be absent in rice. Results were discussed and recommendations were made on data collection and prevention measures on aflatoxin risks.

Changing food consumption behaviours. Concern has been expressed about potentially changing consumption patterns, in the EU population, of caffeine and other active ingredients through the consumption of energy drinks (European Food Safety Authority (EFSA), ongoing-b). In this fast evolving market, the few existing consumption data are rapidly outdated and data for specific consumer groups, such as children and adolescents, are sparse. Youngsters are of particular concern as are those consuming energy drinks whilst carrying out sport and co-consumption with alcohol may be an issue. Thus, the EMRISK unit is now coordinating a European-wide survey to collect data on the consumption of energy drinks and some active ingredients contained in certain energy drinks in specific consumer groups (European Food Safety Authority (EFSA), ongoing-b). The survey includes children (aged 3 to 10 years), adolescents (11 to 17 years), and adults (18-65 years), addressing specific habits (*e.g.* adolescents and adults practising intense physical exercise, and co-consumption of energy drinks and alcoholic beverages) and patterns of consumption (acute and chronic) of energy drinks in EU Member States. Additionally, the consumption and exposure to active ingredients such as caffeine, taurine and glucuronolactone in the context of energy drinks consumption will be evaluated in the same age groups, addressing the same habits and specific patterns of consumption. Exposure to

caffeine from other dietary sources will be taken into consideration (*e.g.* coffee, chocolate, tea and cola soft drinks) to estimate the relative contribution of energy drinks to total caffeine consumption. The project is conducted in strategic consultation with relevant stakeholders, such as EU and national health institutes and organisations knowledgeable in data collection related to human consumption of energy drinks, and industry organisations. Once the results have been assessed, a recommendation will be made on the need or otherwise for risk assessment in this particular area.

Globalisation and trade data. Trade pathways of food and feed commodities, plants and live animals are changing over time and such consideration may be useful in the anticipation of the introduction of hazards (*e.g.* plant or animal diseases) and in the estimation of exposure to hazards linked to a certain importation profiles. In order to evaluate and develop IT tools for ERI, the EMRISK unit screened the Eurostat Comext database for trade volumes of selected food and feed commodities. It was then suggested that a tool could be developed to provide "alerts" indicating for example (i) high increase of the volume of a given product over time to a specific MS or EU in total (ii) new trade partners, or (iii) new food or feed commodities entering the EU. Over the last two years, the EMRISK unit explored the use of two scanning methods (namely the SITF-ARIADNE and FSpike software developed by the JRC in collaboration with the European Anti-Fraud Office, OLAF) on a dataset of food trade data from Eurostat's Comext database (European Food Safety Authority (EFSA), 2012). Most of the signals obtained presented an upward importation pattern of a food product from a specific origin into the EU in 2009 compared to the previous years. Some signals related to low importation quantities were rejected as weak, while others indicated cases of new trade partners. Whilst the outcome of the study on the scanning methods showed some potential in the screening of trade data, it was noted that the results obtained by these tools must be treated with caution due to limitations in the quality of the data sources used. Further investigation using other potential sources of information is required to verify the pertinence of such signals. As part of the evaluation, one case study was prepared based on surveillance of trade databases, *i.e.* recent trends in trade of fish meal used as feed and reporting *of Salmonella* and *enterobacteriaceae* (Appendix C). The starting point for the report was the detection of a change in trade into the EU, analysed in combination with information from the other sources mentioned. Information used for the report was, then, retrieved from the Eurostat Comext, UN Comtrade, and interpreted taking into account information from the RASFF and the scientific literature.

Globalisation and food/feed prices. Price changes, in terms of increase, decrease or fluctuation over time, were suggested as a driving factor that influences food consumption and subsequently the intake of both nutrients and contaminants. They may have negative consequences in terms of food safety, such as compromising safety and quality, adulteration, instability in the food chain and adoption of less healthy diets. The EMRISK unit explored the use of price data as a potential source of information with a view to identifying drivers of emerging risks in the food and feed chain (Appendix A). In the report, freely available sources of food pricing data and market analyses prepared by European and international bodies that could be used to forecast the economic environment influencing the food chain were described. In conclusion, predicting food safety emerging risks from food pricing data is a complex and challenging task, as these data are collected in order to serve areas other than food safety, like trade policies and food security. Moreover, price changes occur due to heterogeneous parameters, like crop production projections and energy cost. Price indices related to the food chain (*e.g.* agricultural commodity prices, producers' prices, consumers' prices) are affected by these parameters in a dissimilar way over time. In order to collect and analyse pricing data for the identification of drivers of emerging risks, expert consultations would be pivotal for the final interpretation of the results.

New analytical technologies. A key objective of EFSA is the evaluation of new methodologies and technologies for risk assessment applied to food and feed safety (EFSA (European Food Safety Authority), 2009c). These may present complex methodological challenges for risk assessment, as

well as opportunities for ERI impacting EFSA's mid- to long-term work. Omics technologies were identified as a driver with potential implications for food and feed safety risk assessment. In the post-genomic era, the scientific community is witnessing major advances in omics technologies (*e.g.* genomics, proteomics, metabolomics, toxicogenomics, etc.). Omics technologies are firmly established as research tools, and are gaining credibility also in risk assessment as they may offer certain advantages over traditional approaches. Compared to traditional methods, omics appear to combine the benefits of relative simplicity and sensitivity with speed of generating information, potentially reducing the need for animal testing. Whilst omics may have major implications for EFSA's scientific activities, current methodological and analytical uncertainties do not yet allow the identification of how and to what extent omics technologies can be integrated within the current risk assessment framework, and to what extent they can be fully exploited for ERI. At an international level, risk assessment bodies, including US-EPA, WHO, and OECD are currently starting to consider the integration of omics in their risk assessment frameworks, mainly in the field of mechanistic toxicology. As a consequence, a project aiming at critically reviewing the state of the art of omics technologies applied to food and feed safety, in order to understand possible future implications for risk assessment and ERI in the areas under EFSA's remit has been initiated (European Food Safety Authority (EFSA), ongoing-c). The project will also deliver a database with data on practical examples of omics applied to food and feed risk assessment, and a study with a foresight look at what are future scenarios for the application of these technologies. The foresight study will cover possible future developments of omics technologies in the next 5-10 years in the context of risk assessment applied to food and feed safety, identify areas which will have the greatest impact in terms of risk assessment, it identify and critically discuss gaps in knowledge, issues and challenges that might limit the regular use of omics in risk assessment, and provide potential options for risk assessors on the possible steps that will allow the consistent integration of data generated from omics technologies into the current risk assessment framework used by EFSA. An EFSA internal task force on new risk assessment methods will also benefit from the results of this project.

New food/feed production/processing technologies. "Synthetic Biology" has been identified as an emerging technology and a driver of change potentially impacting the food chain in the future. The first artificial construction of a complete bacterial genome, and its successful transplantation into a recipient cell was announced in 2010 (Gibson et al., 2010). This represents a substantial step forward in genetic engineering, which may also introduce new hazards into the food chain and/or may require a new risk assessment approach. Whilst the technology is still in its infancy, the proof of principle has now been made. Applications in the food/feed area would probably in the first instance be limited to fermentation technology. As food/feed applications are still some way off, it was recommended that it is too early to carry out risk assessment, but that developments in this area are monitored.

Figure 2. Issues selected by the EMRISK unit, evaluated by ERIC/EREN and prioritised for action (Feb 2010 – May 2012).

DRIVERS

Climate change
- **Emergence of aflatoxins in cereals in the EU due to climate change****

Changing food consumption behaviour
- **Consumption of energy drinks****
- Increasing consumption of raw fruit and vegetables and microbiological infections

Globalisation
- **Fluctuations in trade volumes and food prices as drivers of emerging risks****
- Increasing prevalence reported on food-transmitted parasitic diseases in China and potential implications for EU food imports*
- Population growth, increasing demand of animal proteins and the introduction of edible insects in European diet
- Imported flowers as vector of honey bees infections

Environmental contamination
- Contamination of the food chain by e-waste
- Natural and man made catastrophes (e.g. oil spill in the US, vulcanic eruptions in Iceland)
- Accumulation of pharmaceuticals in crops
- Emerging contaminatns from jet fuels
- Potential implications from the increasing prevalence of alien species in the EU
- Massive concomitant and global deaths of birds, fish and crabs

New technologies
- **Future implications of OMICs technologies in food safety****
- Possible food safety implications of synthetic biology*
- Vacuum cooling and bacterial contamination of fresh products
- Application of laser ablation in food processing
- Possible future implications of bio-energy crops intensification

Food fraud
- Unsafe use of chemical fruit ripeners
- Possible economic fraud of Acai (e.g. ,due to high demand, shortage, high price-value)
- Illigal importation of bush meat in the EU

CHEMICAL

Biotoxins
- Emerging biotoxins (e.g. ciguatoxins, fusarium mycotoxins) in the EU

Novel food ingredients
- More than 30 novel food ingredients (e.g. Cnidium monnieri, epimedium, tongkat ali, Stevia rebaudiana, Desmodium gangeticum, organic yacon root, etc)

Pesticides
- More than 20 issues on increasing reporting on pesticides residues (e.g. oxamyl, clofentezine, tetradifon, dimethoate, chlorpyriphos, endosulfan, triazophos etc.)
- Illegal use of counterfeit pesticides

Hydrocarbons and Persistent Organic Pollutants
- PFCs linked to attention deficit hyperactivity disorder in children
- Prenatal perfluorooctanoic acid (PFOA) exposure in CD-1 mice: low dose developmental effects and internal dosimetry
- Increased trend in RASFF of dioxins in feed
- Estragole in fennel herbal teas
- Migration of ink related compounds from packaging to food
- Migration of tribromophenols/tribromoanisoles into food from wooden pallets
- Mineral oil in walnut oil
- Water disinfection byproducts as a possible health concern
- Influence of cooking processes on various organic environmental pollutants in food

Plasticisers
- Migration of 2-hydroxy-2-methylpropiophenone and of 1-phenyl-2-butanone in plastic drinking bottles
- Acetyl Tributyl Citrate (ATC): a widely used phtalate substitute plasticizer
- Di-pentyl phthalate testing in animal studies shows greater relative potency than other phthalates

Residues of medical products
- Marbofloxacin and dihydrostreptomycin in pork casing*
- Neomycin in fish
- Unauthorised substances in food supplements (e.g. tadalafil, GHRP-2, progesterone)
- Bioaccumulation of metformin in turnip seeds

Heavy metals
- Aluminium in quick cooking noodles
- Antimony in fruit juices
- Heavy metals in drinking waters

New technologies
- Genotoxicity of carbon nanofibers
- Ultraviolet light (UV-C) treatment of various foods and furan formation
- Effect of processing on biotechnology-derived soybean and corn crops

Others
- **Chemical mixtures, including metabolic interactions and synergistic effects of multiple chemical residues for human risk assessment****
- Potential contamination from recycled paper to food
- New emerging contaminants in biosolids
- Taste disturbance after pine nuts ingestion
- High content of iodine in soy milk
- New evidence on the nephrotoxicity of melamine-cyanuric acid in rats
- Glycidol fatty acid esters in refined vegetables fats
- Morpholine in wax coatings for fruits
- Allergic reactions caused by "easy to bake" products with hydrolysed wheat protein
- More than 50 issues on food colours (e.g. sunset yellow, erythrosine, brilliant blue etc)
- Sodium citrate and glycine unauthorised in frozen soles from the Netherlands

BIOLOGICAL

Bacteria
- Seasonal peaks and possible food route for *Extraintestinal pathogenic E. Coli* *
- Potential human foodborne transmission and pathogenic potential of *E. Albertii**
- Survival of *Campylobacter* in bovine manure*
- *Vibrio parahaemolyticus* and *vulnificus* as underreported and emerging problem in European waters*
- Increased awareness of fresh produce microbiological contamination*
- *Stenotrophomas maltophilia* an emerging opportunist pathogen*
- New mechanisms of antimicrobial resistance (e.g. NDM-1 producing Enterobacteriaceae, resistance to aminoglycosides and gentamicin)*
- Toxicity of a new strain of *Lactobacillus paracasei* in an animal study
- Long term health implications (e.g. hypertension, renal impairment, and cardiovascular diseases) after gastroenteritis caused by *E. Coli* and other foodborne infections.
- Changing ecology and reservoirs of *Brucella*
- *C. difficile* in food and domestic animals
- *Increase in Salmonella* contamination of paan leaves
- Increasing number of RASFF notifications on *Salmonella* in feed fish meal

Viruses
- Hepatitis E: increasing reporting of human cases and new reservoirs
- Viral contamination of clams
- Virus infections and cancer risk
- Norovirus: increasing of reporting in the RASFF and appearance of new variants
- New emerging strains of Hepatitis A virus in the EU

Parasites and protozoa
- *Angiostrongylus (cantonensis)* found in rats and potential transmission to lettuce through larvae-containing slime of infected snails/slugs*
- Wild boars as reservoirs for *Trichinella pseudospiralis*
- *T. cruzi* and chagas disease as a foodborne illness

Prions
- TSEs in lower vertebrates
- Lentiviruses and prion transmission to sheep and other animals through dietary exposure to sheep milk.

ANIMAL HEALTH

- **Bee health, including weakening of honey bees colonies****
- Duck egg-drop syndrome

PLANT HEALTH

- Potato Spindle tuber viroid (PSTV) in Australia
- Potential transmission of kiwi disease by Pseudomonas syringae pv actinidiae through the import of contaminated pollen for artificial pollination
- Mass trapping of the pine wood nematode (Bursaphelenchus xylophilus)

GMO ISSUES

- Safety assessment of transgenic salmon
- More than 20 issues on RASFF notifications on unauthorised GMOs genetically modified (e.g. Bt63, KeFeng6, KMD1, CaMV 35S)

* Issues submitted to the Panels / SC ** Issues prioritised for further action

3.1.2. Biological issues

The subject area with the highest number of issues selected for the consideration of the Panels and SC was the biological one. This is likely to reflect the relatively high level of microbiological expertise in the evaluation groups, especially during the early phases of this pilot phase. More than 20 issues were identified and evaluated on bacteria, viruses, parasites and protozoa, and prions.

The issues identified for the consideration of the Panels addressed selected emerging characteristics of six known bacteria, one parasitic pathogen, and two mechanisms of antimicrobial resistance. In particular, these addressed seasonal peaks and possible new routes of exposure of ExPEC (Extra-intestinal *Escherichia coli*), the potential human foodborne transmission of *E. albertii*, the survival of *Campylobacter* in bovine manure, the underreporting of *Vibro parahaemolyticus* and *vulnificus* in European waters.

Finally, fresh produce (fruit and vegetables) has been consistently identified from different kinds of sources as an emerging vehicle for exposure to enteric pathogens. The pertinence of this signal was unfortunately emphasised by the outbreak of *E. coli* O104 in Germany and France in 2011 due to the consumption of raw sprouted seeds (EFSA (European Food Safety Authority), 2011f). The ERI process, as already noted, is not an early warning system, and so did not specifically identify this foodstuff nor anticipate the outbreak strain. Since the outbreak, this issue has been addressed through specific mandates received from the EC (EFSA Panel on Biological Hazards (BIOHAZ), 2011).

3.1.3. Chemical issues

More than 40 signals on a wide variety of chemical issues have been identified and evaluated. These include marine and non-marine bio-toxins, novel food ingredients, pesticides, hydrocarbons and persistent organic pollutants, plasticisers, residues of medical products, heavy metals, and several other miscellaneous subjects.

Despite the large number of issues identified in the preliminary screening, after further data collection and evaluation, it became apparent that most of the chemical issues identified were related to risk management issues such as lack of compliance with existing regulations on known hazards and, only to a lesser extent, to emerging toxicological data for contaminants.

Human health risks from exposure to multiple chemical residues (e.g. chemical mixtures) has been identified as an area that would need further development and harmonisation within EFSA. In particular, chemical mixtures related to metabolic interaction and synergistic effects for human risk assessment was prioritised for follow-up action (European Food Safety Authority (EFSA), ongoing-a). Over the last four years, EFSA has developed new approaches to assess cumulative and synergistic health risks from pesticides and developed case-by-case approaches in the area of food additives, food contact materials and contaminants. Currently, the panel on Plant Protection Products is assessing “common assessment groups” of pesticides based on their toxicity to be considered together for cumulative risk assessment. Furthermore, an internal task force on chemical mixtures is reviewing the national and international frameworks available for the human risk assessment of chemical mixtures in order to discuss a road map and future work priorities at the SC. Building on this work, a horizontal and harmonised approach for the human health risk assessment of chemical mixtures in food and feed needs to be further explored and to support such work. Therefore, the EMRISK unit is coordinating an internal task force and an outsourced project to systematically review the scientific literature and to collect experimental data on metabolic interactions and synergistic toxicological effects of chemical mixtures for human risk assessment.

3.1.4. Animal and plant health, and GMO issues

During this trial period animal and plant health issues were not extensively monitored and so only a limited number of issues were evaluated concerned animal and plant health. Few GMO issues were raised through the monitoring. The issue prioritised for action included different aspects of bee health (European Food Safety Authority (EFSA), ongoing-d). The weakening of honey bees colonies has clearly emerged as an issue for which a mounting body of evidence is becoming available. Across the different areas addressed by EFSA there have been a number of risk assessment activities on specific bee health issues, including plant protection products (EFSA Panel on Plant Protection Products and their Residues (PPR), 2012). There are strong indications that causes behind bee decline are multi-factorial, therefore, in 2012, the EMRISK unit has initiated a task force to develop a more integrated approach in the risk assessment of bees. This task force will first make an inventory of studies conducted on bees, inside and outside EFSA and, based on the information collected, the task force will perform a data gap analysis to identify cross-cutting issues and further research needs in the area of bee risk assessment.

3.2. Follow-up actions

Overall, more than 2200 issues have been screened and more than 120 issues prioritised by the EMRISK unit and evaluated by ERIC (or EREN from May 2011). Of these 17 issues have been submitted for the consideration of the Panels and the SC, or prioritised for further actions. These follow-up activities will contribute to the determination of whether the issues identified are indeed emerging risks.

Thus, this process resulted in the identification of specific issues for which follow-up activities have been initiated. These include 4 outsourced projects (*i.e.* a project on the future emergence of aflatoxins in cereal crops in the EU due to climate change, a European-wide survey to gather data on the consumption of energy drinks, a foresight study on the potential future impact of omics technologies on food and safety risk assessment, a systematic review on metabolic interactions and synergistic effects of chemical mixtures for human risk assessment), 3 task forces (*i.e.* one on the bee health, one on chemical mixtures, and one on emerging tools and methods in hazard assessment), and two reports on the fluctuations in trade volumes and food prices as drivers of emerging risks.

3.3. Assessment of sources of information

The systematic identification of new hazards and assessment of emerging risks is a process involving the gathering and evaluation of large amounts of information from different types of sources. In order to be able to perform an unbiased evaluation of the usefulness of the data sources used, one should consider the amount of resources spent in monitoring and data collection and the proportion of issues identified and prioritised for follow-up actions, over the total number of issues screened. This information has been estimated on the basis of feedback received from scientific officers and taking into account the time spent in the EMRISK monitoring meetings (Table 3). The number of issues prioritised for follow-up actions and for the consideration of the Panels and the SC has been obtained through the EMRISK monitoring database.

In this pilot phase, five principle sources of information have been identified and assessed, namely the RASFF, the scientific literature, the media, and trade and price data (Table 3). In terms of time and resources spent in the monitoring of the sources of information, most of the available resources were initially dedicated to the systematic evaluation of notifications from the RASFF and, to a lesser extent, to signals deriving from the media and Promed. As the procedure evolved, more time and resources were dedicated to the monitoring of selected scientific journals. More recently, representatives nominated from the MS (*i.e.* EREN) have been involved as a primary source of information of new emerging issues.

Table 3. Efficiency of sources of information[a] for providing prioritised emerging issues.

Source of information	**Issues evaluated by the EMRISK unit** Freq.(%)	**Issues prioritised for Panels/SC, or follow-up actions** Freq (%)	**Efficiency (%)[e]**	**Resources per signal[f]**
RASFF[b]	2043 (*90.8)*	1 (*5.9)*	*0.05*	*XXX*
Scientific Literature	148 (*6.6)*	13 (*76.5)*	*9*	*XXX*
Media	27 (*1.2)*	0 (*0)*	-	*XXX*
Promed	19 (*0.8)*	1 (*5.9)*	*5*	*X*
EFSA networking[c]	7 (*0.3)*	2 (*11.8)*	*29*	*X*
Others[d]	7 (*0.3)*	0 (*0)*	-	*variable*
Total	**2251 (100)**	**17 (100)**	***0.8***	**-**

[a] The same information could come from different sources. The source of information firstly captured by the EMRISK unit has been reported.
[b] The real number of notifications evaluated is higher as for several recurrent issues (*e.g.* aflatoxins, pesticides, colorants) notifications were evaluated as clusters and counted once.
[c] EFSA networking include Advisory forum (2), EFSA Units (3), and EREN (2).
[d] Others (other non-EU organisations 4, OECD 1, International Food Chemical Safety Liaison Group 1, trade 1).
[e] Percentage of issues evaluated by EMRISK that are prioritised, for each information source.
[f] Qualitative estimate of the person-time required to generate one issue evaluated by EMRISK

Despite the large number of issues identified in the preliminary screening of the RASFF, after further data collection and evaluation it became apparent that virtually all the issues identified were related to risk management issues and lack of compliance with existing regulations on known hazards. Out of a total of 2251 issues evaluated, only one was prioritised for the consideration of a Panel, eventually leading to no follow-up action. This assessment confirms the results of a previously published report on the usefulness of the RASFF as a source of information for ERI (EFSA (European Food Safety Authority), 2010f). Similarly, none of the issues identified through media monitoring was prioritised for further action.

However, it should be noted that EFSA, in collaboration with JRC, is developing specific IT tools for media monitoring and the usefulness of media monitoring should be reassessed once these tools are finalised and evaluated. On the basis of preliminary results, specific areas such as plant and animal health, and GMO have been identified as candidate areas for which media monitoring appears to be more promising. One issue was identified through Promed (*i.e. Angiostrongylus cantonensis* found for the first time in Spain) and two issues were drawn from the EFSA networking were prioritised for action (*i.e.* climate change and energy drinks). The monitoring of the scientific literature has lead to the identification of 13 issues prioritised for the consideration of the Panels and the SC or for follow-up actions. Whilst the scientific literature appears to be a useful source of information, it is recognised that the systematic monitoring and evaluation of the scientific publications is a very time consuming activity and, in most cases, it requires a high level of expertise and profound knowledge of the past and ongoing EFSA activities and food safety regulation to be useful for ERI. With reference to trade and food price data, the limited number of positive hits is likely to be due to the difficulties in interpreting the large number of signals, leading to the conclusion that in order to collect and analyse trade and pricing data for the identification of drivers of emerging risks, expert consultations would be pivotal for the final interpretation of these data with respect to ERI.

Thus, the assessment of the five sources of information identified highlighted three main issues of potential interest. Firstly, most of the selected data sources currently used do not seem to fit the purpose of ERI, as they deal mainly with well identified risks, whereas information sources should, instead, deal with new hazards, new or increased exposures and new or increased susceptibility. In particular, the RASFF (which generated about 90 % of the issues selected by EMRISK) is driven by lack of compliance with existing regulations and deals mostly with well identified hazards. Similar considerations apply to media monitoring with the complication that media monitoring does not provide standardized or generally accurate information.

Secondly, it has been recognised that the data sources identified in virtually all areas under the remit of EFSA are too numerous to be realistically monitored and scrutinised systematically and comprehensively, with the resources currently available for ERI. Thus, the need has been identified for a more efficient selection and prioritisation of data sources, and for alternative ways to increase the efficiency in the identification of relevant scientific articles and key studies (EFSA (European Food Safety Authority), 2012b).

Thirdly, in order to identify useful sources of information, clear targeted issues/topics should be first identified. In fact, the remit of EFSA is extremely broad, which makes it challenging to be able to monitor systematically all sources of information on all types of hazards possibly coming from biological, chemical, and physical agents as well as human behaviour factors (*e.g.* excessive or unbalanced nutrition). With reference to data collection, the types of data of potential interest are various, ranging from structured and unstructured to qualitative and quantitative information. Similarly, sources of information are extremely variable. They range from human and animal surveillance data, to recent development from research, but also from information collected by the industry from post-marketing surveillance, to open source information available from the media, among others. With reference to possible strategies and tools to facilitate data collection, it has been suggested to establish multilateral agreements to share information with national and inter-governmental agencies, but also to develop and customise web-scanning tools, and to establish reward research programs specifically designed for ERI (EFSA (European Food Safety Authority), 2011c). From the activity carried out so far, it would appear that there are many benefits to be gained by sharing the monitoring activities across a wide-network. Unsurprisingly, the most efficient approach is to collect emerging issues that have been pre-screened by other institutions.

In addition, IT tools for data collection have been further developed and assessed (*e.g.* media monitoring, detection of trends in trade and food price data, RASFF monitoring tools). Whilst IT-tools can provide an important tool for collecting information, they present analysts with the additional problem of being overwhelmed by data that needs to be carefully screened and interpreted by skilled practitioners with certain knowledge of the nature of the data and information that they process.

In conclusion, our experience shows that collecting useful information on emerging risks requires a high level of expertise, due to the data gaps, and broad knowledge of all ongoing EFSA activities.

3.4. Assessment of the prioritization procedure

The ERI procedure piloted includeed a prioritisation activity at each step of the process. This aimed to select issues that could be eventually classified as emerging risks. In order to select and prioritise relevant issues, a qualitative evaluation was carried out based on the expert judgment of scientific officers against a set of agreed criteria (*e.g.* novelty, soundness, imminence, scale, severity). The evaluation of each criterion was done in a qualitative manner, as a rigid scoring framework does not seem appropriate because, by definition, information about emerging risks is inevitably limited and scattered, and hazards may not be sufficiently characterised.

The main critical issue identified in the assessment of the prioritisation procedure refers to the major limitations in the practical application of the evaluation criteria throughout the evaluation process (EFSA (European Food Safety Authority), 2012b). It soon became apparent that most of the criteria used for filtering the relevance of the emerging issues under evaluation could be ambiguous, in that they could be interpreted in different ways (*e.g.* 'new', 'significant', 'identified'). In addition, assessors were often confronted with major data gaps that made the evaluation extremely uncertain. This ambiguity made it difficult, if not impossible, to assess the criteria and to meaningfully evaluate the relevance of the issues scrutinised.

It has been noted that in order to be able to perform a meaningful prioritisation of emerging issues it is of pivotal importance to have a comprehensive and detailed knowledge of EU Food Safety Regulations in place, a precise overview of all EFSA activities (on emerging risks) to avoid duplication of work, and an expert knowledge of recent scientific developments in the different areas under the remit of EFSA.

In order to tackle the limitation identified in the prioritisation process, the EFSA WG on methodology for ERI has developed a structured expert evaluation approach which should allow evaluating issues in a flexible way, expressing their likelihood of being emerging risks as subjective probabilities (EFSA (European Food Safety Authority), 2012b).

With reference to the high level of expertise needed to identify relevant emerging issues among the large amount of information available, it has been suggested that a standing expert WG of the SC consisting of Panel representatives could be established to support the EMRISK unit in focusing its ERI activities and prioritising the emerging issues identified. The direct contribution of panel members at an early stage of the process when emerging issues are firstly identified should be a future priority activity for the EMRISK unit.

4. FURTHER DEVELOPMENT OF A METHODOLOGY FOR EMERGING RISKS IDENTIFICATION

In order to evaluate the current EFSA procedure and further develop a transparent and sustainable ERI framework, the EMRISK unit established and coordinated a WG of selected internal and external experts (EFSA (European Food Safety Authority), 2012b). The main task of the WG included the identification of selected methods that could be applied by EFSA. The WG performed its assessment through an evaluation of the piloted procedure. This work was based on a detailed assessment of the EMRISK activities through statistics and figures provided by the EMRISK unit, observation of some monitoring activities of the unit, and exchanges with its scientific officers. The WG assessed the performance and limitations of the EFSA procedure under development, with the aim of providing recommendations for improvement.

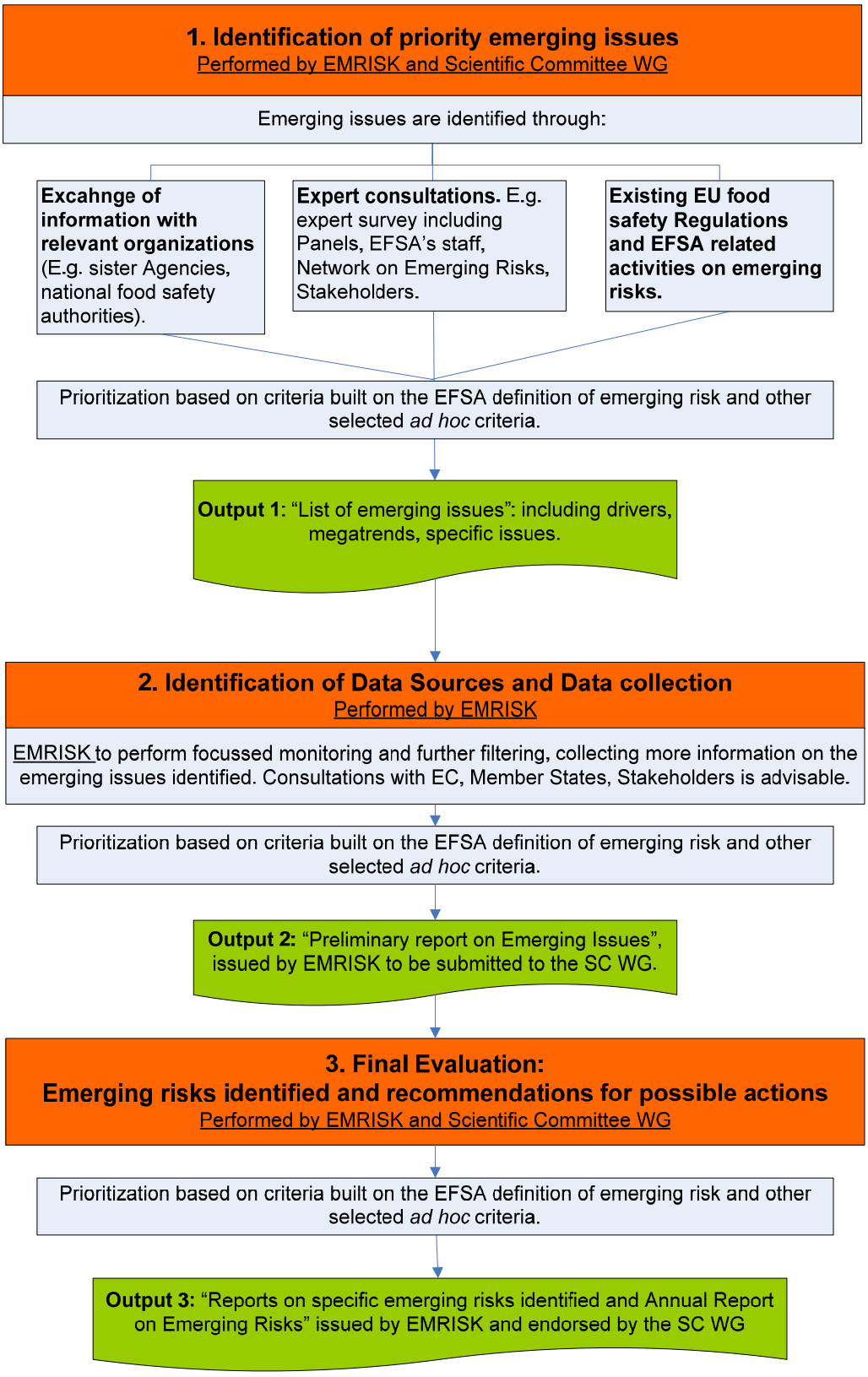
The WG identified the need for an improvement of the current procedure, in particular, through: (i) optimisation of the terminology used, *i.e.* differentiation between "emerging issues" and "emerging risks"; (ii) a more efficient selection and prioritisation of data sources; (iii) higher efficiency of the data pre-filtering and collection steps; (iv) a more focused approach through the adoption of a filtering strategy to identify individual cases of emerging risks in specific priority areas; (v) an increased transparency, balance and coherence of the filtering procedure; (vi) an improved structure of monitoring meetings; (vii) a much enlarged knowledge/expertise base; and (viii) an increased visibility of the outputs produced.

In particular, the WG proposed a revised simplified framework for ERI including three main steps: 1) preliminary identification of priority emerging issues, 2) identification of appropriate data sources and data collection, 3) final evaluation and ERI (Figure 3). The WG suggested that priority emerging issues should be identified preferably through expert consultations and *via* exchange of information with qualified organisations (*e.g.* sister Agencies and other competent organisations). Within the three steps a structured expert judgment approach to filter and prioritise the relevance of the information was proposed. The WG also provided recommendations on how to improve the efficiency and transparency of the collection of information, the formalisation of the outputs and follow-up actions.

The WG recognised ERI as a highly complex task, requiring a high level of expertise due to major data gaps and uncertainties in the evaluation process. It was, thus, proposed to establish a standing WG with experts from the SC and Panels, possibly including selected EFSA's staff members, to work closely with the EMRISK unit. Moreover, EREN and other Community Agencies should be further encouraged to become active partners in this undertaking.

The proposed methodological framework should be tested and further developed in future ERI activities within EFSA. Principles of the internal verification and validation of the proposed procedure should be considered in a stepwise process and should be based on the practical experience gained through at least three years of implementation. The validation of the efficacy of a system for ERI is a challenging issue to be seriously considered by taking into account not only the evaluation of the ability of the system to identify new and re-emerging risks earlier than traditional systems, but also the usefulness of other types of outputs, such as the establishment of networks, the generation of new knowledge and new paradigms, and the fostering of innovation and technologies. Validation could be performed by developing auditable performance indicators using the suggested prioritisation process. Formal tests need to be developed when the process will be more consolidated. More structured methods for validation specifically designed for forecasting methods could be considered once the system is consolidated (Armstrong, 2001). An independent group of experts not involved in its development could review the system and its implementation periodically, *e.g.* every three years.

Figure 3. Procedure proposed by the WG on methodology for Emerging Risk Identification.



5. DISCUSSION

Over the last two years a process for ERI was piloted and further developed. This included the practical implementation of the ERI procedure, the assessment of the usefulness of selected sources of information in terms of ERI, the establishment and the testing of tools for the collection and filtering of relevant information, the consolidation of knowledge networks for sharing information, and the further development of a methodological framework.

The system under development has started to show its potential in the identification of issues that may give rise to emerging risks. However, several areas have been identified to improve its efficiency. More than 2200 issues have been evaluated using a semi-structured expert judgment approach. Specific issues have been identified, for which follow-up activities have been initiated. These include 4 outsourced projects (*i.e.* a study on the emergence of aflatoxins in cereal crops in the EU due to climate change, a European-wide survey to gather consumption data on energy drinks in young populations, a study on the future impact of omics technologies in food and safety risk assessment and ERI, systematic review of metabolic interactions and synergistic effects of chemical mixtures for human risk assessment), 3 task forces (*i.e.* on bee health, chemical mixtures and emerging tools and methods for hazard assessment), and 2 reports on trade volumes and food prices fluctuations as drivers of emerging risks. In addition, briefing notes have been prepared on specific drivers, biological, chemical issues, and more than 250 issues have been filed in the EMRISK monitoring database.

The implementation of the ERI procedure in EFSA indicates that ERI is a complex process involving the gathering and evaluation of large amounts of information from different sources. Independently from the source of information, our experience shows that collecting useful information on emerging risks requires a high level of expertise, due to the data gaps, and broad knowledge of all ongoing EFSA activities to avoid duplication of work. The systematic monitoring, screening and data mining of the sources of information assessed did not appear to be an efficient tool for ERI. The sources of information used in the pilot phase, the RASFF, media, the scientific literature, trade and price data did not seem to fully fit the purpose of ERI. This is mainly due to the fact that they deal mainly with well identified risks, whereas information sources should, instead, deal with new hazards, new or increased exposures and new or increased susceptibility. In order to collect and analyse trade and pricing data for the identification of drivers of emerging risks, expert consultations would be pivotal for the final interpretation of this data with respect to ERI.

The remit of EFSA is extremely broad, which makes it challenging to be able to monitor effectively all relevant hazards possibly coming from biological, chemical, and physical agents, as well as human behaviour factors. Thus, in order to clarify what types of sources (*e.g.* surveillance data, results from recent research projects, online media reports) to look for and which to monitor, clear targeted issues/topics should be first identified. It has been recognised that the data sources identified in virtually all areas under the remit of EFSA are too numerous to be realistically monitored and scrutinised systematically and comprehensively, with the resources currently available for ERI. Thus, the need has been identified for a more efficient selection and prioritisation of data sources. It has been noted that screening the scientific literature through a broad horizon scanning approach appears to be very resource demanding. In order to evolve from broad horizon scanning to a more focussed approach, experts (*e.g.* from the EFSA Panels and the SC) could be involved at an early stage of the process.

In the last few decades, new approaches and technological tools have become available that can enhance the power of traditional systems to systematically gather and filter information from various sources in a relatively short timeframe. IT tools for data collection have been further developed (*e.g.* media monitoring, detection of trends in trade and food price data, RASFF monitoring tools). Whilst IT-tools can provide an important tool for collecting information, they present analysts with the additional problem of being overwhelmed by data that needs to be carefully screened and interpreted by skilled practitioners with certain knowledge of the nature of the data and information that they process.

In order to harmonise and standardise data collection and to facilitate information exchange among the different players involved in ERI, the EMRISK unit has developed in collaboration with its WGs and Network a semi-structured briefing note template. The briefing note template includes all the information needed for the evaluation and prioritization of the issues identified. Information compiled in the briefing notes are then transferred and stored in the EMRISK monitoring database. This database includes essential information on all the issues evaluated and the decisions taken on follow-up actions. The use of templates and the maintenance of this database appear to be a valid support for the development of a standardised procedure for ERI, including *ad hoc* reporting and sharing of information.

Whilst EFSA has a unit dedicated to ERI, the task is a horizontal one, implicating not only EMRISK, but also all of EFSA's scientific units and their associated panels, carrying out relevant activities on emerging risks. Thus, the SC and Panels should have an important role in the proposed framework. Effective networking of experts has been identified as being essential for exchanging experience, methods, data and evaluation of emerging issues. In particular, networking with stakeholders, MS, EU and international agencies is seen as a key step in developing the effectiveness of this process, and the structures for carrying this out effectively are being developed. To this end, two networks were operated, one with stakeholders and a second with MS. In their first year of operation, the emphasis was on describing existing systems and methodologies used to identify emerging risks.

Principles and methods for ERI have been rarely formalised in the context of food and feed risk assessment. As data leading to the identification of risks at their early inception are characterised by considerable limitations and uncertainties, ERI is generally based on expert judgment and qualitative or semi-quantitative priority setting methods. An improved methodological framework for ERI has been proposed to provide information on emerging risks to managers in the European institutions and MS. The proposed methodological framework for ERI proposed consists of three main steps, namely the identification of priority emerging issues, via exchange of information with relevant organisations and/or through expert consultation approaches, identification of data sources and data collection through additional data search in EFSA, and through mobilisation of external data retrieved via MS, European Institutions and Stakeholders, and the final evaluation to identify emerging risk and suggest possible actions.

According to the EC Regulation 178/2002, EFSA has a statutory obligation to communicate on food and feed emerging risks at a European level. When communicating on emerging risks, a careful consideration of the terminology used is warranted to avoid unnecessary scares associated with risk overestimation or a lack of response due to a risk under evaluation. The emerging risks to be transmitted should be carefully selected and clearly explained, avoiding overload of information to risk managers. Similarly, the terminology used to communicate on emerging risks should be carefully weighted. For example, the use of the word "risk" may trigger more concern than appropriate and the term "emerging issue" may be useful to discriminate between early signals and those issues confirmed to be of concern. Moreover, the communication should clearly address and be proportionate to the type of issues (*e.g.* need for immediate action, potential magnitude of the impact, uncertainties entailed).

When considering possible expectations concerning the outputs of any ERI, it should be noted that ERI is a process confronted with technical complexity and constraints, including human and financial resources. For example, standard methods for ERI, including those for gathering and evaluating large amounts of information from a variety of different sources and to deal with severe data gaps and uncertainties are seldom available. Thus, a realistic objective of any ERI system is to exploit the available information to look for plausible future trends and scenarios. This potentially enables risk assessors and managers to be more prepared to engage with future challenges.

Considering the complexity of ERI in such a broad area, more use needs to be made of expert advice. EFSA has access to a large number of experts through its Panels and its many Networks and staff members. Detailed information of more than 3000 selected experts is available through the EFSA expert database (EFSA (European Food Safety Authority), 2011d). Involving experts already working with EFSA in the selection of priority emerging issues could be a particularly efficient approach, as it

would allow account to be taken of issues that are already covered by current EU Food Safety Regulations and related EFSA's activities on emerging risks.

Building on this hands-on experience, the system is starting to show the potential in the identification of issues that may give rise to emerging risks. In particular, useful knowledge has been gained in the area of gathering, evaluating and filtering large amounts of information related to emerging risks. The proposed methodological framework should be further tested and developed in future ERI activities within EFSA.

6. CONCLUSIONS

The operation of the current process for ERI over a limited trial period of approximately two years has provided practical experience indicating several innovations that would improve the efficiency of the procedure. In line with the appraisal presented, this section aims at providing main conclusions and advice on possible actions for the further development of a fully operational ERI procedure:

- Between Feb 2010 and May 2012, a process for ERI was trialled and further developed. Whilst the system under development is now starting to show its potential in the identification of issues that may give rise to emerging risks, the efficiency of the procedure trialled has room for improvement;
- More than 2200 issues have been evaluated using a semi-structured expert judgment approach. Specific issues have been identified, for which follow-up activities have been initiated. These include 4 outsourced projects, 3 task forces, and 2 reports, briefing notes on specific drivers, biological, chemical issues, and more than 250 issues filed in the EMRISK monitoring database;
- Issues prioritised for action have been originally identified mainly from knowledge networks or from the scientific literature. The other sources of information such as RASFF, media, trade and price data do not seem to fit the purpose of ERI, although, media monitoring appears to have some potential in specific areas such as plant health, animal health and GMO;
- Whilst IT-tools can provide large amount of information in short time, they present analysts with the additional problem of being overwhelmed by data that needs to be carefully screened and interpreted by skilled practitioners;
- The use of templates and the maintenance of the EMRISK monitoring database appear to be a valid support for the development of a standardised procedure for ERI, including *ad hoc* reporting and sharing of information;
- Whilst EFSA has a unit dedicated to the ERI, the task is a horizontal one, implicating not only EMRISK, but also all of EFSA's scientific units and their associated panels;
- Our experience shows that collecting useful information on emerging risks requires a high level of expertise, due to the data gaps, and broad knowledge of all ongoing EFSA activities. At present, expert advice is clearly an under-utilised resource for ERI at EFSA. EFSA has access to a large number of experts through its Panels and its many Networks and staff members;
- Effective networking of experts has been identified as being essential for exchanging experience, methods, data and evaluation of emerging issues. In particular, networking with stakeholders, MS, EU and international agencies is seen as a key step in developing the effectiveness of this process, and the structures for carrying this out effectively are being developed;
- As ERI is a task assigned to a number of different bodies in the EU and in third countries, we have started also to interact with other relevant EU-agencies (*e.g.* ECHA and JRC) and, where possible, international authorities and organisations (*e.g.* WHO and FAO);

- Considering the broad spectrum of areas under the remit of EFSA and the nature of ERI, typically based on large data gaps and uncertainties, a structured expert judgment approach appears the most promising approach for ERI;
- EFSA has a statutory obligation to share information on food and feed emerging risks at a European level. When sharing information on emerging risks, a careful consideration of the terminology used is warranted to avoid unnecessary scares associated with risk overestimation or a lack of response due to a risk under evaluation. The term "emerging issue" may be useful to discriminate between early signals and those issues confirmed to be of concern (*i.e.* "emerging risks");
- A realistic objective of any ERI system is to exploit the available information to look for plausible future trends and scenarios. This potentially enables risk assessors and managers to be more prepared to engage with future challenges.

7. RECOMMENDATIONS

- The SC and Panels should have an important role in the proposed framework. It is, thus, proposed to establish a standing WG, including experts from the EFSA SC and Panels, to work closely with the EMRISK Unit;
- Targeted issues/topics should be agreed prior to the selection of sources of information to be monitored. This prioritisation should happen early in the ERI process;
- It is proposed to reinforce the role and membership of EREN to also include European and International agencies, and encourage greater stakeholder engagement through StaCGER;
- In order to avoid overload of information and to facilitate the analysis, it is considered preferable to share intelligence and selected signals already identified through other organisations (*e.g.* through the MS network and EFSA Panels), rather than to attempt to analyse raw data;
- In order to evolve from broad horizon scanning of to a more focussed approach, experts from the EFSA Panels and the SC should be involved at an early stage of the process. This could prove an efficient way of identifying areas not yet addressed by EFSA;
- In order to make best use of the information coming from the ERI process, it is recommended that the outcome of the ERI process is evaluated and endorsed by the SC with a view to prioritisation of actions by the EFSA Mandate Review Committee;
- The proposed methodological framework should be further tested and developed in future ERI activities within EFSA.

REFERENCES

Altieri A, Robinson T, Mengelers M, Havelaar A, Liem D, Silano V and Bronzwaer S, 2011. EFSA 15th Scientific Colloquium: emerging risks in food - from identification to communication. Trends in Food Science and Technology, 22(5), 249-252.

Armstrong JS, 2001. Principles of forecasting: a handbook for researchers and practitioners. Editor. Kluwer Academic, London, 850 pp.

Battilani P, Rossi V, Giorni P, A. P, Gualla A, H.J. vdF-K, Booij CJH, Moretti A, Logrieco A, Miglietta F, Toscano P, Miraglia M, De Santis B and Brera C 2012. Scientific report submitted to EFSA. Modelling, predicting and mapping the emergence of aflatoxins in cereals in the EU due to climate change. Available from: http://www.efsa.europa.eu/en/supporting/doc/223e.pdf

Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N, Johnson A, Kett M, Lee M, Levy C, Maslin M, McCoy D, McGuire B, Montgomery H, Napier D, Pagel C, Patel J, de Oliveira JA, Redclift N, Rees H, Rogger D, Scott J, Stephenson J, Twigg J, Wolff J and Patterson C, 2009. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. Lancet, 373(9676), 1693-1733.

EFSA (European Food Safety Authority), 2007. Definition and description of "emerging risks" within the EFSA's mandate.

EFSA (European Food Safety Authority), 2008. Statement of EFSA on risks for public health due to the presences of melamine in infant milk and other milk products in China. EFSA Journal, 807, 10 pp.

EFSA (European Food Safety Authority) 2009a. Development of web monitoring systems for the detection of emerging risks. Available from: http://www.efsa.europa.eu/en/efsajournal/doc/1355.pdf

EFSA (European Food Safety Authority) 2009b. Report of the EFSA Scientific Cooperation (ESCO) Working Group on Emerging Risks. Available from:

EFSA (European Food Safety Authority), 2009c. Strategic Plan of EFSA for 2009-2013.

EFSA (European Food Safety Authority), 2010a. Bovine Besnoitiosis: an emerging disease in Europe. EFSA Journal, 8, 15 pp.

EFSA (European Food Safety Authority), 2010b. Collection and routine analysis of import surveillance data with a view to identification of emerging risks. EFSA Journal, 8(3), 35 pp.

EFSA (European Food Safety Authority), 2010c. Development and implementation of a system for the early identification of emerging risks in food and feed. EFSA Journal, 8(10), 62 pp.

EFSA (European Food Safety Authority), 2010d. Emerging and novel brominated flame retardants. In preparation.,

EFSA (European Food Safety Authority), 2010e. Emerging toxins in shellfish - brevetoxins. EFSA Journal, 8, 29 pp.

EFSA (European Food Safety Authority), 2010f. Establishment and maintenance of routine analysis of data from the Rapid Alert System on Food and Feed EFSA Journal, 8 26 pp. .

EFSA (European Food Safety Authority), 2010g. Scientific Opinion on marine biotoxins in shellfish – Emerging toxins: Ciguatoxin group. EFSA Journal, 8, 38 pp.

EFSA (European Food Safety Authority) 2011a. Annual report on the Emerging Risks Exchange Network 2010. Available from: http://www.efsa.europa.eu/en/supporting/doc/153e.pdf

EFSA (European Food Safety Authority), 2011b. Data collection for the identification of emerging risks related to food and feed. EFSA Journal, 9, 52 pp.

EFSA (European Food Safety Authority) 2011c. EFSA's 15th Scientific Colloquium on emerging risks in food: from identification to communication. Available from: http://www.efsa.europa.eu/en/supporting/doc/114e.pdf

EFSA (European Food Safety Authority), 2011d. Expert Database 2010 Annual Report of Activities. 2011,

EFSA (European Food Safety Authority) 2011e. Report on Stakeholders' activities in the area of emerging risks. Available from: http://www.efsa.europa.eu/en/supporting/pub/170e.htm

EFSA (European Food Safety Authority), 2011f. Shiga toxin-producing E. coli (STEC) O104:H4 2011 outbreaks in Europe: Taking Stock. EFSA Journal, 9(10), 22 pp.

EFSA (European Food Safety Authority) 2012a. Draft Science Strategy of EFSA for 2011-2016. Available from: http://www.efsa.europa.eu/en/consultations/call/111104.htm

EFSA (European Food Safety Authority) 2012b. Towards a methodological framework for emerging risks identification. Available from: http://www.efsa.europa.eu/en/supporting/doc/243e.pdf

EFSA Panel on Biological Hazards (BIOHAZ), 2011. Scientific Opinion on the risk posed by Shiga toxin-producing Escherichia coli (STEC) and other pathogenic bacteria in seeds and sprouted seeds. EFSA Journal, 9, 101 pp.

EFSA Panel on Plant Protection Products and their Residues (PPR), 2012. Scientific Opinion on the science behind the development of a risk assessment of Plant Protection Products on bees (Apis mellifera, Bombus spp. and solitary bees). EFSA Journal, 10, 275 pp.

European Centre for Disease Prevention and Control (ECDC) 2011. Emerging and vector-borne diseases programme. Available from: http://ecdc.europa.eu/en/activities/diseaseprogrammes/emerging_and_vector_borne_diseases/

European Environment Agency 2011. BLOSSOM — Bridging long-term scenario and strategy analysis: organisation and methods. Available from: http://www.eea.europa.eu/publications/blossom

European Food Safety Authority (EFSA) 2012. Evaluation of a system for the scanning of Eurostat's data to detect trends in trade. Available from: www.efsa.europa.eu/publications

European Food Safety Authority (EFSA), ongoing-a. Internal mandate proposed by EFSA to the Emerging Risks Unit for an internal science Project on international frameworks dealing with the human risk assessment of chemical mixtures. EFSA-Q-2011-00765.

European Food Safety Authority (EFSA), ongoing-b. Internal Mandate proposed by EFSA to the Emrisk Unit for a Procurement on data collection for the consumption of energy drinks and specific ingredients in specific consumer groups. EFSA-Q-2011-00309.

European Food Safety Authority (EFSA) ongoing-c. Internal Mandate proposed by EFSA to the EMRISK Unit for a Procurement on emerging risks: A foresight study on emerging technologies: State of the art of Omics technologies and potential applications in food and feed safety. EFSA-Q-2011-00800.

European Food Safety Authority (EFSA) ongoing-d. Inventory of studies conducted on bees, inside and outside EFSA, to identify cross-cutting issues and further research needs for a more integrated approach on the evaluation of risks to bees and their ecosystem services. EFSA-Q-2012-00531.

Gibson DG, Glass JI, Lartigue C, Noskov VN, Chuang RY, Algire MA, Benders GA, Montague MG, Ma L, Moodie MM, Merryman C, Vashee S, Krishnakumar R, Assad-Garcia N, Andrews-Pfannkoch C, Denisova EA, Young L, Qi ZQ, Segall-Shapiro TH, Calvey CH, Parmar PP, Hutchison CA, 3rd, Smith HO and Venter JC, 2010. Creation of a bacterial cell controlled by a chemically synthesized genome. Science, 329, 52-56.

Havelaar AH, Brul S, de Jong A, de Jonge R, Zwietering MH and Ter Kuile BH, 2010. Future challenges to microbial food safety. Int J Food Microbiol, 139 Suppl 1, S79-94.

International Risk Governance Council 2009. Emerging Risks. Sources, drivers and governance issues Available from: http://www.irgc.org/IMG/pdf/IRGC_Revised_Emerging_Risks_Concept_Note_March2010.pdf

JRC IPTS Team Working in European Foresight 2010. European Foresight. Available from: http://foresight.jrc.ec.europa.eu/index.html

Kocharov A, 2010. EFSA and Identification of Emerging Risks. European Food and Feed Law Review, 3, 144-155.

Linge JP and Belyaeva J 2011. Customization of MedISys for the monitoring of food and feed hazards.

Marvin HJP, Kleter GA, Prandini A, Dekkers S and Bolton DJ, 2009. Early identification systems for emerging foodborne hazards. Food Chem Toxicol, 47(5), 915-926.

Mottram DS, Wedzicha BL and Dodson AT, 2002. Acrylamide is formed in the Maillard reaction. NATURE, 419 (6906), 448-449.

OECD (EECD), 2003. Emerging risks in the 21st Century: an agenda for action. Available from: http://www.oecd.org/dataoecd/20/23/37944611.pdf

Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), 2009. Emerging Issues and the Role of the SCENIHR. Position Paper. 2011,

VWA, BfR, BVL, FAO, FAVV-AFSCA, FSA, CSL, OIE, RIKILT and RIVM 2006. Forming a Global System for Identifying Food-related Emerging Risks, EMRISK. Available from: http://www.efsa.europa.eu/en/supporting/doc/224r.pdf

ABBREVIATIONS

DACO	Data collection for the identification of emerging risks related to food and feed
EC	European commission
ECHA	European chemicals agency
ECDC	European Centre for Disease Prevention and Control
EFSA	European food safety authority
EMRISK	Emerging risks (unit)
ERI	Emerging risk identification
ERIC	Emerging risks internal collaboration group
EU	European union
FAO	Food and agriculture organisation
GMO	Genetically modified organisms
JRC	Joint research centre
Promed	Program for monitoring emerging diseases
RASFF	Rapid alert system for food and feed
SC	Scientific committee
SCENIHR	Scientific committee on emerging and newly identified health risks
StaCG-ER	Stakeholder consultative group on emerging risks
WG	Working group

APPENDICES

A. Technical report of EFSA. Overview of food price data sources.

B. Briefing note template.

C. Technical report of EFSA. Trade data surveillance.

APPENDIX A

TECHNICAL REPORT OF EFSA

Overview of food price data sources[1]

European Food Safety Authority[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

SUMMARY

Price changes, in terms of increase, decrease or fluctuation over time, have been suggested in the scientific literature as a driving factor that influences food consumption and subsequently the intake of both nutrients and contaminants. They may have negative consequences in terms of food safety, such as compromising safety and quality, adulteration, instability in the food chain and adoption of less healthy diets.

With a view to identifying drivers of emerging issues in the food and feed chain, the Emerging Risks unit of EFSA is exploring the use of price data. This report describes freely available sources of food pricing data and market analyses prepared by European and international bodies that could be used to forecast the economic environment influencing the food chain.

It is, probably, difficult to predict food safety emerging risks from food pricing data. These data are collected in order to serve areas other than food safety, like trade policies and food security. Moreover, price changes occur due to heterogeneous parameters, like crop production projections and energy cost. Price indices related to the food chain (e.g. agricultural commodity prices, producers' prices, consumers' prices) are affected by these parameters in a dissimilar way over time.

If it is considered useful to collect and analyse pricing data for the identification of drivers of emerging risks by EFSA, external consultation would be necessary either through outsourcing or by setting up a group of experts in economics, trade policy and food market functioning.

KEY WORDS

Emerging risks, food prices

[1] On request from EFSA, Question No EFSA-Q-2012-00258, issued on 26 April 2012.
[2] Correspondence: emrisk@efsa.europa.eu
[3] Acknowledgement: EFSA wishes to thank EFSA staff: Tilemachos Goumperis and Tobin Robinson for the support provided to this scientific output.

Suggested citation: European Food Safety Authority; Overview of food price data sources. Supporting Publications 2012: EN-278. [27 pp.]. Available online: www.efsa.europa.eu/publications

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BACKGROUND

Price guides consumers on which foods to choose; the Eurobarometer survey of 2005 showed that "Europeans are more guided by the quality and price of food than by health and food safety concerns" (EC, 2006). Food price has been suggested in the scientific literature as a driving factor that influences food consumption (Havelaar et al., 2010; Quested et al., 2010).

The EFSA Scientific Cooperation Working Group on Emerging Risks identified that a possible consequence of the increase in food prices is likely to further stimulate the search for alternative food sources, including the importation of food into the EU from new sources4.

In 2010, mixing edible with inedible varieties of pine nuts caused taste disturbances to European consumers and one of the possible drivers for this activity was the increase in price of this commodity during the previous years. Similarly the adulteration of milk with melamine in 2008 was driven by the attempt to falsify the protein content of milk, the protein content being the criteria used to measure the quality and thus the price paid for milk.

Price data of agricultural commodities is collected at EU level by Eurostat and DG AGRI, and at the global level by FAO.

TERMS OF REFERENCE

According to the EFSA-M-2012-00258 self-mandate named "collection and analysis of pricing data for the identification of drivers of emerging risks", the emerging risks unit (EMRISK) is requested to prepare a Technical Report describing food price data sources at European and global level, assess the tools available for monitoring the data and discuss the usefulness of screening food prices for emerging risk identification in the food and feed chain.

[4] http://www.efsa.europa.eu/en/efsajournal/pub/224ar.htm

INTRODUCTION

A price is an amount of money paid by the buyer to the seller of goods or services as agreed upon in a transaction. These transactions can concern industrial goods, different kinds of services or agricultural products. Altogether, prices and their interrelationships make up the system of prices, which affect all sections of society, and determine how resources are allocated. For example, to consumers the structure of prices indicates the terms on which they can acquire the goods; to producers prices indicate the terms on which they may dispose of their goods and services or acquire the goods and services of others (Eurostat, 2008).

In particular in the agricultural sector, agricultural price statistics provide information on trends in producer prices of agricultural products and purchase prices of the goods and services consumed by agriculture in the production process (Eurostat, 2010).

Price influences consumer choice; the Eurobarometer survey of 2005 showed that "Europeans are more guided by the quality and price of food than by health and food safety concerns" (EC, 2006). Food price has been suggested in the scientific literature as a driving factor that influences food consumption (Havelaar et al., 2010; Quested et al., 2010).

According to the EFSA's strategic plan for 2009-2013[5], the European food supply is expected to be increasingly influenced by a range of different factors, including energy prices, the increased use of land for biofuels and the growing world demand for food. Developments in these areas are reflected in the spike in food prices in 2008 but, in the longer term, it is difficult to gauge what specific impact they may have on EFSA's work.

Food prices are determined by supply and demand. However, unlike many other products, the demand for food per capita is, to a large degree, invariant of price for high-income countries (Quested et al., 2010). The same authors suggest that pressures on food prices could lead to a reduction of consumption of expensive or luxury foods for which cheaper substitutes exist and subsequently increase the consumption of these foods. An example of this scenario could be the substitution of lamb meat with less costly poultry meat. On the other hand, staple food products like bread have few substitutes and an increase in their price would not lead to a proportional decrease in consumption.

Price changes include increase, decrease or fluctuation over time. When prices rise, this could potentially lead the different actors in the food chain i.e. producers, manufacturers, retailers or consumers, to practice one or several ways to neutralise the price increase or their economic loss. One of the ways that this could have an impact on food safety could be to compromise safety and quality. For example, higher food prices may cause consumers to more frequently use food past its shelf-life, and may increase recycling of food (Havelaar et al., 2010).

In other cases, the high price of a food commodity could motivate producers or traders to dilute this commodity with a cheaper substitute. In 2010, mixing of edible with inedible, cheaper varieties of pine nuts in China, caused taste disturbance to European consumers[6].

The EFSA Scientific Cooperation Working Group on Emerging Risks identified that a possible consequence of the increase in food prices is likely to further stimulate the search for alternative food sources, including the importation of food into the EU from new sources (EFSA, 2009).

On the contrary, when prices drop there is a need for food chain players to reduce costs (e.g. transport, processing, packaging, waste disposal costs) to remain price competitive or to maintain profit margins. Havelaar et al. reported that in the Netherlands, during the 2008–2009 economic downturn, food

[5] http://www.efsa.europa.eu/en/corporate/doc/stratplan09en.pdf

[6] http://www.nutfruit.org/inc-projects/chinese_pinenuts

producers and retailers more frequently violated regulations relating to cleaning and maintenance due to cost cutting (Havelaar et al., 2010).

Price volatility (consecutive ups and downs) impacts on trust and traceability in the food chain as it can lead companies to close down or lead manufacturers to buy ingredients from different suppliers or frequently change transporters. If these changes and their implications for microbial food safety are not fully considered and managed, there is the potential for a significant impact on public health (Quested et al., 2010).

A possible consequence of price volatility would be on diets. Dietary shifts impact on the daily intake of both nutrients and contaminants. Also, any dietary shift could have a significant impact on the magnitude and nature of the food-borne disease burden (Quested et al., 2010). Based on price data of 2004 to 2008 in Seattle (USA), Monsivais et al. reported a growing price disparity between nutrient-dense foods and less nutritious options over this period; they concluded that cost may pose a barrier to the adoption of healthier diets and limit the impact of dietary guidance (Monsivais et al., 2010).

Another study in the US, suggested that changing fast food and fruit and vegetable prices may affect people's dietary quality and to some extent their adiposity; higher fast food prices were associated with higher fiber intake, lower saturated fat, and better overall diet quality due to lower consumption of fast food, whereas lower fruit and vegetable prices protected against obesity and was associated with improved dietary quality in terms of lower cholesterol and sodium intakes (Beydoun et al., 2008).

This Technical Report describes food price data sources at European and global level, assesses the tools available for monitoring the data and discusses the usefulness of screening food prices for emerging risks identification in the food and feed chain.

METHODS

Sources of freely available pricing data have been identified through internet search. Also, a visit to the European Commission's Directorate-General for Agriculture and Rural Development (DG-AGRI) was organised in order to discuss how pricing data can be used for emerging risks identification in food and feed.

Whilst the list of price data sources might not be exhaustive, it gives a picture of the available data as they are maintained by well-known European and international organisations and cover a diverse range of food products.

RESULTS

1. Sources of pricing data

At the EU level, Eurostat and DG-AGRI report pricing data, whereas at the global scale the sources identified were the Food and Agriculture Organisation of the United Nations (FAO), the Global Information and Early Warning System (GIEWS), the statistics division of the FAO (FAOSTAT), the Organisation for Economic Cooperation and Development (OECD) and the World Bank (WB). These sources are summarised in Appendix I and their description follows.

1.1. EU level

1.1.1. Eurostat

Member States (MSs) provide Eurostat with prices of agricultural products. They are stored in the data base "agricultural prices and price indices (apri)"[7], which is divided into two sub-databases (see Figure 1):

(i) The "Selling prices of agricultural products (absolute prices), land prices and rents (apri_ap)". Selling prices are recorded at the first marketing stage excluding transport and show prices on main agricultural outputs and inputs[8]. Since 2006 only annual prices have been collected. Although much progress has already been made in the harmonisation of the time series across MSs, caution must still be exercised when comparing the actual agricultural prices among MSs. Differences in the prices can still reflect methodological differences (for example different forms of commercialisation of the product concerned) and not factual differences, in every case, in the prices themselves.

(ii) The "Price indices of agricultural products (apri_pi)". The purpose of this database is to provide information on trends in producer prices of agricultural products and purchase prices of the means of agricultural production[9].

These databases include a list of approximately 100 crop and 30 animal products. However, not all MSs report prices for all products in the list. There is no official regulation for the collection of these data. Eurostat gathers data on agricultural prices according to what is termed a "Gentleman's agreement" with the MSs.

[7] http://epp.eurostat.ec.europa.eu/portal/page/portal/agriculture/data/database

[8] http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/apri_ap_esms.htm

[9] http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/apri_pi_esms.htm

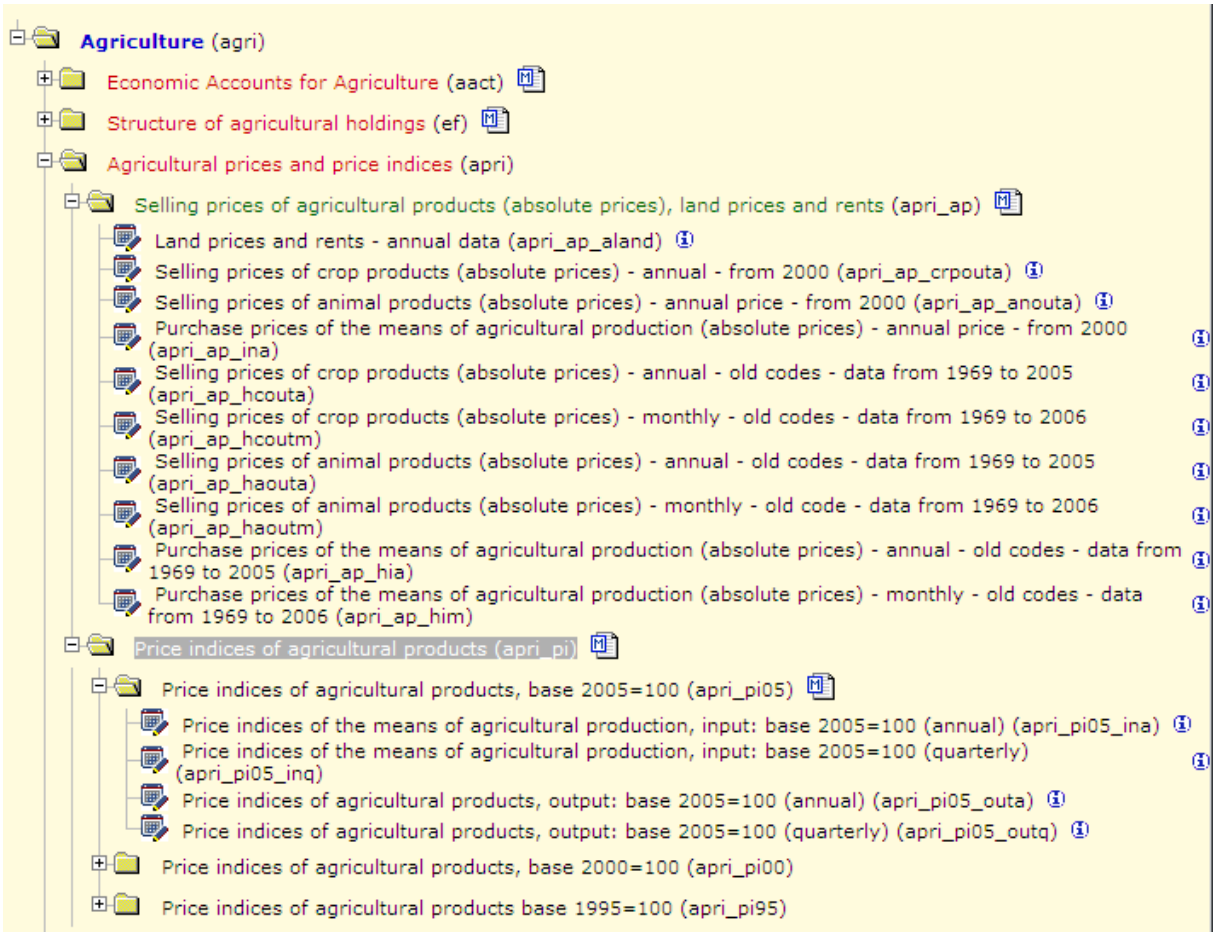

Figure 1: List of Eurostat's "agricultural prices and price indices (apri)" sub-databases

Food supply chain monitor

For the purpose of monitoring food prices and in order to analyse the price developments along the supply chains, Eurostat has developed a monitoring tool where the prices for some types of food products along the supply chain can be compared[10]. According to Eurostat "to give a comprehensive description of all supply chains for all products throughout Europe is an impossible task to perform; instead, a summary of some parts of the full chain for a selection of products is given".

A supply chain is a series of economic activities performed by different economic actors, that all contribute to the production and distribution to the consumers of one or a group of consumer products. To date, 17 supply chains in the food sector have been analysed (see Appendix II). The tool gives information on price developments for different parts of the selected supply chains. For each supply chain and per country, the following series are presented:

- The Harmonized Index of Consumer Prices (HICP) for the product group in the selected chain (which gives comparable measures of inflation) according to COICOP (Classification of Individual Consumption by Purpose).
- The Producer Price Index (PPI) for a maximum of two NACE classes related to the selected chain (NACE: Statistical Classification of Economic Activities in the European Community).

[10] http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/prc_fsc_esms.htm

- The Agricultural Commodity Prices index (ACP) for a maximum of two commodities related to the selected chain.

1.1.2. Directorate-General for Agriculture and Rural Development (DG-AGRI)

1.1.2.1. AgriView

AgriView is a database that includes monthly EU market price developments, for both the EU on average and for individual MSs, for representative products from 1997 until the present[11]. The data are published monthly on the basis of information communicated by the MSs. They cover 31 product groups divided in seven sectors: cereals (for food and feed), dairy products, bovine meat, pork meat, poultry meat, oils and ovine meat (an example is given in Figure 2).

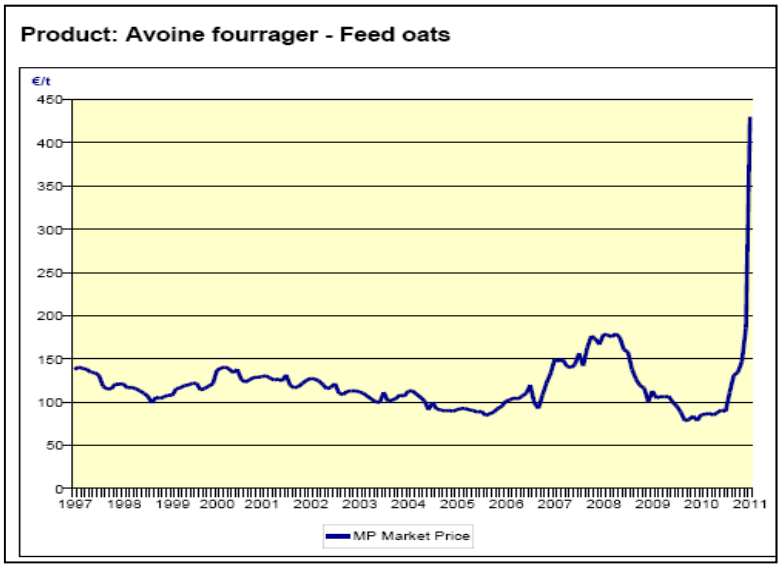

Figure 2: EU market prices (euros/tonne) of feed oats from 1997 until 2011. Taken from the AgriView database report (http://ec.europa.eu/agriculture/markets/prices/monthly_en.pdf)

1.1.2.2. Economic analyses

DG-AGRI produces economic and quantitative studies involving short, medium and long-term forecasts of EU and world agricultural commodity markets[12]. This includes research, analysis and impact assessments on topics related to agriculture and the rural economy in the EU and third countries. They also provide analysis of the agricultural trade policies of major World Trade Organisation (WTO) players, focusing on bilateral and multilateral trade issues and the impact of individual agricultural policies on world markets.

A description of publications most relevant to this report follows.

[11] http://ec.europa.eu/agriculture/markets/prices/monthly_en.pdf

[12] http://ec.europa.eu/agriculture/analysis/index_en.htm

EU agricultural commodity and food price developments

These analyses monitor price developments for agricultural commodities and food in MSs and the EU in total. The reports are published on a monthly basis, including graphs[13] (an example is given in Figure 3). The sources used are Eurostat and AgriView.

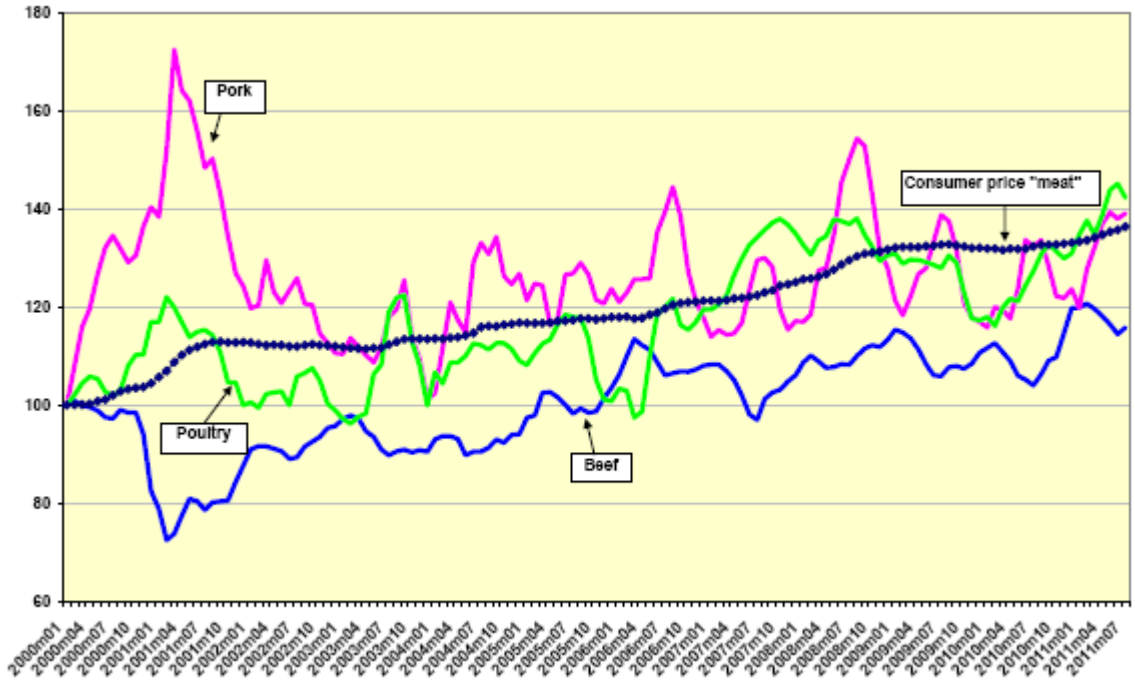

Figure 3: EU agricultural market and consumer price developments of meat (January 2000 until July 2011, Jan2000=100). Sources Eurostat, AgriView. Taken from the DG-AGRI document "August 2011 update on recent agricultural commodity and food price developments in the EU (based on July 2011 prices)" (http://ec.europa.eu/agriculture/analysis/markets/foodprices/food08_2011_en.pdf)

International Price Monitoring Newsletter

Monthly newsletter highlighting the latest developments on a global scale[14].

Agricultural Markets Briefs

The *Brief* looks at recent factors driving price developments in agricultural markets over the long term. It is based on in-house analysis of price developments in agricultural markets, in an attempt to identify the key drivers. For example, the issue of June 2011 discusses "high commodity prices and volatility"[15].

[13] http://ec.europa.eu/agriculture/analysis/markets/foodprices/index_en.htm

[14] http://ec.europa.eu/agriculture/analysis/tradepol/commodityprices/price-monitoring-newsletter/7-8-2011_en.pdf

[15] http://ec.europa.eu/agriculture/analysis/tradepol/commodityprices/market-briefs/01_en.pdf

Agricultural commodity markets-Outlook of ten-years period

These are reports published annually comparing projections for agricultural commodity markets[16]. The issue of 2010[17] "Agricultural commodity markets; outlook 2010-2019" is a comparative analysis of projections published by the OECD and the FAO, the Food and Agricultural Policy Research Institute (FAPRI) and the US Department for Agriculture (USDA). According to the authors, it "seeks to provide an overview of trends, main drivers and uncertainties on the international commodity markets".

Food prices; causes of food prices increase

An analysis of the causes of the boom in agricultural prices (published in August 2008)[18]. Commodity analyses cover 11 agricultural products.

1.2. Global level

1.2.1. FAO Price Indices

Food Price Index

FAO's Food Price Index is a measure of the monthly change in international prices of a group of food commodities[19] (see Figure 4). It consists of the average of the five commodity group price indices mentioned below (cereals, oils/fats, diary, meat and sugar price indices), weighted with the average export shares of each of the groups for 2002-2004.

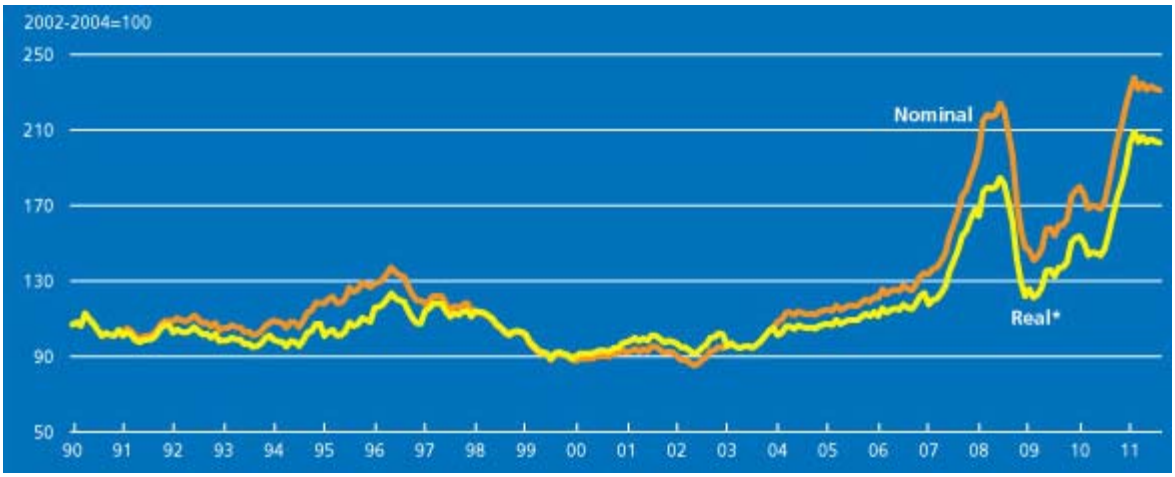

Figure 4: FAO Food Price Index (http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/). Note: the real price index is the nominal index deflated by the World Bank Manufactures Unit Value Index

[16] http://ec.europa.eu/agriculture/analysis/tradepol/worldmarkets/index_en.htm

[17] http://ec.europa.eu/agriculture/analysis/tradepol/worldmarkets/outlook/2010_2019_en.pdf

[18] http://ec.europa.eu/agriculture/analysis/perspec/foodprice/index_en.htm

[19] http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/

Dairy Price Index

The Diary Price Index (Figure 5) consists of butter, skimmed milk powder, whole milk powder, cheese, casein price quotations; the average is weighted by world average export trade shares for 2002-2004.

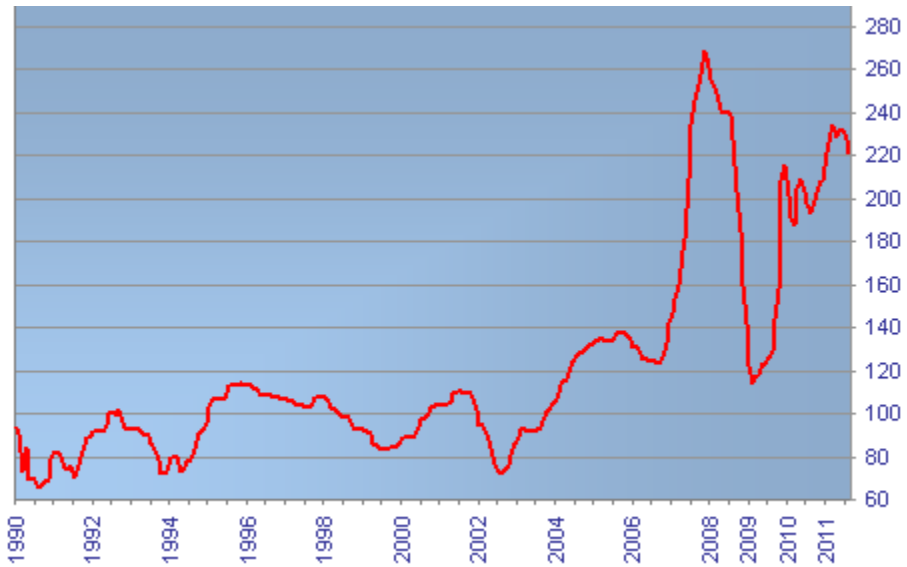

Figure 5: FAO Diary Index from 1990 to 2011, consisting of butter, skimmed milk powder, whole milk powder, cheese, casein price quotations; the average is weighted by world average trade shares for 2002-2004. Source: FAO, http://www.fao.org/economic/est/est-commodities/dairy/en/.

Meat Price Index

FAO Meat Price Index is computed from average prices of four types of meat, weighted by world average export trade shares for 2002-2004 (Figure 6). Quotations include two poultry products, three bovine meat products, three pork meat products, and one ovine meat product (see Appendix III).

Cereals Price Index

This index is compiled using the grains and rice price indices weighted by their average trade share for 2002-2004. The Grains Price Index consists of International Grains Council (IGC) wheat price index (itself average of nine different wheat price quotations) and one maize export quotation; after expressing the maize price into its index form and converting the base of the IGC index to 2002-2004. The Rice Price Index consists of three components containing average prices of 16 rice quotations: the components are Indica, Japonica and Aromatic rice varieties and the weights for combining the three components are assumed (fixed) trade shares of the three varieties.

Oil and Fat Price Index

It consists of an average of 12 different oils (including animal and fish oils) weighted with average export trade shares of each oil product for 2002-2004 (see Appendix IV).

Sugar Price Index

This is an Index form of the International Sugar Agreement.

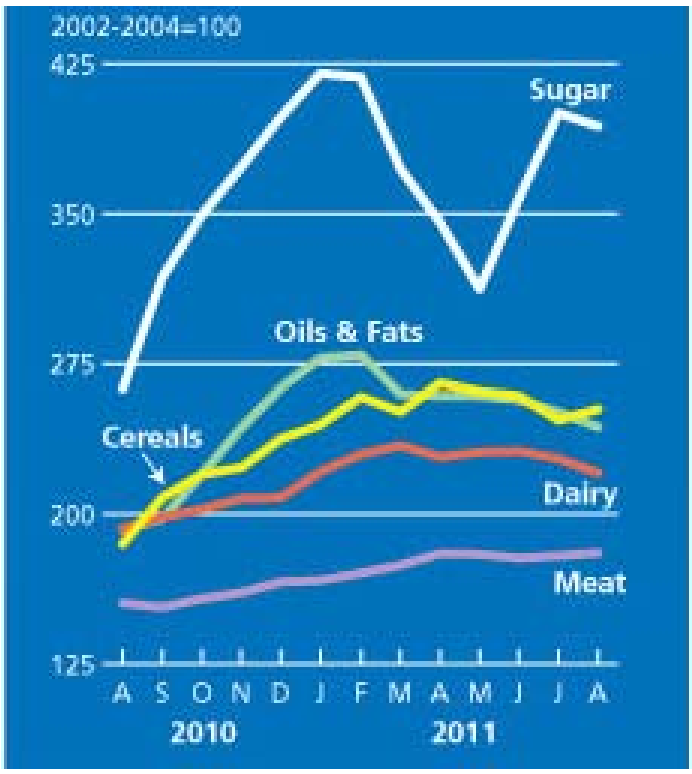

Figure 6: FAO Food Commodity Price Indices as by September 2011 (http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/). Prices with 2002-2004 as base.

1.2.2. International Commodity Prices

The International Commodity Prices database of FAO includes weekly or monthly as well as annual averages for a range of food commodities[20] (an example is given in Figure 7). Prices include different origin and transport costs e.g. "Coconut oil (Philippines, c.i.f.[21] Rotterdam)" and "Wheat (Argentina, Up River, f.o.b.[22] Tuesday".

[20] http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en

[21] Cost, Insurance and Freight
[22] Free On Board

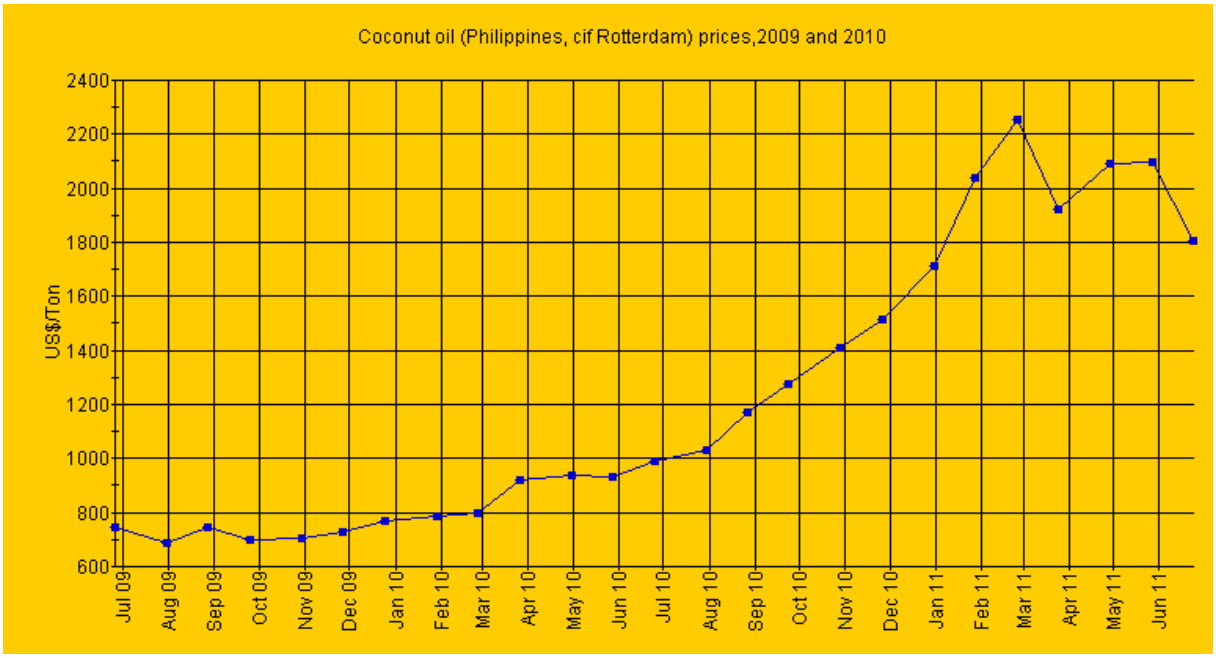

Figure 7: International commodity prices (US dollars per tonne) of "Coconut oil (Philippines, cif Rotterdam)" from July 2009 to June 2011. Source : FAO (http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en).

1.2.3. Global Information and Early Warning System (GIEWS)

Global Food Price Monitor

Under the GIEWS, the Global Food Price Monitor[23] short reports describe current food prices at world, regional and country level, focusing on developing countries, and thus is more related to food security.

Food Price Data and Analysis Tool

GIEWS Food Price Data and Analysis Tool is a database of basic food prices (an example is given in Figure 8). The database currently includes over 1,000 monthly domestic retail and/or wholesale price series of major foods consumed in 78 countries and 24 international cereal export price series, covering a total of 20 different food commodity categories.

The Tool allows the analysis of different data series including the conversion of quotations from national currencies to US dollars, as well as comparisons of domestic and international price trends. With few exceptions, the price quotations are collected from national official sources.

[23] http://www.fao.org/giews/english/gfpm/index.htm

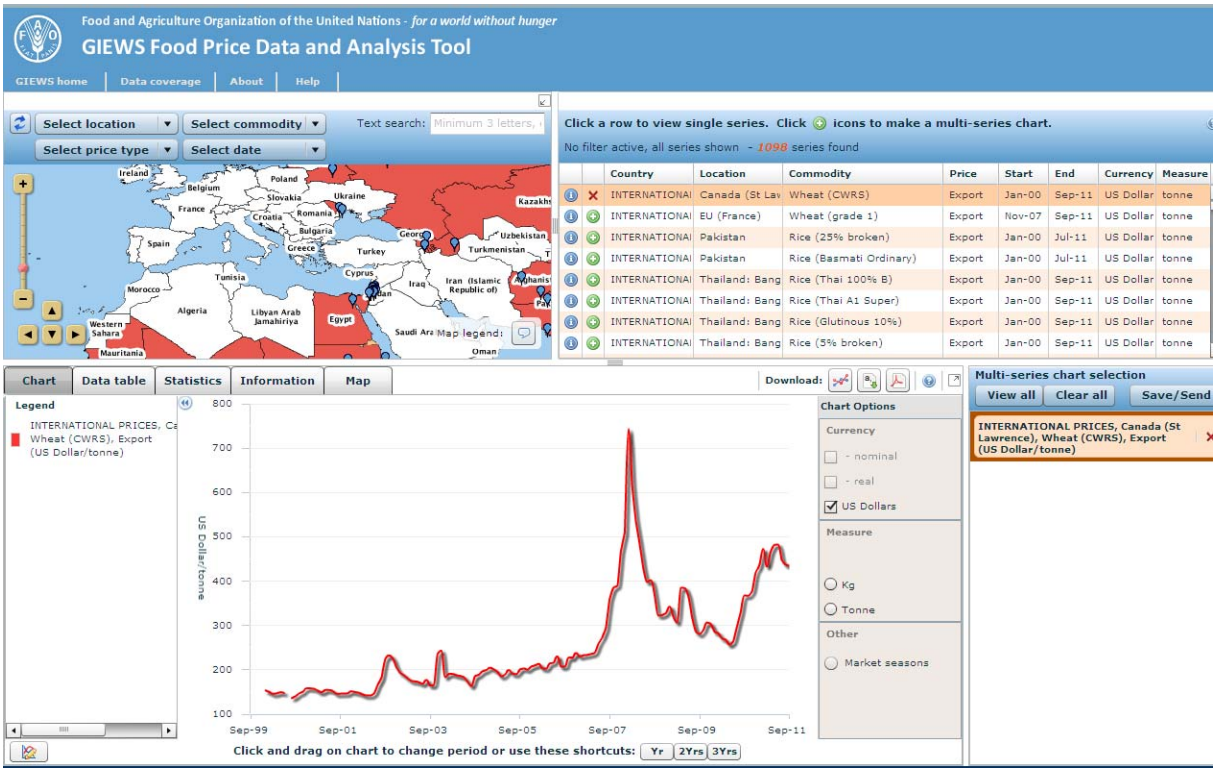

Figure 8: GIEWS Food Price Data and Analysis Tool (http://www.fao.org/giews/pricetool2/). The chart shows the price of the commodity "Canada (St Lawrence), wheat, export-US Dollar/tonne" from September 1999 to September 2011.

1.2.4. Statistics Division of the FAO (FAOSTAT)

The price domain of FAOSTAT[24] contains annual data on producer prices for primary crops, live animals and livestock primary products as collected at the point of initial sale (prices paid at the farm-gate). Data are provided for over 130 countries and for approximately 200 commodities (see Figure 9). In September 2011, the latest data available were from 2009.

[24] http://faostat.fao.org/site/570/default.aspx#ancor

Figure 9: FAOSTAT price domain (http://faostat.fao.org/site/570/default.aspx#ancor)

1.2.5. OECD-FAO Agricultural Outlook Database

The OECD-FAO Agricultural Outlook Database[25] includes historical pricing data (the same as in the International Commodity Prices database of FAO; see 1.2.2) and projections for the next ten years.

A summary report that assesses agricultural market trends and prospects for production, consumption, trade, stocks, and prices of agricultural commodities, including biofuels, is published once a year. Year's 2011 edition[26] (Agricultural Outlook 2011-2020; published on 17 June 2011) includes a section on price volatility and price transmission from world to domestic markets, analysing the evidence of and changes in price volatility over the longer term.

1.2.6. World Bank (WB)

The WB monitors major food commodity markets important to developing countries[27]. **Monthly prices** for over 70 series are published each month, 36 of them related to food and beverages (see Figure 10). **Price forecasts** for the next 10 years are published on a quarterly basis (see Figure 11). A **review of commodity markets** is published twice a year.

[25] http://www.oecd.org/document/15/0,3746,en_36774715_36775671_48172367_1_1_1_1,00.html
[26] http://www.agri-outlook.org/pages/0,2987,en_36774715_36775671_1_1_1_1_1,00.html#publication
[27] http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:21574907~menuPK:7859231~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html

COMMODITY PRICE DATA

		Annual averages			Quarterly averages					Monthly averages		
		Jan-Dec	Jan-Dec	Jan-Aug	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jun	Jul	Aug
Commodity	Unit	2009	2010	2011	2010	2010	2010	2011	2011	2011	2011	2011
Beverages												
Cocoa	b/ ¢/kg	288.9	313.3	318.5	321.0	305.9	296.6	334.3	307.4	301.6	316.7	306.4
Coffee, arabica	b/ ¢/kg	317.1	432.0	619.5	392.0	468.5	513.9	620.0	636.5	606.2	590.9	595.2
Coffee, robusta	b/ ¢/kg	164.4	173.6	251.0	161.0	183.2	199.4	241.5	262.6	260.0	248.5	247.1
Tea, auctions (3) avg.	b/ ¢/kg	272.4	288.5	297.4	276.4	295.1	303.5	288.7	299.7	301.8	310.1	304.0
Tea, Colombo auctions	b/ ¢/kg	313.7	329.0	331.6	316.2	322.1	342.4	356.3	319.7	311.8	309.6	315.7
Tea, Kolkata auctions	b/ ¢/kg	251.5	280.5	285.6	274.0	320.6	311.7	229.2	313.0	322.8	341.2	316.9
Tea, Mombasa auctions	b/ ¢/kg	252.0	256.0	275.0	238.9	242.7	256.3	280.6	266.3	270.8	279.5	279.5
Food												
Fats and Oils												
Coconut oil	b/ $/mt	725	1,124	1,916	955	1,159	1,546	2,073	1,996	1,803	1,662	1,454
Copra	$/mt	480	750	1,284	634	769	1,038	1,379	1,342	1,186	1,121	985
Groundnut oil	b/ $/mt	1,184	1,404	1,860	1,352	1,301	1,604	1,723	1,830	1,980	2,120	2,100
Palm oil	b/ $/mt	683	901	1,171	813	875	1,108	1,251	1,147	1,133	1,089	1,083
Palmkernel oil	$/mt	700	1,184	1,845	1,034	1,161	1,619	2,131	1,874	1,765	1,371	1,375
Soybean meal	b/ $/mt	408	378	414	342	378	424	437	400	394	400	401
Soybean oil	b/ $/mt	849	1,005	1,331	875	984	1,242	1,349	1,311	1,324	1,337	1,330
Soybeans	b/ $/mt	437	450	560	409	452	522	565	557	558	559	558
Grains												
Barley	b/ $/mt	128.3	158.4	205.5	146.9	161.9	181.1	198.1	209.5	210.1	215.5	206.1
Maize	b/ $/mt	165.5	185.9	299.6	157.7	181.7	241.5	282.8	312.6	310.6	300.8	310.2
Rice, Thailand, 5%	b/ $/mt	555.0	488.9	514.8	452.4	457.0	510.8	511.2	493.1	513.8	538.3	567.0
Rice, Thailand, 25%	$/mt	458.1	441.5	475.6	399.1	418.5	471.4	465.4	456.8	473.8	506.8	531.7
Rice,Thai, A.1	$/mt	326.4	383.7	425.6	333.8	376.9	423.1	411.3	419.2	427.5	449.3	464.3
Rice, Vietnam 5%	$/mt	n.a.	428.8	489.6	366.1	411.1	504.7	479.8	479.7	475.3	492.0	546.2
Sorghum	$/mt	151.1	165.4	268.8	142.6	153.6	208.6	255.2	270.5	260.4	271.2	302.5
Wheat, Canada	$/mt	300.5	312.4	456.4	260.9	326.1	383.6	449.0	474.6	486.8	445.8	434.9
Wheat, US, HRW	b/ $/mt	224.1	223.6	330.0	177.4	237.9	283.6	330.5	339.3	326.4	303.9	327.1
Wheat, US, SRW	$/mt	186.0	229.7	301.5	186.9	253.4	284.9	320.8	301.9	282.2	266.4	277.6
Other Food												
Bananas, EU	$/mt	1144.9	1002.2	1200.4	1029.0	932.6	1033.4	1251.4	1250.2	1186.1	1075.8	1022.5
Bananas, US	b/ $/mt	847	868	977	862	922	909	964	1,004	976	961	951
Fishmeal	$/mt	1,230	1,688	1,636	1,814	1,663	1,613	1,740	1,648	1,547	1,490	1,435
Meat, beef	b/ ¢/kg	264	335	405	342	331	353	410	406	390	395	399
Meat, chicken	b/ ¢/kg	188.8	189.2	190.6	190.2	193.6	189.3	188.2	191.0	191.7	192.6	194.3
Meat, sheep	¢/kg	427.6	531.4	663.5	486.8	572.5	618.7	637.1	668.5	677.2	690.7	700.5
Oranges	b/ $/mt	909.0	1033.2	878.6	1083.6	1162.9	877.9	824.0	877.9	916.4	971.6	951.7
Shrimp, Mexico	b/ ¢/kg	945	1,004	1,245	945	n.a.	1221.7	1245.6	1,244	1,240	n.a.	n.a.
Sugar, EU	b/ ¢/kg	52.44	44.18	46.08	42.66	43.29	44.38	44.69	47.02	47.03	46.67	46.82
Sugar, US	b/ ¢/kg	54.88	79.25	84.02	69.62	78.20	84.86	86.56	80.28	78.39	83.62	88.03
Sugar, world	b/ ¢/kg	40.00	46.93	58.65	34.93	42.98	58.01	62.70	52.56	55.58	62.21	61.18

Figure 10: Commodity Price Data of food and beverages published by the World Bank (version of September 2011).

Commodity	Unit	Forecast									
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Beverages											
Cocoa	¢/kg	310	260	240	230	220	216	212	208	204	200
Coffee, Arabica	¢/kg	580	450	380	350	330	319	309	299	289	280
Coffee, robusta	¢/kg	230	200	170	165	160	158	156	154	152	150
Tea, auctions	¢/kg	287	281	274	270	265	261	257	253	249	245
Food											
Fats and Oils											
Coconut oil	$/mt	1,800	1,300	950	900	850	836	821	807	794	780
Groundnut oil	$/mt	1,600	1,400	1,380	1,350	1,325	1,299	1,274	1,249	1,224	1,200
Palm oil	$/mt	1,100	900	850	810	800	782	765	748	731	715
Soybean meal	$/mt	420	350	330	310	308	307	307	306	305	304
Soybean oil	$/mt	1,250	900	865	855	850	840	830	820	810	800
Soybeans	$/mt	530	450	400	395	390	387	384	381	378	375
Grains											
Barley	$/mt	205	203	172	171	174	177	181	184	187	191
Maize	$/mt	270	230	180	171	172	172	171	171	170	170
Rice, Thai, 5%	$/mt	500	480	475	470	470	466	462	458	454	450
Wheat, US, HRW	$/mt	300	250	200	198	195	194	193	192	191	190
Other Food											
Bananas US	$/mt	950	850	800	770	750	746	742	738	734	730
Meat, beef	¢/kg	408	320	290	290	290	292	294	296	298	300
Meat, chicken	¢/kg	192	194	196	198	198	199	199	199	200	200
Oranges	$/mt	905	905	905	905	905	908	911	914	917	920
Shrimp	¢/kg	1,240	1,203	1,168	1,133	1,100	1,105	1,110	1,115	1,120	1,125
Sugar, world	¢/kg	55.0	40.0	36.0	35.0	34.0	34.4	34.8	35.2	35.6	36.0

Figure 11: Price Forecast in current US dollars from 2011 to 2020. Source: World Bank, Economic Policy and Prospects Group. Projections as of June 2, 2011.

DISCUSSION

A limited number of products are covered by all the sources described above. Most often product commodities include technical terms of origin and transport costs e.g. ”Coconut oil (Philippines, c.i.f. Rotterdam)”, “Wheat (Argentina, Up River, f.o.b. Tuesday)”. Faster evaluation of the current situation can be performed through the broad categories that have been created by FAO taking into account average trade weights i.e. the Food Price Indices.

New data are available, depending on the source, on a weekly, monthly or yearly basis. Data from the Eurostat cover only the EU area and usually there are not data for all MSs. The most detailed tool (FAOSTAT Price domain) has a two-year reporting delay, whereas the WB reports a ten-year price forecast for a number of food commodities.

Instead of using raw pricing data, market analyses prepared by European and International bodies could be useful for forecasting the economic environment influencing the food chain. DG-AGRI produces such analyses for the EU, as well as comparative analyses of projections published by international organisations. The FAO and the WB also publish reviews of food commodity markets.

Forecasting food price developments could be performed taking into account heterogeneous parameters, the impact of which can change over time and for different food commodities. Some of these parameters could be:

- Exchange rates, as many commodity prices are quoted in US dollars and changes in exchange rates can have a significant impact on prices listed in other currencies (EC, 2010);
- Crop production projections, as they are related to land used, rainfall, natural catastrophes etc. that can change over time;
- Local and international demand, especially in developing economies with a big population i.e. China and India;
- Price of crude oil, as it impacts on transport, production costs and ammonia based fertilisers (Quested et al., 2010);
- Stock to utilisation ratio. Developed country governments would like to reduce expensive stocks, but consequently, when stock ratio is low, there will be more price volatility (Piesse and Thirtle, 2009);
- Inflation and the general economic environment.

As an example of the complexity of analysing pricing data, the FAO reported[28]: “Tuna prices were on average 550 US dollars per tonne, lower in the course of 2009, compared with 2008. This was because of lower fuel prices, which in turn led to higher catches”. Even in this example covering a single product (tuna), one has to deal with many parameters to explain the evolution of a price commodity in the past. Analysts who want to predict the future price developments in order to anticipate food safety risks have to deal with these parameters/uncertainties as well.

Price changes could be an indicator of a future food safety issue. Figure 5 shows the fluctuation of international prices of diary products published by FAO. Prices escalated from 2007 to 2008. In 2008, the scandal of melamine contaminated milk was discovered in China that caused children deaths and health problems to humans and animals. Retroactively, one can hypothesize that this steep price

[28] http://www.globefish.org/homepage.html

increase was a signal that there would be an increased incentive for dairy manufacturers to practise fraud to falsify protein tests of milk, as the price of milk may be based on its protein content.

Different price indices exist for the various sectors of the food chain. Figure 12 shows the developments of agricultural commodity prices, food producer prices and food consumer prices as well as the overall inflation from January 2007 to July 2009 (EC, 2009). According to the authors, from mid-2007 to mid-2008, agricultural commodity prices rose sharply, which resulted in increased consumer food prices and higher inflation levels overall; after that, prices of many commodities came down to levels comparable to or even lower than those reached before the start of the price rise. However, consumer food prices continued to increase and only started declining in May 2009.

The existence of different price indices poses the question of which price index to monitor in order to predict an emerging risk in the food chain. It has been suggested that agricultural commodity price index could be used to predict potential emerging risks in long term, whereas food producer and consumer price indices could be used for signals in short term (DG-AGRI, personal communication).

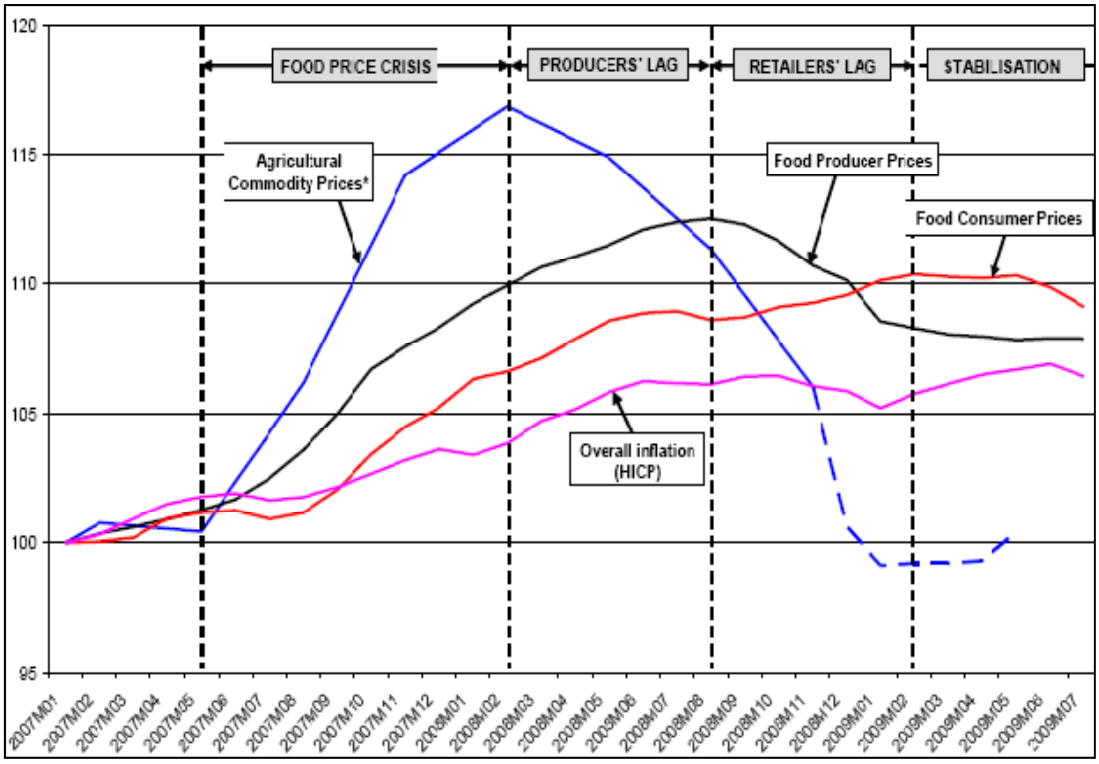

Figure 12: Price developments along the EU food supply chain. Monthly nominal price indices from January 2007 to July 2009; 2007M01=100. Sources: Eurostat and AgriView. Note: quarterly data for agricultural commodity price index; from January 2009, the index has been extrapolated based on price levels of major commodities available in AgriView database. (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0591:FIN:EN:PDF)

It is, probably, difficult to predict food safety emerging risks from indirect indicators like food pricing data. One reason is that these data are collected for reasons other than food safety (e.g. trade, governmental policies, food security) and, therefore, do not serve directly this topic. Secondly, after a price fluctuation is considered relevant to trigger a food safety issue, another step is necessary to interpret the data in two ways:

(i) Understanding the reasons of the price volatility, as it might be a signal for a change in the food or feed chain, for example in supplying of raw materials, processing techniques, distribution channels and adaptation to legal requirements;

(ii) Identifying possible consequences in the field of food safety, for example deliberate hazardous actions, like adulteration or fraud.

If EFSA has an interest to use food pricing data for the identification of drivers of emerging risks, the usefulness of disposing resources for the collection and analysis of pricing data has to be explored further. Then, as forecasting of food price developments are dependent on heterogeneous parameters as described above, a consultation with external experts would be necessary. This is because much of the expertise needed is not related to EFSA's core activities on risk assessment e.g. economics, trade policy, functioning of food markets and knowledge of transportation channels.

Two possible ways for performing collection and analysis of pricing data would be (i) by outsourcing both activities to an institution that has the relevant expertise or (ii) by setting up a group of experts to analyse the raw data and/or use the analyses published by European and international organisations. Essentially, in both ways, the outcome of the analysis should link price developments of a food commodity with potential food safety hazards.

CONCLUSIONS

Food pricing data are collected by credible organisations and are freely available and accessible on the internet. However, they refer to a limited number of single food commodities or to more generic food groups. Instead, using raw pricing data, market analyses prepared by European and International bodies could be useful for forecasting the economic environment influencing the food chain.

It is, probably, difficult to predict food safety emerging risks from food pricing data. These data are collected in order to serve other areas than food safety, like trade policies. Moreover, price changes occur due to heterogeneous parameters, like crop production projections and energy cost. Price indices related to the food chain (e.g. agricultural commodity prices, producers' prices, consumers' prices) are affected by these parameters in a dissimilar way over time.

In order to exploit food pricing data, EFSA would require expert consultation either by outsourcing or by setting a group of experts. This is because much of the expertise needed to interpret pricing data is not related to EFSA's activities on risk assessment e.g. economics, trade policy, functioning of food markets and knowledge of transportation channels.

REFERENCES

Beydoun May A., Powell Lisa M., Wang Youfa, 2008. The association of fast food, fruit and vegetable prices with dietary intakes among US adults: Is there modification by family income? Social Science & Medicine 66, 2218-2229.

EFSA, 2009. Technical report of EFSA prepared by the ESCO WG on Emerging Risks. EFSA Technical Report (2009) 224, 1-34.

EC, 2006. Special Eurobarometer, Risk Issues. Available on http://ec.europa.eu/food/food/resources/special-eurobarometer_riskissues20060206_en.pdf.

EC, 2009. A better functioning food supply chain in Europe. Available on http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0591:FIN:EN:PDF.

EC, 2010. January 2010 update on the price developments on international agricultural commodities markets (reflecting December 2009 prices). Available on http://ec.europa.eu/agriculture/analysis/tradepol/commodityprices/012010_en.pdf

Havelaar Arie H., Brul Stanley, Aarieke de Jong, Rob de Jonge, Marcel H. Zwietering, Benno H. ter Kuile, 2010. Future challenges to microbial food safety. Int. J. Food Microbiology, 139, S79-S94.

Monsivais Pablo, Mclain Julia, Drewnowski Adam, 2010. The rising disparity in the price of healthful foods: 2004–2008. Food Policy, 35, 514-520.

Piesse Jenifer, Thirtle Colin, 2009. Three bubbles and a panic: An explanatory review of recent food commodity price events. Food Policy, 34, 119-129.

Quested T.E., Cook P.E., Gorris, Cole M.B., 2010. Trends in technology, trade and consumption likely to impact on microbial food safety. Int. J. Food Microbiology, 139, S29-S42.

APPENDICES

APPENDIX I: SUMMARY OF SOURCES DESCRIBED IN THIS REPORT

Level	Organisation	Name
EU	Eurostat	Agricultural prices and price indices (apri) database
		Food supply chain monitor
EU	DG-AGRI	AgriView database
		Economic and trade policy analyses
Global	FAO	Food Price Indices
		International Commodity Prices
		GIEWS: Global Food Price Monitor
		GIEWS: Food Price Data and Analysis Tool
		Statistics Division of the FAO (FAOSTAT)
Global	OECD-FAO	Agricultural Outlook Database
Global	World Bank (WB)	Monthly prices; Price forecasts; Reviews of commodity markets

APPENDIX II: FOOD SUPPLY CHAIN MONITOR

List of supply chains and the related groups from COICOP/HICP, from NACE Rev 2. and from agricultural prices covered by the Eurostat's food supply chain monitor[29].

Product supply chain	**COICOP** (source: HICP)	**NACE Rev.2** (source: PPI index)	**Agricultural Commodity** (source: Agricultural Prices Index)
1 **Food**	011 - Food	C10 Manufacture of food products	140000 - Agricultural goods
2 **Bread and Cereals**	0111 - Bread & Cereals	C106 Manufacture of grain mill products, starches and starch products; C107 Manufacture of bakery and farinaceous products	010000 - Cereals (including seeds)
3 **Meat**	0112 - Meat	C101 Processing and preserving of meat and production of meat products	110000 - Animals
4 **Fish**	0113 - Fish and seafood	C102 Processing and preserving of fish, crustaceans and molluscs	No reference
5 **Dairy**	0114 - Milk, cheese and eggs	C1051 - Operation of dairies and cheese making	120000 - Animals products; 121100 - Cows' milk
6 **Oils and fats**	0115 - Oils and fats	C104 - Manufacture of vegetable and animal oils and fats	021000 - Oil seeds and oleaginous fruits (including seeds)
7 **Fruits**	0116 - Fruits	C103 - Processing and preserving of fruits and vegetables	060000 - Fruits
8 **Vegetables**	0117 - Vegetables	C103 - Processing and preserving of fruits and vegetables	040000 - Vegetables and horticultural products; 050000 - Potatoes (including seeds)
9 **Sugar**	0118 - Sugar, jam, honey, chocolate and confectionary	C1081 - Manufacture of sugar; C1082 - Manufacture of cocoa, chocolate and sugar confectionary	024000 - Sugar beet
10 **Milk**	01141 - Milk	C1051 - Operation of dairies and cheese making	121000 - Milk

[29] http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/prc_fsc_esms.htm

Product supply chain	**COICOP** (source: HICP)	**NACE Rev.2** (source: PPI index)	**Agricultural Commodity** (source: Agricultural Prices Index)
11 **Cheese**	01144 - Cheese	C1051 - Operation of dairies and cheese making	121000 - Milk
12 **Eggs**	01146 - Eggs	No reference	122000 - Eggs
13 **Pork**	01122 - Pork	C101 - Processing and preserving of meat and production of meat products	112000 - Pigs
14 **Beef**	011211 - Beef	C101 - Processing and preserving of meat and production of meat products	111000 - Cattle
15 **Chickens**	01124 - Poultry	C101 - Processing and preserving of meat and production of meat products	115100 - Chickens
16 **Potatoes**	01174 - Potatoes	No reference	051000 - Potatoes for consumption
17 **Apple**	011613 - Apple	No reference	061100 - Dessert apples

APPENDIX III: COMPOSITION OF SUB-INDICES OF FAO MEAT PRICE INDEX[30]

Poultry Index

USA: Broiler cuts, export unit value

Brazil: Export unit value for chicken (f.o.b.)

Pig Index

USA: Frozen pig meat, export unit value

Brazil: Frozen pig meat, export unit value

Germany: Monthly market price for pig carcase grade E

Bovine Index

USA: Frozen beef, export unit value

Brazil: Frozen beef, export unit value

Australia: Up to Oct02 : cow forequarters frozen boneless, 85% chemical lean, c.i.f. US port (East Coast) ex-dock; from Nov02: chucks and cow forequarters

Ovine Index

New Zealand: Lamb, frozen whole carcasses, wholesale price Smithfield Mkt. London

30 http://www.fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Meat/Documents/TABLE_pricesandindices.pdf

APPENDIX IV: COMPOSITION OF SUB-INDICES OF FAO OIL AND FAT PRICE INDEX[31]

Soybean oil, Dutch, f.o.b. ex-mill;

Sunoil, EU, f.o.b. northwest European ports;

Rape oil, Dutch, f.o.b. ex-mill;

Groundnut oil, any origin, c.i.f. Rotterdam;

Cotton oil, US, PBSY, f.o.b. Gulf;

Coconut oil, Philippines/Indonesia, c.i.f. Rotterdam;

Palm kernel oil, Malaysia/Indonesia, c.i.f. Rotterdam;

Palm oil crude, c.i.f. northwest Europe;

Tallow US, bleach, fancy, Rotterdam;

Lin oil, any origin, ex tank, Rotterdam;

Castor oil, ex tank Rotterdam;

Fish oil, any origin c.i.f. northwest Europe.

[31] http://www.fao.org/economic/est/est-commodities/oilcrops/price-indices-for-oilcrops-and-derived-products/en/

ABBREVIATIONS

ACP	Agricultural Commodity Prices index
CIF	Cost, Insurance and Freight
COICOP	Classification of Individual Consumption by Purpose
DG-AGRI	European Commission's Directorate-General for Agriculture and Rural Development
EC	European Commission
FAO	Food and Agriculture Organisation of the United Nations
FAOSTAT	Statistics Division of the FAO
FOB	Free on Board
FAPRI	Food and Agricultural Policy Research Institute
GIEWS	Global Information and Early Warning System
HICP	Harmonized Index of Consumer Prices
MS	Member State
NACE	Statistical Classification of Economic Activities in the European Community
OECD	Organisation for Economic Cooperation and Development
PPI	Producer Price Index
USDA	US Department for Agriculture
WB	World Bank
WTO	World Trade Organisation

APPENDIX B

(This is a template for "Briefing notes on emerging issues" identified by EMRISK)

BRIEFING NOTE ON EMERGING ISSUES[1]

Lasty updated by EMRISK on DD MM YYYY

Presented to EREN MTG on DD MM YYYY

The scope of this briefing note is to present priority emerging issues identified by EMRISK to EREN. EREN is requested to (i) evaluate the relevance of the issue presented and (ii) facilitate the exchange of any relevant information. The information provided in this briefing note is not comprehensive and is intended as a quick summary and a point of departure.

Title and ID

DESCRIPTION OF THE ISSUE

Include a short description of the issue, mentioning the hazard under evaluation (e.g. which virus, bacteria, parasite, chemical, driver etc). Use the following criteria to explain why EMRISK considers this an emerging issue. Evaluation criteria to be considered include at least one of the three criteria listed below.

ADDITIONAL SUPPORTING INFORMATION

Provide any additional background information you believe is important in order to support the evaluation of the issue. For example:

- *Any additional information on the source of information (scientific or grey literature, inputs from AF, EFSA's Units, Experts, surveillance systems…);*
- *Limitations of the analysis/study;*
- *Toxicological information of this (or similar) agents/compounds;*
- *Any other information you believe is important.*
- *Has this related to any other issues already discussed in EMRISK monitoring meetings.*

LEGAL AND INSTITUTIONAL ASPECTS

- *Report the results of a basic search for EFSA risk assessment or action, and Commission documents or legislation on the subject.*

[1] "*Emerging issues*" are identified at the beginning of the Emerging Risk Identification process as issues that may merit further investigation and additional data collection. Emerging issues can include specific issues (*e.g.* specific chemical substance or a pathogen), as well as general issues such as drivers of change (*e.g.* climate change). Risk management issues resulting from a lack of compliance with existing regulations should be excluded.

EVALUATION / PRIORITIZATION

Main criteria

- **Driver:** *(e.g. is this a new driver?)*
- **New hazard:** *(e.g. Has a new hazard been identified? If so, which one and how?)*
- **New or increased exposure:** *(e.g. Has a possible exposure through food/feed to the new hazard been identified?)*
- **New susceptible group:** *(e.g. Has a new vulnerable group been identified?)*

Other qualifying criteria: *The following criteria can be addressed if any information is readably available*

- **Soundness:** *(e.g. What is the reliability of sources of information? e.g. peer-reviewed journals)*
- **Severity:** *(e.g. What could be the severity of the health effects in terms of morbidity and/or mortality?)*
- **Imminence:** *(e.g. how soon it is estimated that the potential hazard will manifest in the food, feed, environment? How soon is it estimated that this health risk will manifest in the population?)*
- **Scale:** *(e.g. number of people and Member States potentially exposed?)will IT, e.g. days, months, years)*

CONCLUSIONS

Enter a brief summary of the reasoning that led to identify this as an emerging issue.

QUESTIONS FOR THE EXPERT GROUP

1.	Have you already identified this issue before?	□ Yes	□ No	□ N/A
2.	Do you have any additional information/data on this issue?	□ Yes	□ No	□ N/A
3.	Do you believe that this is an emerging issue/risk?	□ Yes	□ No	□ N/A
4.	Should the Expert Group start exchanging information?	□ Yes	□ No	□ N/A

EXPERT GROUP COMMENTS: _____

EXPERT GROUP RECOMMENDATIONS

1. EFSA should keep monitor the issue.
2. EFSA should start a review of this issue aiming at publishing a report.
3. EFSA should start a project to generate data on this issue (e.g. outsourcing).
4. EFSA should start a risk assessment.
5. EFSA should consult other bodies (e.g. the Stakeholder consultative group).

REFERENCES

APPENDIX C

Trade data surveillance: Summary of a case study.

As part of the regular reporting on specific emerging risk subjects, one technical report was prepared based on surveillance of trade databases. This technical report compile information retrieved from the Eurostat Comext, UN Comtrade, RASFF and scientific literature. The starting point for the report is a change in a recent trend in trade into the EU, analysed against information from the other sources mentioned, as a means of identifying a potential emerging risk, i.e. signal generation. A summary of each technical report is given in the following section.

It is noted that the conclusions derived must be treated with caution as the data sources used have limitations and weaknesses. Further investigation using other potential sources of information is required to verify the pertinence of such signals.

Recent trends in trade of fish meal used as feed, and reporting of Salmonella and enterobacteriaceae

Animals can become infected when fed with *Salmonella*-contaminated feed. This may cause occasional clinical disease in some animals, but the major outcome is asymptomatic carriage. In addition, animals may also become infected from other *Salmonella*-infected animals, directly or via a contaminated environment for which the original source could have been contaminated feed. Transmission of *Salmonella* from feed to the animals consuming the feed and to food products derived from the animals has been shown. Among the different types of feedingstuffs, fish meal also has been reported to have high potential for the spread of *Salmonella.*

During the routine monitoring of the Rapid Alert System for Food and Feed (RASFF) database the Emerging Risks (EMRISK) unit noted several notifications on fish meal contaminated with *Salmonella* and enterobacteriaceae originating from Peru and Morocco in 2009. This information prompted EMRISK to further investigate the import patterns of fish meal into the EU.

Eurostat's trade data indicate that EU imports of fish meal accounted for 486,510 tonnes in 2008 and increased to 503,632 tonnes from January to October 2009. Peru is the main exporter to the EU; 49% and 68% of the imported fish meal in 2008 and from January to October 2009 respectively originated from Peru. Imports of fish meal from Morocco were less significant and accounted for 16,176 tonnes in 2008 and 9,545 tonnes from January to October 2009.

Whilst fish meal only contributes a small proportion of the total demand of protein feed materials in the EU (2% on protein equivalent in 2008), it could represent an important route for the introduction of *Salmonella* into feed, contamination at primary animal production and possibly thence to food products. This route of exposure could become more important as the reporting of *Salmonella* in fish meal through the RASFF and the importation of fish meal from specific countries are rising.