EFFECTIVE STAKEHOLDER INVOLVEMENT IN AGRI-FOOD GOVERNANCE AND POLICY DEVELOPMENT

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CHAPTER 1

General introduction

Ensuring an adequate and secure global food supply involves appropriate regulation across the entire food production system, including primary production, processing, and inspection of food products made from agricultural commodities. Food production can be associated with the occurrence of risks related to different types of potential hazards at varying levels of impact. Food safety or animal health may be compromised as a consequence of the unintended introduction of biological, chemical or physical contaminants into the food chain, or as the result of deliberate fraud for economic gain or a as a political act (as in the case of bioterrorism). Contamination due to foodborne agents can be found as a consequence of improper food handling practices by the consumer (Fischer & Frewer, 2008; Havelaar et al., 2010). Most commonly reported foodborne outbreaks in the EU are caused by Salmonella, viruses, Campylobacter and bacterial toxins. Foods related to these outbreaks are eggs and egg products, mixed or buffet meals and vegetables, juices and products thereof (EFSA/ECDC, 2012). An example of deliberate fraud is that of melamine in milk, where melamine was deliberately added to raw milk for reasons of economic gain which consequently contaminated infant formula. This resulted in an increased incidence of kidney stones and renal failure among infants. The Chinese Ministry of Health confirmed a total of six deaths and 294.000 Chinese infants and young children were affected. The fall out of this scandal resulted in major losses to the Chinese dairy industry and affected other producers in the South East Asian region (Gossner et al., 2009).

Ensuring food safety within the agri-food domain may require the integration of a diversity of policy areas, including: economic policy, health policy, environment policy, social policy, morality or ethics (Lang et al., 2001). These diverse policy areas require the integration of both social and natural sciences research. Social science inputs may be associated with understanding social values which also influence food safety (e.g. animal welfare concern, consumer trust or understanding consumer behaviours and food choices), the environmental sciences (e.g. climate change, waste reduction), human health sciences (e.g. safety, nutritional value), or modelling the economic drivers of food safety (Lang & Barling, 2013; Lang, et al., 2001). Complexity within the agri-food domain is expressed by the multitude of involved actors who can be identified in various domains (Waltner-Toews & Lang, 2000). Stakeholders range from national and international governmental institutions and organisations to local, national or multinational food corporations, farmers and primary producers, and third sector organisations such as environmental pressure groups and charities, as well as consumers (sometimes but not always represented through consumer organisations). The globalising world economy, with stakeholders located in different places around the world, has introduced geographical dispersions into many food chains. The multitude of stakeholders with expertise relevant to the agri-food area requires a complex multi-level policy making process which is able to take into account multiple factors simultaneously (Lang & Barling, 2013).

Developing effective agri-food regulations must therefore take full account of the complexity of the agri-food domain. It is thought that stakeholder involvement may improve policy decisions in food safety governance (Millstone, 2009), although effective practices regarding stakeholder involvement are lacking. Stakeholder involvement in risk assessments is of special interest, as these heavily rely on the involvement of experts rather than lay persons (Patterson et al., 2007). It is important that opinions and priorities provided by experts are reliably recorded, collated, interpreted and reported. However, at this point in time there is no guidance how to do this in the most effective manner (Luyet et al., 2012).

The first chapter provides an introduction to this thesis and introduces the empirical work presented in the subsequent chapters. It starts with providing some background on relevant concepts of regulation and policy development in the agri-food domain. Subsequently, challenges associated with expert involvement in the development of agri-food policy are examined. Finally, the aim and scope of this thesis are presented, and a brief introduction to the remaining chapters is provided.

1.1. Regulation and policy in the agri-food domain

Agri-food policy deals with the management of complex, and sometimes uncertain, risks within the agri-food domain, taking due account of the priorities and preferences of diverse stakeholders and food chain actors. An important part of agri-food policy development involves the incorporation of regulation at multiple governmental levels (e.g. localised, regional, or international), as well as relevant socio-cultural factors.

As a starting point, it is important to provide a working definition of the term "policy". Maetz and Balie (2008) define policy as: "A plan of action to guide decisions and actions based on a set of preferences and choices. The term may apply to the work of government, private sector organisations and individuals". Policy can be applied on five different levels ranging from local, sub-national, national, regional/continental, to global (Lang & Barling, 2013). This thesis will discuss (mainly) agri-food policy issues, where globalisation characterises the different policy levels and varying policy topics. It is important to note that policy differs from legislation (i.e. rules of law), as law can prohibit behaviours, and policy guides actions toward those that are most likely to achieve a desired outcome, and are, therefore, not included.

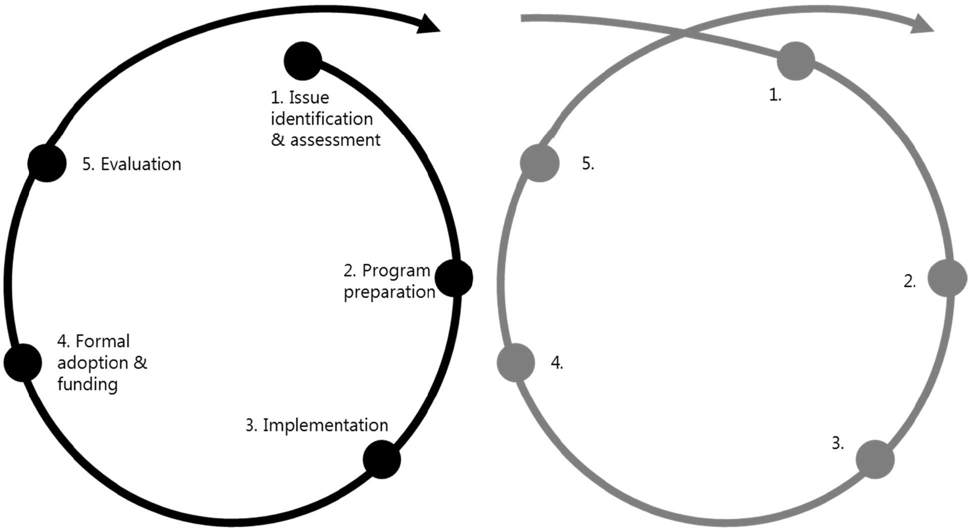

Figure 1.1. Iterative policy development framework (adapted from FAO/GESAMP, 1996).

There is an extensive literature regarding policy development. Policy development frameworks are often cyclic and include various phases linked to different stages of policy development (e.g. FAO/GESAMP, 1996; IRGC et al., 2005; Klinke et al., 2006). These phases range from exploratory phases, where the issue under consideration is formulated, and relevant data is collected (including risk characterisation and assessment of possible consequences), to the phase where a policy option is chosen (i.e. a decision regarding future actions is made), and implemented. Interestingly, the policy development framework as described for coastal management by the FAO (FAO/GESAMP, 1996; Maetz & Balié, 2008), acknowledges that effective policy development is obtained when policy processes are refined through iteration. This dynamic policy process is explicitly designed to evolve through real world experience and allow for inclusion of novel methods and techniques. It emphasises the continuum of policy through five iterative phases: (1) issue identification and assessment; (2) program preparation; (3) implementation; (4) formal adoption and funding; and (5) evaluation (Figure 1.1.). In particular the last, evaluation, stage is suitable for questioning the effectiveness of governance responses, and facilitates further refinement and improvement of the policy.

Agri-food safety policies aimed at managing public health hazards are based on risk analysis. The dominant framework adopted in this domain is based on basic concepts laid down by the FAO and WHO (1995). This risk analysis framework comprises of three interconnected components: risk assessment, risk management and risk communication (Figure 1.2). The components are defined as follows:

> *Risk assessment*. The scientific evaluation of known or potential adverse health effects resulting from human exposure to foodborne hazards.
>
> *Risk management.* The process of weighing policy alternatives to accept, minimize or reduce assessed risks and to select and implement appropriate options.
>
> *Risk communication*. An interactive process of exchange of information and opinions on risk among risk assessors, risk managers, and other interested parties.

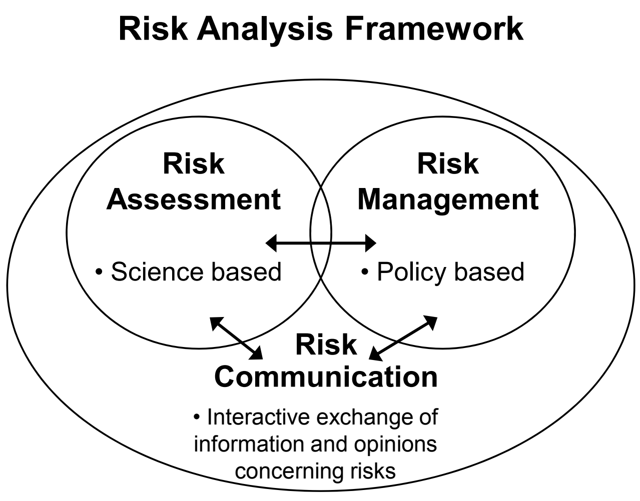

Figure 1.2. The FAO/WHO Risk Analysis Framework (adapted from FAO/WHO, 1995).

Policy and regulations within agri-food are developed and implemented at a local or national level, as well on supra-national (e.g. EU or global) level. Control of agri-food safety and associated issues is frequently arranged through the application of standards. These may be either "private" standards developed within companies, or within production chains, to facilitate competitive advantage, or "public" standards, i.e. those enforced through (national) legislation (Hammoudi et al., 2009). International (agri-) food standards, both public and private, are becoming more influential and are in part based on risk assessment incorporated into the risk analysis process (Boisrobert et al., 2010). These international safety standards are provided by the Codex Alimentarius Commission, and deal with specific food hazards as well as more general agri-food issues relating to food production (including livestock) and food safety.

Developments in the food safety arena have led to changes in its governance since the risk analysis framework was first presented in 1995 (e.g. Houghton et al., 2006; Millstone, 2009). Examples such as the increased globalisation of the food chain makes the issue of (emerging) food risk more complex (Le Heron, 2003). In addition, the growing complexity of the food chain is attributed to, for example, (public) concerns with novel technologies applied to the agri-food domain (e.g. Eiser et al., 2002; Rollin et al., 2011). In this context, a series of food safety incidents (e.g. BSE crisis (Berg, 2004; Rowe et al., 2000); or the dioxin scandal (Verbeke, 2001)) has also dented societal confidence in food safety. These issues have intensified the focus of public attention on regulatory systems. A call for change and demand for transparency within food risk analysis was heard due to a decline in societal trust in institutional actors (e.g. de Jonge et al., 2007; Frewer et al., 2004; Houghton et al., 2008; Van Kleef et al., 2007), increased demand for inclusivity in decision making processes in relation to, the food risk analysis process in general (König et al., 2010; Reed, 2008; Renn, 2006).

The European governance system relating to (agri-)food safety has been reorganised into a system that attempts to take into account the complexities of the agri-food domain in response to these developments (European Commission, 2000). European food law is arranged through international standards (for example, food standards developed within the Codex Alimentarius), as well as through national legal systems of the Member States (van der Meulen & van der Velde, 2004, chapter 1). Its primary regulation, which applies to the whole of the EU, is known as the General Food Law (Regulation (EC) 178/2002, 2002). It sets the general principles and requirements of food safety law, and states that the protection of human life and health should be based on scientific risk assessment. It also takes into account the protection of animal health and welfare, plant health and the environment. As part of these changes, the European

Food Safety Authority (EFSA) was established (through Article 22 of the General Food Law), which is solely responsible for risk assessment and risk communication. This allows for a functional division of risk assessment (EFSA) and risk management (European Commission; European Parliament; EU Member States), as part of the requested (institutional) changes. In order to develop an effective risk assessment and risk communication process within EFSA, expert and stakeholder views are consulted through scientific panels and fora, as well as public consultations.

On a more general level, some scholars have suggested changing the current food risk analysis framework into a more iterative process (e.g. König, et al., 2010). These suggested changes can be traced back to the more general policy frameworks, where policies are iteratively improved (FAO/GESAMP, 1996). Changes that have been suggested within the agri-food domain relate to, for example, including (different) stakeholders at various parts of the process through involvement exercises (De Marchi & Ravetz, 1999; Klinke, et al., 2006). One particular EU-funded project, entitled SAFE FOODS, addressed the limitations of the current risk governance framework by developing a novel framework for risk policy evaluation (König, et al., 2010). This integrated framework describes an iterative decision process with four stages for future risk policies consisting of: (1) framing, (2) risk-benefit assessment, (3) evaluation, and (4) risk management. The framework explicitly incorporates stakeholder consultation and public participation at appropriate stages in the process. Besides formalizing an iterative process for policies that goes beyond the identification of the three main areas of attention in the FAO/WHO definition of risk analysis, the proposed framework also formally addresses other parameters which tend not to be considered explicitly, like health impact assessment including societal and economic factors (Cope et al., 2010; Dreyer et al., 2010). The suggestions of impact assessment are likely to be incorporated in policies as these proposals are in line with the General Food Law. This regulation lays down the basis for risk management taking due account of scientific risk assessment as well as other relevant factors including societal, economic, traditional, ethical and environmental factors, and the feasibility of controls (Regulation (EC) 178/2002, 2002).

To summarise, a good agri-food policy framework requires continuous improvement of evidence and data, continuing assessment of policies and administrative arrangements, options for problem resolution and a robust administrative system (FAO/GESAMP, 1996). While the SAFE FOODS project stresses the need for such an iterative process, a novel policy framework will not be easily implemented. To better understand why this is, it is essential to sketch the complex web in which (iterative) policy making in agri-food operates.

1.2. The agri-food domain: a complex web of interactions

Agriculture, food, human health, environment and society all interact and make the agri-food domain a multi-stakeholder domain (Waltner-Toews & Lang, 2000). In addition, agri-food policies are nowadays developed and implemented at five levels (i.e. local, sub-national, national, regional/continental, global). The influence of actors, rules, conventions, processes and mechanisms concerned with how relevant agri-food risk information is collected, analysed and communicated to the public and among stakeholders needs to be taken into account, in the context of how decision are taken (Dreyer et al., p. 10). All of these factors and their relations make this domain a complex web of interactions executed at different levels. The challenge for regulating agri-food issues lies in how to effectively protect the public and the environment while taking into account a possibly wide range of factors.

Waltner-Toews and Lang (2000) use the metaphor of health as "the roof under which life shelters", where health relies on a wide diversity of factors. These factors include, *inter alia,* ensuring food safety, nutrition, the development of a sustainable food supply, the development and application of appropriate technology, understanding climate (change), animal and plant health and the role of local cultural factors such as dietary preferences. Effective food policy development is dependent on understanding the complex social and environmental factors which shape food production, and how these interact (Lang & Barling, 2013). For example, expertise within the social sciences may focus on how nutrition is embedded within culture and ways of living, and will need to take into account socio-economic processes and the interaction of the public with foods. Expertise within the natural sciences may focus on nutrition and/or food safety as a function of the biophysical environment; population and the available food supply as well as biophysical factors such as soil, biodiversity, water, and climate.

One factor that provides a relevant perspective for study is globalisation. As the food chain becomes increasingly globalised, humanity will be confronted with new challenges if safe food is to be ensured. The global market has expanded to accommodate (and potentially drive) increasing consumer demand for the availability of fresh and even seasonal foods throughout the year, necessitating sourcing from a range of international locations (Jones, 2002). At different stages in the food chain (i.e.

from primary production to the consumer), pathogens, chemicals and parasites can contaminate food (Tauxe, 2002; Tauxe et al., 2010). The globalisation of food trade and food industry has created new opportunities for contamination of the food supply chain and at the same time increases the potential for many people being adversely affected following an outbreak of disease or contamination incident. With faster and more extensive transport networks, which have contributed to an increasingly globalised and complex system of food distribution, this has only become larger (Jones, 2002). Globalisation of the food chain potentially causes both increases in the spread of food-borne risks and increased spread of emerging infectious animal diseases, either through animal transports, food based pathogens or mitigating vectors organisms. Both the spread of disease, and increasingly strict efforts to control spread of disease, may have a negative impact on livestock populations and result in serious economic consequences. For example, the emergence of Bluetongue in Europe had profound negative economic consequences on the economic functioning of the agri-food domain (Wilson & Mellor, 2009).

Food production, purchase and consumption have a wide range of effects on the (international) economy. Although the food economy is thriving in an increasingly globalised market, it may also be negatively affected through direct and indirect economic costs needed to control food safety in these globalised markets. The loss of consumer confidence in food products or specific food brands may lead to indirect economic losses, such as loss of market share after a food crisis has occurred (Pennings et al., 2002). Direct economic costs include, for example, health care costs associated with human illness, and time lost from employment, costs incurred by industry as a consequence of food recalls (El-Gazzar & Marth, 1992), losses in production or trade embargoes (Tauxe, et al., 2010). A recent example that illustrates these types of costs is the recent enterohaemhorragic Escherichia coli (EHEC) outbreak in Germany where the destruction of produce lead to huge direct losses, mostly in Spain and the Netherlands (Sekkides, 2011).

Reactive control is no longer sufficient for effective governance, as the globalised and fast moving agri-food chain demands a more pro-active control system to deal with emerging risks. Failures in preventing various food safety incidents in the recent past, have shown an increased need for rapid identification of food risks at an early stage for effective prevention, control and mitigation measures to be implemented (Marvin, Kleter, Prandini, et al., 2009). Emerging food risks are defined as unanticipated risks that occur accidently or naturally, as well as those arising from deliberate fraud or acts of malevolence (Astier, 2009; Barnaby, 1999; Kleter et al., 2009). In addition, emerging food risks may, but do not need to, be new risks. Some emerging risks are existing risks that become known as the result of improved detection techniques. Other emerging risks are known, but have not been identified as a serious threat before, as they currently emerge as a result of adapting to changes in their environment (Skovgaard, 2007). It is reasonable to assume that these definitions on 'emergence of risks' not only apply to risks to human health associated with food consumption, but also to other emerging risks within the agri-food domain, such as animal disease. For all of these risks it is important to develop effective and timely risk identification mechanisms in order to prevent negative consequences for human and animal health as well as the environment (Marvin, et al., 2009).

Globalisation also has an effect on local environments where food is produced. Demographic changes, in particular urbanisation, in combination with population growth will result in increased food demand, requiring transport of food to more locations, which may influence the spread and emergence of food-borne diseases (Alexander & McNutt, 2010; Cascio et al., 2011; Jones et al., 2008). Climate change may affect regions differently according to their location, showing effects ranging from water stress to the migration of invasive species (Lang, 2010). The migration of species acts as a vector for animal and human (infectious) diseases (Jones, et al., 2008). Furthermore, newly developed technological innovations may have unintended environmental consequences (e.g. nanosilver applied as an anti-microbial agent affecting the environment after disposal, see: Chaudhry et al., 2011). Detailed discussion of the influence of the agri-food domain on the environment is provided elsewhere (see for example: FAO & Bioversity International, 2010; Lang, 2010; Lang, et al., 2001; Pretty et al., 2010).

From this, it can be concluded that a comprehensive framework for the relations between different disciplinary expertise is needed in order to develop appropriate policies. However, this is difficult due to the multi-factorial, multi-sectoral, multi-disciplinary and transnational nature of the agri-food domain (Lang & Barling, 2013). Complex multi-level policy making processes are required (Lang & Barling, 2013), in which experts are used to inform policy if explicit (empirical) data is unavailable, if there is lack of consensus across expert groups, or if expertise from diverse disciplinary perspectives is required. The use of experts to inform policy is, arguably, considered the best alternative to create fair and balanced policies. It is essential that expert involvement is systematic and transparent, and that the route by which the knowledge developed is incorporated into policy is publicly available.

1.3. Expert involvement in agri-food policy development

Policy makers have used stakeholder advice to develop their policies, as it is thought that stakeholder involvement may improve these (Millstone, 2009). The decline of public trust in risk management and subsequent (institutional) changes have also resulted in wider inclusion of stakeholder views in policy decisions, and it has been assumed that the wider involvement of diverse stakeholders may be beneficial in restoring societal trust in risk management (e.g. de Jonge, et al., 2007; Houghton, et al.; Van Kleef, et al.). Within EU regulation, when empirical evidence is deficient (or not publicly available), expert views are elicited to obtain most reliable information in order to complete the risk assessment. Given the importance is placed on expert involvement exercises, it is imperative that these exercises are properly executed in order to effectively incorporate these into the development and implementation of policy (Kropp & Wagner, 2010; Renn, 2006).

To determine whether expert involvement has been properly conducted and applied to policy development, it is necessary to differentiate between the different types of stakeholder involvement which can be utilised as part of the process. Stakeholder involvement takes into account individuals or groups that have a stake in the policy under consideration. This may include anyone (i.e. individuals or organisations) in a particular society who may be affected by a specific policy and its impacts (Rowe & Frewer, 2000). Inclusion of the public in policy development is frequently referred to as public participation or public engagement. The “public” includes various individuals and groups with a broad range of interests, and may have a stake in policies which directly or indirectly affect them (for example in relation to agri-food technology implementation). For a more elaborate discussion of public participation processes see, for example, Rowe and Frewer (2000) or Reed (2008). Stakeholder involvement may, alternatively, include the views of individuals professionally or institutionally involved with the specific issue under consideration, often termed “expert involvement”. Examples of “experts” include policy makers, producers, and academic scientists. In practice, experts included in consultations have often been limited to academics (e.g. Nishida et al., 2004), although other “experts” may also possess extensive experience or expertise of direct relevance to the policy issue under consideration. It is these broader groups of experts whom the EU consults to provide scientific information when data is lacking. This thesis will focus on assessing the efficacy of existing expert involvement methodologies, and testing the relevance of evolving methods. The following working definition of an expert stakeholder is utilised throughout: "those stakeholders who have gained domain specific expertise through their profession".

Numerous expert involvement methods have been applied to provide expert inputs into agri-food policy (see Table 1.1.). Within this table, these methods have been divided among individual and group methods, however, these methods can as well be characterised on the type of outcome data. Interviews and group methods (e.g. focus groups, workshops) in general report on qualitative data collection and analysis techniques. In contrast, questionnaires and Delphi studies generally provide quantitative data collection and subsequent analysis, although this may be combined with qualitative data.

Sequential stages in policy development allow for the input of expert views at various points throughout the process of policy development and implementation (IRGC, et al., 2005; König, et al., 2010). It stands to reason that inputs from experts at different stages in the policy cycle (i.e. from information gathering to decision making), require different approaches if expert views are to be effectively included. Each stage in policy development has different requirements for expert inputs in terms of information required as well as the type of expert needed to provide inputs (Patterson, et al., 2007). For example, when no complete overview of the policy issue is available, information gathering, or exploration of the policy topic is needed. Often such information seeking occurs at an early stage in the policy development cycle, although it may also be needed to clarify issues arising during policy implementation. At this stage experts can provide relevant information or data. Once the issues associated with a policy are identified, then quantification of opinions or testing of assumptions becomes more relevant. When, afterwards, a policy decision needs to be made, some kind of final recommendation may once again require expert opinion, which could, for example, be reached through the development of consensus or through a voting procedure within the expert group.

The policy question itself influences the type of expertise needed. Some policy issues requiring stakeholder consultations are potentially ambiguous and uncertain (Renn et al., 2011), and may require inputs from diverse expert constituencies. This diversity may be the result of experts being geo-dispersed or possessing differing types of expertise relevant to the policy, which are associated with different disciplinary "languages". Policy development related to existing and emerging agri-food risks require inclusion from several related subdomains e.g. food safety, human and animal health, and logistics, and is taking place in an increasingly international arena. Cultural

Table 1.1. Examples of expert involvement methods in agri-food policy development.

Methods	Characteristics	Example references
Individual methods		
Questionnaires	No social interaction between experts, nor between expert and researcher. Mostly quantitative data, little information to contextualise and explain provided statements and facts.	(Roberts et al., 2010; van Dijk et al., 2011)
Interview	No social interaction between experts, but interaction between interviewer and expert. Qualitative (exploratory) information to contextualise and explain provided statements and facts.	(González-Zapata et al., 2010; Jones et al., 2005)
Group methods		
Focus groups	Direct social interaction between experts and moderator. Qualitative (exploratory) information to contextualise and explain provided statements and facts.	(Whitmarsh, Turnpenny, et al., 2009)
Workshop	Direct social interaction between experts and moderator. Qualitative (exploratory) information to contextualise and explain provided statements and opinions on discussion topic or document.	(Newell et al., 2010; Rantavaara et al., 2005; Walls et al., 2011)
Delphi	Multi-round consultation. Indirect social interaction between experts and moderator. Quantitative data to confirm findings and assess consensus or dispersion, and may contain as well qualitative (exploratory) information to contextualise and explain provided statements and facts.	(Kenyon et al., 2008; Medeiros, 2001; Soon et al., 2012)

and regional diversity in prioritisation for research and standard setting needs to be incorporated into the discussions, as well as local requirements for diversification in regulation where appropriate. In addition, experts may often be limited by time, and the available resources to arrange the expert elicitation exercise need to be taken into account while designing a consultation. All these different factors influence the type of expert involvement that is needed at a certain policy stage.

In all cases, an important issue is the need to study the adequate application of expert involvement techniques, taking into account the characteristics of both the stage in policy development to which it relates and of the (appropriateness of) the expert involvement technique applied. Many expert involvement methods may only be appropriate for use at a particular stage in the policy cycle. For example, semi-structured interviews may be useful to explore the policy issue under discussion and to collect initial information regarding expert views. The use of interviews may raise further policy questions amenable to being answered using larger groups of experts, for example through a questionnaire, or a workshop. Both of these latter methods have different characteristics which make them more applicable to obtain certain goals. For example, questionnaires may be more relevant where prioritisation or quantification of expert opinion is needed. Workshops may be more appropriate where there is diversity in expert opinion, or where uncertainty or ambiguity are associated with expert views. In order to reach a decision, the expert involvement method applied needs to incorporate the opinions of (possibly, large groups of) experts. For some policy development stages, agreement (related to the policy option or options under consideration) is needed (Renn, et al., 2011), which requires consensus, or at least a clear overview of existing fundamental disagreements across the group of experts consulted. Such consensus may need to be reached through an iterative discursive process, and if the policy option is ambiguous or sensitive (Renn, et al., 2011) anonymised expert opinion may be appropriate.

Different expert involvement methods have their advantages and disadvantages, not just in terms of their use at a certain policy stage or stages, but also in terms of their associated methodological limitations and strengths. For example, the use of an internet based questionnaire facilitates inclusion of as many (international) experts as can be reached in the exercise. This is more difficult to achieve whilst eliciting expert views through an international workshop, which often involve only a small number of participants. Availability of workshop participants is often limited by time, or available financial resources to arrange for disparate experts to be together in the same location. It should be noted that group processes in a workshop may bring social and political issues to the table, which may limit participants in providing their actual opinion, and thus result in sub-optimal decision making (Rowe et al., 1991). Against this, questionnaires do not allow for interaction, and may be free of such processes. A disadvantage may be the omission of an option to resolve issues through exchange of opinions, or responding on issues raised by others is (as can be facilitated in a workshop).

It is arguable that for more – iterative – policy development to occur, the application of one single approach across several stages within the policy development process may increase continuity and facilitate comparative analysis between stages. However, as described, different methodologies may yield data or information more relevant to some policy development requirements than others. Thus any technique used for such a multi-stage consultation should fit requirements of all stages, as well as being able to involve the same experts over multiple iterations. One technique in particular, Delphi, may provide a solution to these problems as it can be used at several stages of policy development associated with global or regional consultation. Delphi can be applied to gather both qualitative and quantitative data, can be used to establish consensus or collect opinions, allows for social interaction without bringing political or social pressure to the table, and can be applied through distant polling methods.

The Delphi method in its essence involves the repeated polling of experts through anonymous questionnaires interspersed with controlled opinion feedback. Responses of earlier 'rounds' are used as feedback on subsequent 'rounds', and the final round outcomes produce a group judgement by equally weighing the responses (Dalkey & Helmer, 1963; Linstone & Turoff, 1975). There are four key features of Delphi that need to be emphasised: 1. anonymity; 2. iteration; 3. use of controlled opinion feedback; 4. statistical aggregation of group response (Table 1.2.). First, while individual experts remain anonymous, feedback of other experts is disseminated to the group and may lead to revised judgments of any member of the group. Providing feedback enables a degree of highly restricted expert interaction, and provides an opportunity for experts to review their own opinions using the novel information from their peers. Anonymity of experts is an important feature of Delphi, it is a deliberate tactic to pre-empt the kind of social and political pressures that often emerge within interacting groups. Anonymised feedback is supposed allow experts to concentrate on the merits of the feedback information itself without being influenced by potentially irrelevant cues, such as seniority of the person bringing it to the table, or political scheming. Second, Delphi is a structured process, where the questionnaires are repeated over a number of rounds. The judgements (and sometimes expert rationales) of all participants are provided in subsequent questionnaires alongside the repeated previous questions. Third, each subsequent round experts receive feedback with the questionnaire. As the researcher (or facilitator, moderator) decides on the type of feedback it is named 'controlled' feedback. Fourth, the judgements of the final round are statistically averaged. The equal weighting of the group responses, allows all participants to equally be part of the outcome.

Table 1.2. Overview of essential and adaptable Delphi characteristics.

Delphi characteristic	Features	Reference
Essential		
Anonymous participation	Anonymity through use of questionnaire. To undue social pressures (e.g. from dominant individuals or from a majority).	(Dalkey & Helmer, 1963) (Linstone & Turoff, 1975)
Iteration	Provides opportunity for participants to change their opinions.	(Dalkey & Helmer, 1963) (Linstone & Turoff, 1975)
Use of controlled opinion feedback	Feedback is provided to inform participants of opinions of others in the group. Controlled as moderator decides on type of feedback and what is fed back. Usually a simple statistical summary, sometimes rationales of participants.	(Dalkey & Helmer, 1963); (Linstone & Turoff, 1975; Rowe & Wright, 1999)
Statistical aggregation of group response	Statistical average (mean/median) of final group judgement.	(Dalkey & Helmer, 1963; Linstone & Turoff, 1975; Rowe & Wright, 1999)
Adaptable		
Structuring of first round	- Structured: make application of procedure simpler for panellists and monitor team.	(Rowe & Wright, 1999)
	- Unstructured: identify important issues	(Rowe & Wright, 1999; Woudenberg, 1991)
Type of feedback	- Quantitative: numerical (e.g. mean, median, interquartile range, standard deviation) or graphically (e.g. histogram, frequency polygon) presented.	(von der Gracht, 2012)
	- Combined quantitative with qualitative	(Rowe & Wright, 1999)
Measurement goal	- Consensus: reaching (pre-defined) level of agreement	(von der Gracht, 2012)
	- Collect opinions: elicit expert knowledge and obtain overview of viewpoints	(Henson, 1997)
	- Dissent: identify disagreement	(von der Gracht, 2012)

Delphi was initially developed as a method to obtain consensus of opinion of a group of experts and as a foresight methodology (Dalkey & Helmer, 1963). Many different Delphi-like approaches have emerged, which do not aim to achieve expert consensus or elicit “the future” (Linstone & Turoff, 1975; Linstone & Turoff, 2011). These changes allowed Delphi methodology to develop further, in particular in terms of the methodological variation on one hand, and (policy) implementation on the other. Reviewing existing Delphi application variations, the following three characteristics contribute as well to Delphi, but their exact execution may vary depending on the specific issue at hand: 1. structuring of first round; 2. type of feedback; 3. measurement goal (Table 1.2.). First, advantages can be identified related to both structured or unstructured first rounds. An unstructured first round allows experts to identify important issues that may be overlooked by the researchers. A structured first round simplifies the procedure for both the experts as well as the researchers, as structured questions tend to be quantitative and thereby easier to respond to and to analyse. Second, quantitative feedback is provided through a simple statistical aggregation of results. Sometimes these quantitative responses are combined with qualitative rationales (i.e. explanations of why particular quantitative responses were made): the expert’s arguments for his / her response to a specific question. Finally, Delphi studies vary in their desired goal. Although most Delphi studies aim to achieve consensus (or a specified level of agreement), sometimes differing viewpoints are measured for example in a ‘policy Delphi’ (von der Gracht, 2012). Alternatively, Delphi may be used to elicit expert knowledge (making it irrelevant whether consensus or dissent is measured) in order to obtain currently lacking information (see e.g. Henson, 1997).

Despite the changes and variations to the Delphi method, developing rigour and agreeing on a definition of what Delphi methodology constitutes, was often overlooked (Hasson & Keeney, 2011). Some practitioners have called for a strict definition of Delphi to limit what constitutes a Delphi (see e.g. Bolger & Wright, 2011). Yet a broad scope of what constitutes a Delphi can be seen as one of the merits of the process, i.e. providing a “canvas” to adapt to the specific research need. This does not mean that anything should be allowed within a Delphi; it is essential to address quality issues in the practice of Delphi. Nor does a broad definition of Delphi exclude the potential to adopt a high quality Delphi research, as this depends on implementation of appropriate procedures and quality checks for the chosen type of Delphi, rather than the definition of the method. Empirical support for conducting high quality, broadly, defined Delphi studies is, however, largely missing.

Expert involvement in agri-food policy development requires the use of a method that takes into account the various factors, stakeholders and policy levels relevant to this domain, next to the factors important to policy development and expert involvement. The Delphi method has the potential to cope with these problems as it can be used at several stages of policy development associated with inclusion of global or regional consultation of diverse experts. The technique has already been successfully applied within the complex and geo-graphically dispersed agri-food domain (Green et al., 1993; Henson, 1997; Hop et al., in press; Medeiros, 2001; Menrad, 1999), showing that it is indeed a candidate methodology for expert involvement in agri-food policy.

Formal inclusion of scientific advice within the governance and policy development of agri-food issues shows an increasing responsibility of science, experts and other stakeholders (Boisrobert, et al., 2010). With the involvement of experts in policy development, the question arises as to what is the best way to consult experts in order to gain valid and reliable information and opinions most relevant to the development of effective policy? As a *de minimis*, one could state: “whatever you do, it should be done the right way”. However, at this point in time it is not clear what constitutes the right way to conduct expert involvement exercises, nor which quality indicators should be used.

Evaluation of expert involvement processes is needed to determine optimal expert involvement strategies. While in the context of public participation, increased efforts by researchers and sponsors have been placed on the development of effective consultative processes, and their evaluation in this regard (e.g. Reed, 2008, for overview), no similar development can be found for expert involvement exercises (Luyet, et al., 2012). An overview of criteria for evaluating public participation processes is provided in Figure 1.3.

Acceptance criteria	
Representativeness	Participants should comprise a broadly representative sample of the population of the affected public.
Influence	The output of the procedure on policy (policy impact; does the method provide the right type of outcome to assist in policy development).
Transparency	The process should be transparent so that the public can see what is going on and how decisions are being made.
Early involvement	Involvement of the public as early as possible process, as soon as value judgements become salient.
Independence	The participation process should be conducted in an independent, unbiased way (independent of undue influences by the exercise sponsors).
Process criteria	
Resource accessibility	Participants should have access to the appropriate resources to enable them to them to successfully fulfil their brief (provision of time and of (in advance) information and other material resources in order to effectively take part in exercise).
Task definition	The nature and scope of the participation task should be clearly defined.
Structured decision making	The participation exercise should use / provide appropriate mechanisms for structuring and displaying the decision-making process.
Cost effectiveness	Cost effectiveness of the procedure (e.g. time and money).

Figure 1.3. Evaluation criteria for public participation processes (Rowe & Frewer, 2000).

Similar assessment frameworks for expert involvement are rarer. However, expert involvement may benefit from a similar systematic evaluation. Both with respect to how these expert involvements are conducted, and the impact of the results on the policy process itself. The criteria as reported by Rowe and Frewer would, however, provide a good starting point to develop evaluation criteria for expert involvement exercises (see for an example: Walls, et al., 2011). Only recently Kampen and Tamás (2013) suggested a checklist for policy supporting research focussing on several research quality aspects of empirical social science research. Although evaluation criteria are effectively missing for expert involvement, there is no reason to assume that current expert involvement practices are optimal, nor that their outcomes are effectively included in policy development. More attention needs to be paid to evaluating the process of expert involvement, and its impact on policy development, so that policy development will make the most effective use of expert involvement exercises.

1.4. Aim and scope of the thesis

Insight into appropriate application of specific expert involvement methodologies within agri-food policy development is essential due to the increased demand for inclusion of expert views. These expert involvement methods need to be able to incorporate the complexities of the domain (e.g. diversity in stakeholders, geo-dispersed experts, inclusion of several related subdomains). Furthermore, appropriate application of expert involvement methods is needed to perform evaluations assessing both the quality of the process and the uptake of the output into the policy process. Therefore, the aim of this thesis is to develop insight into expert involvement practice within the agri-food governance and policy making domain. This will be explored by applying one particular expert involvement method relevant to the agri-food policy development domain (Delphi) and considering its strengths and weaknesses throughout the process (Figure 1.4.).

Chapter 2 reviews current practices in the application and evaluation of expert involvement in policy development by means of a systematic literature review. The chapter presents an overview of expert involvement methods available in the existing literature, and proposes a framework for classifying different types of methodological approaches in line with the policy issue under consideration.

Chapters 3 – 5 present three case studies, focussing on the Delphi technique, to gain insight into what constitutes best practice in expert involvement in agri-food policy development.

Chapter 3 explores the feasibility to attract a broad range of geo-graphically dispersed experts through application of the Delphi method. The study illustrates problems with participant recruitment and participation and the need for an initial exploratory (qualitative) stage to be included in the Delphi process in order to "frame" key issues for presentation as part of the Delphi exercise itself. Within the Delphi study key stakeholders with relevant expertise on food risk analysis from within and outside the EU provide their views on a newly developed food risk analysis framework.

In *Chapter 4* the potential of Delphi to deal with geo-dispersed food safety experts is further explored in a global Delphi study. The global aspect of this study illustrates possibility of extreme expert dispersion for Delphi studies. Furthermore, it incorporates the lessons learned from the previous study with regard to recruiting participants and creating initial rounds based on exploratory research. It also investigates how to deal with linguistic issues and internet accessibility among respondents. The Delphi study aims to develop a common global research agenda providing insight in emerging food risk drivers and barriers to identification of emerging food risks.

The Delphi study conducted in *Chapter 5* included a preparatory workshop and addressed expert sampling issues at the outset of the study, seeking a more inclusive process. The Delphi study itself contributes to the development of a common strategic research agenda on emerging and major infectious diseases of production animals in Europe, resulting in a more direct policy impact compared to the other cases. Expert views are explored on drivers that may influence the incidence of emerging infectious animal diseases, as well as related threats to animal health and possible mitigating actions.

Finally, *Chapter 6* concludes this thesis by providing a discussion of the outcomes of the previous chapters and relating these back to the research question. This chapter also addresses the limitations of this research and the implications for future research as well as considerations for best practice in this area in the future are given.

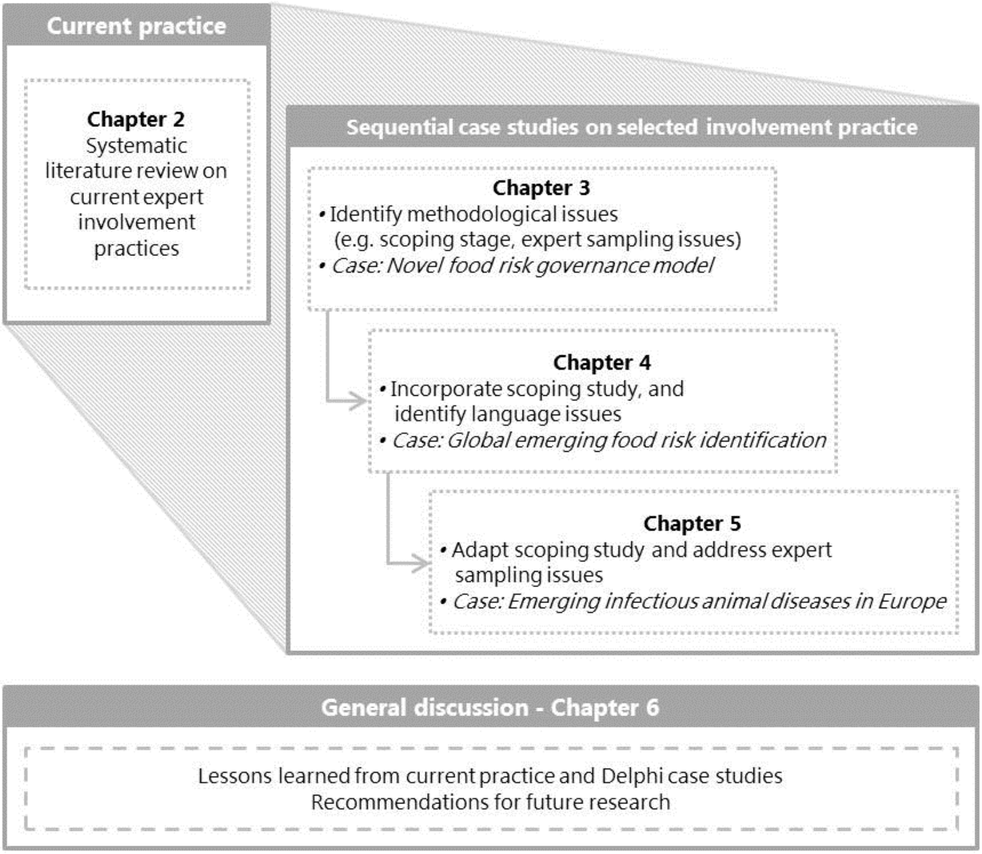

Figure 1.4. Schematic outline of the thesis.

CHAPTER 2

Expert involvement in policy development: a systematic review of current practice

Abstract

Systematic review was applied to the literature in the area of expert involvement in policy development. If the purported goals of increased transparency associated with the decision-making process, and policy impact associated with the outcomes are to be assessed, the expert involvement methodologies used to assess expert stakeholder views need to be explicitly described and published. This is needed to enable assessment of the quality of both the process of expert involvement and the uptake of the outputs into the policy process. One hundred and one papers were identified which met the inclusion criteria set in this systematic review. Coding of the contents of these papers indicated that evaluation (both of the process of expert involvement and in terms of policy impact) was infrequently applied, and that the application of robust evaluative processes are needed to both refine the efficacy of involvement processes (and the accuracy with which involvement methods are aligned to specific types of policy questions) and policy translation of the outcomes. A framework to selecting appropriate expert involvement methods for specific policy questions is proposed, which would need to be validated in future activities. Finally, some criteria for future reporting of expert involvement processes in the future are suggested.

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2.1. Introduction

There is currently extensive discussion about how the opinions and expertise of key stakeholders may be most effectively incorporated into the development and implementation of various policy issues (Renn, 2006). In this context, the definition of stakeholders may include individuals with expertise in a particular policy domain, representatives of societal groups with an interest in an area affected by policy development, or the general public. The term “stakeholder involvement” includes those individuals or organisations who perceive that they have a stake in the policy issue under consideration. Thus, in a broad sense, the term stakeholder involvement may be understood to include anyone in society who may be affected by a specific policy and its impacts (e.g. Rowe & Frewer, 2000). Although the general public has a stake in many policy discussions, their involvement has generally described as “public engagement” or “public participation”, rather than stakeholder *involvement*. If the general public is not included in the broader definition of stakeholder involvement, the term may be understood to be limited to people professionally or institutionally involved with the specific issue under discussion. Expert involvement, or consultation, is a type of stakeholder involvement that, in practice, is often limited to academics (e.g. Nishida, et al., 2004). However, other experts may possess extensive experience or expertise of direct relevance to the policy issue under consideration. In this chapter, the focus will be on “expert stakeholders”, which includes both academics and other stakeholders with expertise of specific relevance to a particular policy issue which is the focus of a specific consultation activity. In the discussion that follows, the working definition of an expert stakeholder is “those stakeholders who have gained domain specific expertise through their profession”. This chapter aims to systematically review current practice in the area of expert involvement, the methodologies applied, together with “currently applied” evaluation criteria regarding appropriate consultation practices, and the extent to which they influence policy development and implementation. From this, it may be possible to develop a framework selecting expert involvement methods and provide guidelines for an evaluative framework which may ultimately lead to improved practice in expert engagement and thereby better policy development.

There are various reasons as to why societal demand for increased stakeholder inclusion into policy processes has arisen. These include, *inter alia*, general decline in societal trust in the motives of institutional actors, in particular in industrial and regulatory sectors, regarding policy directed towards the protection of human and environmental health (Houghton, et al., 2008; Wagner & Armstrong, 2010). As well as increased societal demand for transparency and inclusivity in decision–making processes regarding policy development. The increase in institutional transparency is a requirement of implementing a more democratic approach to decision-making in relation to issues where various sectors in society may be directly or indirectly affected by the resulting policy. In addition, the consideration of a broader range of expertise in the information relevant to assessing different policy options associated with a specific policy issue or domain may not only increase the democracy associated with the decision itself, but lead to a better outcome as more evidence is considered as part of the decision-making process (König, et al., 2010; Reed, 2008; Renn, 2006).

Despite increased effort being placed on developing mechanisms to optimise expert involvement the methodological approaches used are fragmented and unsystematic. The adoption of systematic evaluative frameworks to assess the process and impact of stakeholder engagement has largely been confined to "public participation" (see, for example: Rowe & Frewer, 2000, 2005). Expert involvement also requires a good knowledge as to when and how stakeholders might be usefully consulted in relation to which policy processes. Insight into these issues will support future stakeholder consultations, as it allows researchers to choose the method that is most appropriate under specific contexts and in relation to specific policy areas, and enables the researchers to assess how the impact of such policy processes might usefully be assessed.

The inclusion of experts and other stakeholder groups in policy development and implementation also merits systematic analysis with regard to best practices. Little attention has been paid to the evaluation of the extent to which expert and stakeholder involvement exercises are appropriately conducted, but, as is the case with public participation, there is no reason to assume that current practices are optimal, nor that the purported benefits to the policy process are actually delivered. In addition, some policy actors question the credibility of certain (groups of) stakeholders in relation to whether they have sufficient expertise (or expertise which aligns to that defined as expertise by the policy actors themselves) to meaningfully engage in technical debates (Reed, 2008).

There are various expert involvement methods which have been applied to policy development. As in the case of public participation (see: Rowe & Frewer, 2005), there may be different ways that similarly named methods are applied in practice. For example, the term "workshop" has been applied to different gatherings of people; such as small groups engaging in unstructured discussions (where there is no predefined agenda available, nor is the route for the potential impacts of the outputs of the workshop on the policy process explicitly described (e.g. Newell, et al., 2010). In contrast, the term "workshop" has also been applied to a large meeting of people systematically discussing a number of policy issues in a very structured way, as they have been, for example, provided, *a priori*, with relevant materials and information about the aims of the meeting and an agenda (e.g. Ooms et al., 2010). If the purported goals of increased transparency associated with the decision-making process, and (assessment of) policy impact associated with the outcomes are to be assessed, the stakeholder involvement methodologies used to assess stakeholder views need to be explicitly described (in the report of the consultation, and / or the associated journal article). This is needed to enable assessment of the quality of both the process of expert involvement and the uptake of the outputs into the policy process. While methodologists will agree with this claim, practice may be different, and it is this practice that will determine the quality and relevance of expert involvement. To our knowledge there is no such overview currently available regarding existing practices, and their evaluation in relation to methodologies applied. There is therefore a need to systematically review current practices in the area of expert and stakeholder consultation and, from this starting point, to identify what might represent best practice, in terms of both methodologies applied, the evaluation of their effectiveness, and assessment of policy impact. In order to identify the methodologies which have been applied, a systematic literature review allows for a transparent and reproducible synthesis of available knowledge in this area, which can also be applied to the identification of any gaps in existing practices and evaluation of their effectiveness. More specifically, there is a need to:

1. Review types of expert/stakeholder involvement methodologies applied in the policy domain.

2. Review the current practice regarding assessment of application and policy impact of expert/stakeholder involvement.

3. To propose the criteria to be incorporated into an evaluative framework for expert/stakeholder involvement.

2.2. Methods

2.2.1. Selection procedure and databases

A systematic review was conducted to identify relevant papers. Search terms were developed through an iterative process reflecting the research objectives, which resulted in the inclusion of three blocks of keywords: the type of professional participant (*expert, stakeholder*, or *end-user*), the type of exercise (*consultation, engagement*, or *involvement*), and those identifying that the exercise was being conducted in order to inform policy or governance development and implementation. During the period of fine-tuning of key terms, it became clear that phrases combining "type of professional participant" with "type of exercise" were necessary to arrive at a reasonable selection of relevant papers (i.e. an appropriate number for review which also were representative of the relevant literature). Hence the final search term was:

(("expert consultation" OR "stakeholder consultation" OR "end-user consultation" OR "expert engagement" OR "stakeholder engagement" OR "end-user engagement" OR "expert involvement" OR "stakeholder involvement" OR "end-user involvement") AND (policy OR governance))

Within the current systematic review process, an eligible professional participant in eligible exercises has been defined as "those stakeholders who have gained domain specific, policy relevant expertise through their profession." Thus this review focuses on both experts and stakeholders who are judged to possess expertise relevant to a particular question, with the exception of the general public. However, the term "expert" will be used in this chapter to indicate this type of participant. In addition, with regard to the type of expert exercise, variations have been included in the literature search, namely consultation, engagement, and involvement. For consistency, the term "involvement" will be used to refer to all types of expert exercises.

Two electronic databases, listing abstracts from a wide range of scientific disciplines and publications, were searched (SCOPUS and Web of Science[1]). The search was limited to peer reviewed journal articles in order to meet quality criteria (i.e. that articles were judged to be published as peer reviewed journal articles). No limits were set for year of publication. In addition, for pragmatic reasons, the search was limited to English language publications. The final search was performed such that the title,

[1] See www.scopus.com and http://apps.webofknowledge.com/WOS. Both databases are subscription based.

abstract and keyword fields were searched, in both electronic databases, on 19th January 2011. The search results from the databases were saved in a bibliographical database.

2.2.2. Quick scan abstract selection

Abstracts were screened against exclusion criteria to remove non-relevant papers for the following reasons:

1. **Duplication.** Document duplicates another document in the database.

2. **Expert, or stakeholder, or end-user not used as intended.** The use of the "professional participant" was different to that intended in the objectives of this this systematic review (e.g. although a relevant term like "stakeholder involvement" is included, the document reports on a public participation exercise involving non-experts).

3. **Consultation, or engagement, or involvement not used as intended.** The use of the "type of exercise" was different to that intended in this systematic review and was not related to a professional participant exercise.

4. **No indication of methodological justification.** The abstract indicated that the paper did not include any methodological or other information relevant to assess application of methods.

5. **No indication for data usage.** The abstract indicated that the paper did not contain relevant and original data about an exercise which included expert participants.

6. **Outcome of exercise was not reported.** The abstract indicated that the results of the expert involvement exercise were not reported in the paper.

When an abstract did not provide relevant details (which could potentially be included in the full paper), the abstract was kept for further assessment.

The first author (Wentholt) performed the "quick screening" of all extracted abstracts to determine whether the abstracts met with the exclusion criteria described above. Ambiguous abstracts were listed (n=56), and independently evaluated by the second author (Fischer). Differences in opinion were discussed and resolved between the reviewers.

2.2.3. Data extraction and analysis

The full text paper was retrieved for each of the references that remained after the quick scan of abstracts. The full text papers were assessed against the exclusion criteria from the quick screening, to evaluate the papers where the abstract was inconclusive. In addition, papers not published in journals were excluded if the paper may not have been subjected to the highest standards of formal peer review[2] (e.g. conference proceedings, book chapters), if the body text of the paper was in a language other than English, or if the paper could not be retrieved.

The coding scheme to extract relevant data was based on the main objectives of this chapter and refined through an iterative process. The coding scheme was tested using a randomly selected subset of the papers (n=10). Following this initial test, some additional codes were added. Subsequently, the coding scheme was piloted once more (n=14), which resulted in some further refinements. The finalised coding scheme included the following five groups of codes:

1. **Document identification**. Bibliographical data (i.e. reference number; authors; title; year of publication; journal).

2. **Study descriptors**. Information was extracted from the full text papers about the characteristics related to the wording used for the type of participant and type of exercise, and the methodology adopted to elicit response. In addition, disciplinary scope and research aim of the study as well as the number of studies reported in a single paper were recorded.

3. **Sample details**. Information about the number of participants, participant selection, geographical information (i.e. where the study was conducted) and whether participants were representative of a particular stakeholder constituency was recorded.

4. **Data collection within specific studies**. Details on the process by which the data were collected and analysed were recorded. The duration of the procedure and the effort to keep researcher bias under control were also recorded if these were reported in the paper.

[2] Both Scopus and Web of Science demand a clear peer review procedure for journals included.

5. **Impact indicators**. Information was extracted regarding whether policy impact was measured, whether evaluation of exercise had been conducted and if so, which criteria for such an evaluation were applied.

It is important to note that multiple factors potentially influence best practice in expert involvement exercises. The criteria applied in the research reported in the current chapter were adapted from (Rowe & Frewer, 2000), originally developed for application to public participation and not expert involvement exercises, and so may not all be (equally, if at all) relevant to expert involvement exercises. However, the criteria provide an initial set of principles that can be extrapolated to the expert domain, and subsequently evaluated as to their relevance.

Most codes were "closed", and comprised of discrete categories, (e.g. a list of types of expert involvement methods). Free formats were provided to allow for alternative outcomes, or for the coders' comments regarding the paper. A few codes were free formats (e.g. disciplinary scope of the study).

The first author (Wentholt) performed the data extraction. Each study within a paper was coded in detail and the coding recorded in a spread sheet to facilitate further analysis. For the code categories containing both closed and free format answering options, the free format responses were analysed using thematic analysis and, where relevant added as one of the closed codes (calculating summary statistics such as the calculation of frequencies and percentages within coding categories).

2.3. Results

2.3.1. Sample selection

The initial search of the two databases yielded 839 papers (528 in Scopus and 311 in Web of Science), of which 197 were duplicate papers that were automatically removed from the bibliographical database. The quick screening of the abstracts resulted in the exclusion of a further 385 papers. Of these, 63 were duplicate papers that were not automatically detected. Twenty-three were excluded because the use of the term 'expert', 'stakeholder', or 'end-user' was not used as intended within this systematic review, and, similarly, 16 were excluded because the use of involvement' or 'consultation' or 'engagement' was not as defined in this systematic review. Seventy-one papers were excluded because they gave no indication of the methods used to identify and/or evaluate expert views. In addition, 139 papers were excluded as the abstract suggested that the paper contained no original data regarding expert involvement, and 63 abstracts reported that the paper was about 'expert involvement' (or equivalent terms) without reporting the outcomes of this involvement. Finally, for 10 papers the peer review status could not be guaranteed. This process resulted in 257 papers remaining in the database.

The full text of the papers was retrieved from the Wageningen University library. If the library had no subscription to the journal, a copy was requested through the interlibrary service. Five papers could not be retrieved, and the remaining 252 were coded in detail.

During the data extraction phase, a further 156 papers were excluded. Six papers were excluded as the use of 'expert' (or 'stakeholder' or 'end-user') was not as intended in the current review, 24 had no usable data relevant to the objectives, 56 did not contain extractable data, and another 24 were excluded because they did not actually discuss 'expert involvement' *per se*. For 35 papers, the inclusion criterion of peer review could not be guaranteed (these were mostly conference proceedings). Finally, 6 papers were excluded on the basis of being duplicates (1), or in a different language to English (5). The content of the remaining 101 papers was analysed (see the Appendix A for all references). A schematic overview of the selection process is provided in Figure 2.1.

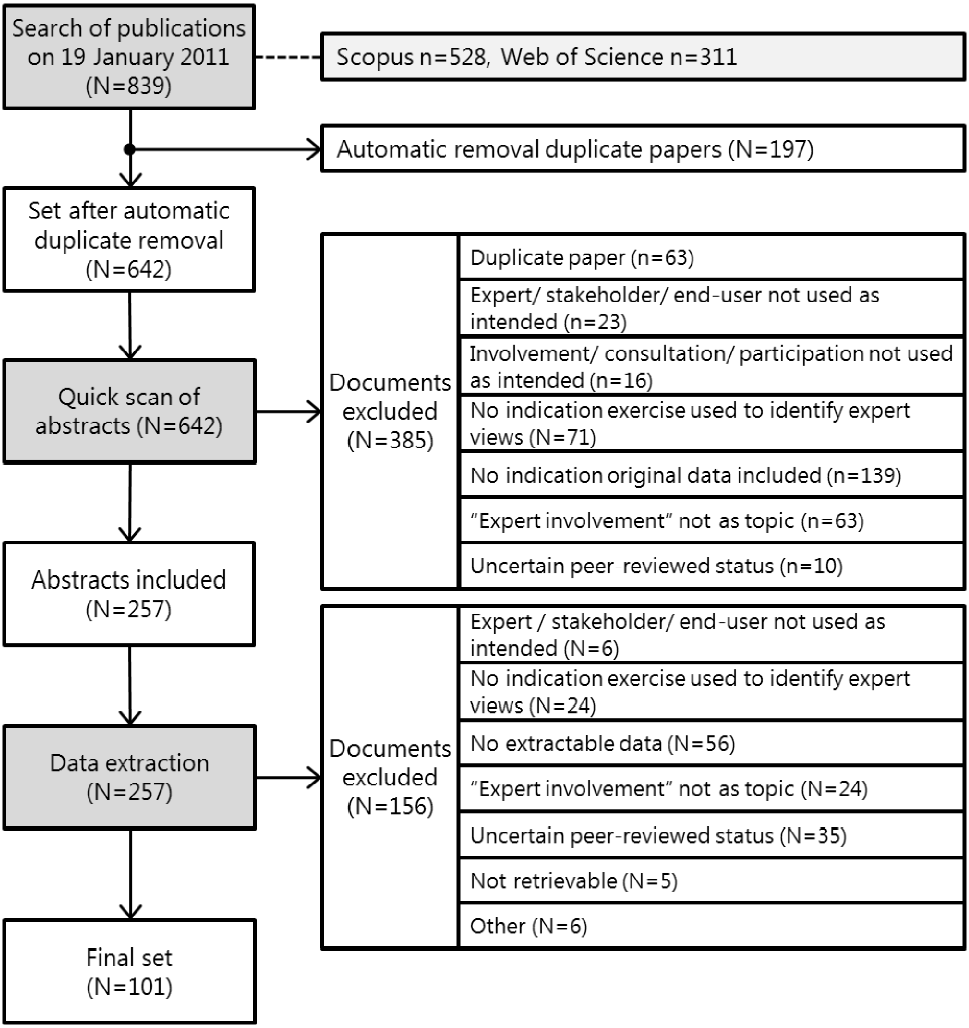

Figure 2.1. Flowchart of systematic review process.

2.3.2. Characteristics of the sample

The first publication included in the review was published in 1978 and the most recent in 2011. A steep increase in publications was observed from 2000 onwards (Figure 2.2). Note that the data search was concluded on 19 January 2011 making this year far from complete).

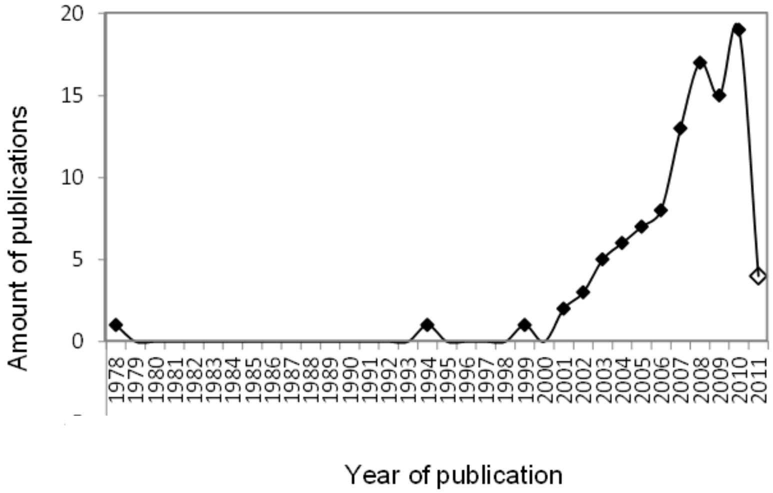

Figure 2.2. Publication trend of manuscripts included in systematic review analysis.

The 101 publications included in the review were published in 85 different journals, most of which reported only one or two publications. The "Australia and New Zealand Health Policy" journal provided three publications, and "Environmental Policy and Governance" and "Marine Policy" each provided four publications. Within these papers, a total of 157 studies were reported. Most papers (n=70) reported a single study, 18 reported two studies, the remainder reported 3 to 6 studies (3 studies n=8; 4 studies n=4; 5 studies n=1; 6 studies n=1).

Data collection occurred in 52 different countries. Papers reporting data from a single country (N=72) most frequently originated in the United Kingdom (n=27). Other frequently reported countries were Australia (n=12), the USA (n=10), China (n=9) and Canada (n=8). Considering the geographic distribution across different continents, nearly half (n=34) of the papers reported data which originated in Europe (mainly in EU member states), followed by those originating in North America (n=17), Oceania (n=12), Asia (n=7), and Africa (n=2). Papers reporting data collection in multiple countries (N=21) were most frequently identified as originating across Europe (n=11) or were global (n=8). Only one, global paper (Borre et al., 2001) involved South American participants.

The majority of studies were conducted at the national level (n=53), or within a region of a country (n=37). The remaining studies were conducted at the local level (n=23), or within a geographic region involving multiple countries, (n=16) or at the global level (n=8). This information was not available for 21 studies (13% of the total).

2.3.3. Type of exercise and participant

The search terms included in the search string, 'consultation' (n=34), 'involvement' (n=32), and 'engagement' (n=18) were most frequently used to describe the expert involvement exercise. The involvement exercises were also referred to as 'participation' (n=16); 'perception' (n=12); 'view' (n=6); 'perspectives' (n=5); 'opinion' (n=3); 'assessment' (n=2); 'survey' (n=2); and 'values' (n=2). An additional 13 terms to describe the type of exercise were used only once. These terms included testing tool by expert panel (Rowley, 2011), mixed method (Jones & Cowie, 2010); representation (Ingley et al., 2010), debate (Fan, 2009), stakeholder deliberation (Keune et al., 2009), elicitation (Fazil et al., 2008), attitudes (Cocklin et al., 2007), input (Fletcher & Pike, 2007), appraisal (Borg & Fogelholm, 2007)and judgment (Failing et al., 2004). In addition, three more abstract terms were used: multidisciplinary approaches (Fonderflick et al., 2010), social learning process (Blackstock et al., 2009), management (Timur & Getz, 2009).

The majority of the papers (n=68) consistently used a single term for the type of exercise throughout the paper. The other 35 papers used either two or three different terms. Use of multiple terms could be applied to consistently identify different types of involvement, for example (Keune, et al., 2009) used the terms 'expert assessment' and 'stakeholder deliberation' consistently to discuss different types of involvement. However, different terms could also refer to the same exercise, for example, in one paper (Peterson, 2004) the terms 'perspectives', 'perceptions' and 'involvement' were applied interchangeably.

Participants were frequently referred to as 'stakeholders' (n=76) and 'experts' (n=32). Sometimes specific expertise was used to describe participants (n=7) (e.g. fishermen, landholders, directors of public health, farmers, or managers). In addition, the term 'participant' itself, (n=4), as well as 'informant' (n=2) was used in this context. Some papers reported involving 'citizen' (n=2) or 'public' (n=2) participants as well as experts in the exercises. Finally, five papers referred to their participants in other ways. Most papers used only one term for the type of participant (n=83), in 20 papers participants were referred using up to 4 different terms, mostly when using different participant groups in their study. For example, (Whitmarsh, Swartling, et al., 2009) used the terms: 'expert', 'citizen', and 'stakeholder', of which the latter was used to refer to analyses related to the combined expert and citizen sample.

2.3.4. Selection of expert samples in the literature

From the 159 studies, 81 studies reported the sample selection method used to recruit participants. Five studies described the selection method in an insufficient level of detail to allow replication. The remaining 73 studies did not report on the sample selection method used in participant recruitment.

Studies most frequently reported quota sampling as part of the recruitment process (i.e. the use of criteria to select participants; n=37). Other methods included a form of convenience sampling (i.e. approaching researchers *via* existing networks (n=17), identification of potential participants by (project) partners (n=10), construction of the sample from the published literature or through Internet search (n=5). In some studies, the whole population of interest was approached (n=23), or random sampling of this population was applied (n=5). In addition, 19 studies adopted the "snowballing method" (asking participants for name and contact details of additional experts they consider relevant), of which 8 studies reported to have applied this as a second stage methodology following initial recruitment of participants. In all, 47 studies used a single method, 26 studies used two methods, and 8 studies used three or more methods to recruit participants.

2.3.5. Overview of expert involvement methodologies

Most frequently reported methods were "semi-structured interviews" (n=45), "one-off questionnaires" (n=28), "workshops" (n=37), "focus groups" (n=12), "consultations" (n=11), "Delphi" (n=5), "iterative questionnaires" (n=2), a "jury" (n=2), or some kind of "observational process" (n=2). An additional 14 methods were reported only once: school-based longitudinal case studies (Jones & Cowie, 2010); submission of scenarios for comments and validation (Fonderflick, et al., 2010), brainstorming and expert elicitation sessions (Fazil, et al., 2008), participatory simulation sessions (Becu et al., 2008), conference (Acworth, 2008), expert panel (Stilma et al., 2007), contact with experts and population surveys (Medilanski et al., 2007), a working group (Dougill et al., 2006), professional stakeholders telephone focus group or telephone interviews (Jones, et al., 2005) literature review and a request for study participants unpublished literature as well as requesting information from focal points and libraries (Fitch et al., 2004), consultation papers (Tiwari et al., 2002), evaluation workbook containing self-administered questionnaire (Arvai et al., 2002), and a "national summit" (Abkowitz et al., 1999).

Those methods that have been reported at least 5 times have been summarised in tabular form which provide method characteristics in relation to participants (Table 2.1), design and analysis (Table 2.2), and procedure (Table 2.3).

Consultations were excluded from these tables as these included little relevant data, making inclusion in the summary tables irrelevant. However, it was noteworthy that 'consultations' tended to be conducted by international governmental institutions (e.g. FAO, WHO; 7 out of 11 studies), whereas "workshops" (included in this review) were not conducted by these sponsors.

2.3.6. Participants: the experts involved

In Table 2.1 the different methodologies are characterised on the basis of number of experts involved, whether participants were consulted individually or as a group, and, where possible, on the basis of the participant selection method used. Unlike the other methods, Delphi methodology typically utilises a combination of individual expert consultation with aggregated feedback of group responses provided to individual experts over a series of "rounds".

Table 2.1. Characterisation of expert involvement exercises based on participant features.

Name method	N	Number of experts involved [a]			Experts consulted individually or as a group	Participant selection method [b]
		n_{tot}	min…max	Mdn		
Interview	45	38	3…279	25	Individually	Approach whole population of interest (n=2) Convenience sampling (n=8) Quota sampling (n=11) Random sample (n=1) Snowballing (n=12)
One-off questionnaire	28	23	14…1200	70	Individually	Approach whole population of interest (n=10) Convenience sampling (n=7) Quota sampling (n=6) Random sample (n=2) Snowballing (n=12)
Workshop	37	18	2…193	24	Group	Approach whole population of interest (n=7) Convenience sampling (n=6) Quota sampling (n=12) Random sample (n=1) Snowballing (n=3)
Focus group	12	7	13…76	24	Group	Convenience sampling (n=4) Quota sampling (n=4) Random sample (n=1) Snowballing (n=2)
Delphi	5	5	12…400	30	Mixed. Individual response, but through feedback may be influenced by group. Outcomes on group level.	Convenience sampling (n=3) Quota sampling (n=1)

[a] n_{tot} = number of studies reporting; minimum…maximum; Mdn = median
[b] only those studies that reported selection method are indicated by (n=x)

2.3.7. Design and analysis

Table 2.2 provides information relating to design and data analysis. Both interviews and focus groups used face-to-face researcher and participant methodologies to collect (primarily) qualitative data which is subsequently content analysed by researchers. One-off questionnaires and Delphi studies generally combined quantitative and qualitative data collection and analysis techniques. Again, only some of the studies reported all relevant information regarding the design and analysis of the expert involvement exercise.

Some studies also reported using a combination of data collection instruments (respectively for: workshop (n=5), interview (n=3), one-go questionnaire (n=1), focus group (n=1), Delphi (n=2)). For example, Roberts et al. (2010) report combining a telephone interview, email questionnaire, postal questionnaire and 6 stakeholder groups (Roberts, et al., 2010). Other combinations include group discussions and questionnaires (Whitmarsh, et al., 2009), iterative methods consisting of a mix of e-mail surveys and face-to-face discussions (Sibbald et al., 2009), teleconference, email discussion, and (Delphi) surveys (Alberts, 2007) and telephone focus group, telephone interview, videoconference and person-to-person interviews (Jones, et al., 2005). What is apparent is that no standardised approach to combining methodologies has been identified.

Table 2.2. Characterisation of expert involvement exercises related to design and analysis.

Name method	N	Data type [a]				Collection instrument [b]	Data analysis [c]
		n_{tot}	n_{qt}	n_{ql}	n_{both}		
Interview	45	21	1	13	7	Face to face (n=28) Face to face using questionnaire (n=5)	Content (n=16) Descriptive (n=5)
One-off questionnaire	28	19	5	2	12	Questionnaire (n=27)	Content (n=4) Descriptive (n=11)
Workshop	37	7	1	3	3	Outcome collation (n=10) Questionnaire (n=3) Observation (n=1)	Content (n=3) Descriptive (n=3) Consensus (n=2)
Focus group	12	4	0	3	1	Face-to-face (n=5)	Content (n=1) Descriptive (n=2)
Delphi	5	3	0	0	3	Questionnaire (n=2)	Content (n=1) Descriptive (n=1)

[a] n_{tot}= number of studies reporting data type in total; n_{qt}= quantitative; n_{ql}= qualitative; n_{both}= both
[b] n= number of studies reporting details about data collection instrument
[c] n= number of studies reporting details on data analysis

2.3.8. Procedure

In terms of duration required to collect data from (individual or groups of) experts, the questionnaires, interviews and focus groups were designed to all fit into a half day time slot (see Table 2.3). Interviews, conducted by the researcher and often at a location chosen by the expert, have an average duration of about one-and-a-half hours per interview. In contrast, workshops often took much longer, with durations ranging from less than a day up to three days, with a median duration of 1.5 days.

The extent to which expert participants in the different studies had been provided with information relating to the objectives and structure of the exercise in advance of the consultation was not frequently described in the studies. For example, the purpose of the exercise was communicated in advance of the expert involvement exercise in 14 studies, and the methodology to be used in 11 studies, at least as far as could be deducted from the information provided in the published papers.

In general, the direction of information flow (for example, between participants and researchers) differs between the different methods used. Interviews and one-off questionnaires are designed as *unidirectional* methods in which the participant provides information *to* the researcher (and by implication to the research sponsor), whereas workshops, focus groups, and Delphi methodologies allow for a certain degree of horizontal participant interaction as well as the potential to interact with the sponsor, as well as, in many cases, engage in a "dialogue" or two-way information flow.

Table 2.3. Characterisation of expert involvement exercises related to procedure.

Name method	N	Duration
Interview	45	Mean: 87 minutes[1] (minimum 15 minutes, maximum 180 minutes)
One-off questionnaire	28	Duration of data collection reported (n=2): 10; 40 minutes Time with participants: 3 months (median) (minimum 2 months, maximum 9 months)
Workshop	26	Median: 1.5 days (minimum less than 1 day, maximum 3 days)
Focus group	12	1 study: 45-90 minutes 1 study:180 minutes
Delphi	5	

[1] Each study was represented as one case by the represented mean duration or the average of minimum and maximum duration. One study provided only a minimal duration (30 minutes) and was omitted.

2.3.9. Field of application of the expert involvement exercises

Most papers (which may report multiple studies) originated from consultations associated with policy related research in the area of environmental sciences (43 papers), public health (37 papers), and agriculture and food safety (9 papers). An additional 14 domains were included at least once in the studies contributing to data base: finance (Ingley, et al., 2010), organisation management (Hine & Preuss, 2009), nuclear crisis management (Ioannides et al., 2005), e-government (Rowley, 2011), application of ICT in education (Jones & Cowie, 2010); knowledge exchange between academia and industry (Acworth, 2008), development of hydrogen as energy carrier (Seymour et al., 2008), transportation management (Collantes, 2008), space policy making (Arvai, et al., 2002), public policy formation (Skelcher et al., 2005), ethical framework development (Kaiser et al., 2007), sustainable development management

(Nelms et al., 2007), and sustainability assessment of mobility (Whitmarsh, et al., 2009). A final paper addressed the development of foresight methods itself (Klenk & Hickey, 2011).

Studies falling into the domain of public health include all of the methods addressed in the typology developed in this systematic review. The use of interview methodology was the most frequently across in the three primary policy areas (Table 2.4).

Table 2.4. Expert involvement methods across field of application.

Name method	N (method)	environmental science (N=67[a])	public health (N=59[a])	agriculture & food (N=13[a])	Other (N=20[a])
Interview	45	24	14	4	3
One-off questionnaire	28	15	9	1	3
Workshop	26	11	7	4	4
Focus group	12	1	7	2	2
Delphi	5	1	3	0	1
Other methods		15	19	2	7

[a] Note that this table reports studies, rather than papers, the presence of multi-study papers allows totals to surpass the paper totals for the discipline.

2.3.10. Methodological rigour

From the 101 papers included in analysis, only 12 papers reported having applied evaluation (or evaluative criteria) to assess the quality of the process of consultation. Of these papers, 5 embedded the evaluation as part of the exercise itself (of which 3 described to have executed a questionnaire to evaluate the exercise); 3 used multiple methods to assess the quality process (of which all used a questionnaire together with focus groups, a case study, feedback sessions or qualitative evaluation by the authors). For the remaining 4 papers it was unclear how the evaluation was conducted, as further details were not provided. An important issue relates to the fact that, even for the exercises where evaluation occurred, the impact on policy was not explicitly assessed.

One paper referred to a set of four evaluation criteria. However, details regarding how the evaluation was actually conducted were not included (Saarikoski et al., 2010). The authors provided four criteria for evaluating the effectiveness of participatory processes. These comprised of inclusiveness (a broad range of interest groups were present, and no stakeholder or interest group who was willing to participate was deliberately excluded from the process), interactiveness (formation of deliberative spaces, joint problem solving), fairness (all views heard and respected, an unconstrained process, and free access to all relevant information), and impact (potential to influence decision-making, reconciliation of different interests, capacity building). Furthermore, the paper investigated perceived inclusivity, assessing whether the experts involved in the exercise perceived that all relevant representatives of the full range of required expertise were included, whether participants thought that sufficient interaction between participants was achieved, whether participants perceived that the exercise ensured fair discussion of all issues relevant to their point of view; and whether the participants believed their involvement would lead to some kind of impact on the decision making process (Saarikoski, et al., 2010).

An additional 7 papers reported the use of participant perception criteria to evaluate either the 'process' (n=7), 'outcomes' (n=3), or the 'exercise' itself (n=2). One paper, for example, expert involvement was assessed regarding the effectiveness of the process (the development of an ethical engagement framework), a qualitative assessment of the outcomes was performed, and the participants' own assessment of the process incorporated into the evaluation (Jensen et al., 2010). Another paper evaluated the impact of the exercise, in terms of the social goals of participants feeling more confident due to their participation after the exercise (Alberts, 2007).

A total of 10 papers reported on the researchers' effort to control for researcher bias. These studies typically adopted semi-structured interviews (n=9), Delphi methodology (n=2) or focus groups (n=1) as the primary consultation process. Out of the 9 interview studies that put effort into controlling researcher bias, 8 reported that audio taping and transcription of the interviews had occurred, and 1 (Newell, et al., 2010) reported that the reviewer noted the major points as they were presented by participants. Six papers reported having used a formal interview schedule. The focus groups were video-taped and transcribed. Of these 10 papers, the authors reported 6 times how they dealt with participant selection, for example, through adding interview participants until response saturation occurred. In 5 studies, it was reported that qualitative data analysis ('coding') was conducted by multiple researchers to control for researcher bias, while one other study reported that an independent researcher verified the coding scheme by checking 3 transcripts. Five studies reported that the participants were requested to confirm the veracity of the transcripts or results prior to subsequent analysis by researchers.

The majority of the papers included in the analysis (n=92) do not make reference to the impact the study may, or may not, have had on policy development and implementation (Table 2.5). One paper reported an evaluation of policy impact (Jones & Cowie, 2010), and another 10 papers identified potential policy implications but did not measure these. Two of these papers were directly connected to policy development through their sponsors and provided specific recommendations of interest to the policy development body concerned. Another 2 papers described how the conclusions of the exercise were submitted to the sponsor (in this case government agencies) and were either under consideration by the relevant Minister (de Witte, 2009), or described how the recommendations were being dealt with by the sponsoring body, or in terms of the reactions of the press (Keune et al., 2008). The other papers describe the effect of a policy (Tiwari, et al., 2002), the process of policy implementation (Coffee et al., 2010), or provided recommendations to policy-makers in general rather than a specific sponsor or policy development institution.

2.3.11. Reflection on methodology

For just over half of the papers (n=61) the authors provided not any critique of the methodologies applied. The discussion section typically focused on the outcomes and topic of the research only. In less than half of the papers (n=42), the authors provided a critique of the methodology in either the discussion or methodology sections. Most frequently, the authors reflected on methodological shortcomings related to the sample (n=15), such as sample size, participant representativeness, selection bias, or specific properties of the used method (n=12). Issues concerning the generalizability of results were also frequently discussed (n=4). Evaluation of policy impact was generally not addressed by the authors when reflecting on limitations of the paper.

Table 2.5. Methodological rigour reported in expert involvement exercises.

Quality of Consultation		Control of researcher bias [a]		Impact on policies		Reflection on quality of own research [a]	
Evaluation as part of the consultation	5	Audiotaping and full transcription	8	Posteriori analysis	1	Sample issues	15
Multiple methods	3	Minutes	1	Policy implication submitted to sponsor	2	Generalizability of research	4
Mentioned but unclear	4	Use of formal interview protocol	6	Policy implication under consideration by policy makers	2	Methodological strength and weakness	12
		Procedure for participant inclusion	6	Generic description of potential policy relevance	6	Other discussion	11
		Inter-coder reliability	5				
		Participant feedback on veracity of transcripts	5				
Not evaluated	**91**	**Not mentioned**	**93**	**No reference**	**92**	**None**	**61**

[a] Multiple of these actions could have been applied within a single paper.

2.4. Discussion

This chapter has systematically reviewed current practice of expert involvement within the policy domain. The scientific literature which was included in the review has predominantly originated in the domain of environmental and health sciences or policy development applied to the agriculture and food sector. Most papers reported on a single exercise using data originating from one country.

2.4.1. Identification and selection of expert involvement method

Five primary methods have been identified in the typology of expert involvement methodologies applied to policy development and implementation, where experts tended to be consulted on an individual basis (interview, one-off questionnaire) in groups (i.e. workshop, focus group), or a special hybrid form (Delphi) which allows individualised interaction.

The choice of method tended to be based on pragmatic reasons, rather than being aimed at fitting the specific research goal, or context. For that reason, a more structured framework for selecting research methods to conduct expert involvement exercises will be proposed (Table 2.6.). This framework combines the characteristics of the policy issue under consideration, with characteristics of the expert group.

The policy issue under consideration is based on three characteristics. First, it may be relevant to distinguish between the extent to which there is uncertainty associated with the impact of a particular issue, for example in association with a risk assessment, as well as potential for differential effects to apply to different demographic groups, populations, or regions, which is not well-described (Renn, et al., 2011). Second, it is useful to distinguish between topics that are ambiguous, compared to those which are not ambiguous, where ambiguity is here defined as a case where there are multiple legitimate interpretations and opinions that potentially influence the way an individual experts interprets specific issues (i.e. the "value mapping" of the involved expert (Renn, et al., 2011). Finally, it may also be valuable to differentiate between situations where experts are (potentially) in agreement, or in disagreement with each other at the onset of the exercise. Although this distinction may seem superfluous in the context of ambiguous opinions, this is not necessarily the case. For example, food processing industries may have different opinions and values compared to environmental NGO's regarding the structure of the global food chain, leading to ambiguity in opinion, but at the same time reach an agreement regarding a strategy for the development of sustainable and low environmental impact production of crops.

The characteristics of the expert group is based on the goal of the expert elicitation exercise and the characteristics of contributing expert groups. The goal of the expert elicitation exercise can be divided into either being an exercise aimed at decision making (see e.g. de Witte, 2009) or at sampling opinions to reach an overview of the opinions in the relevant stakeholder domain (information gathering) (e.g. Gonzalez-Zapata et al., 2007). These different goals will have consequences for selection of the type of involvement method. In the case of a policy "decision", some kind of final recommendation is needed to inform it, whether this is arrived at through the development of consensus, or through a voting procedure within the expert group. However, it is also possible that the policy process requires identification of a broad range of expert opinions regarding a specific issue and associated policy translation. Experts may constitute of individuals with different opinions regarding the development of a specific policy (for example, the development of a future research agenda delivered to meet a specific societal problem) (Wentholt et al., 2012), or may represent a broad range of societal stakeholders with an interest in a broad policy issue such as local governance (see e.g. Edelenbos & Klijn, 2006). An additional issue relates to the distribution of expertise geographically, where a specific policy issue under discussion may require the involvement of experts in divers geographical locations such that it is not pragmatic to bring them to a specific location (Frewer et al., 2011).

Specific types of methods for expert involvement are more likely to deliver the relevant information required for policy if the most appropriate approach is selected for a particular policy context (Table 2.6.). The different groups of methods (categories) will be described in more detail below. Specific methods are suggested in italic at the end of each of the relevant subsections.

Table 2.6. A proposed framework for selecting expert involvement method*.

Characteristics of the policy issue under consideration			Characteristics of the expert group					
			Decision making			Information gathering		
Level of expert agreement required as part of the policy process	**Level of ambiguity regarding potential initial positions of expert participants**	**Extent to which there is certainty regarding issue impact**	Expert group with expertise focused in a specific domain	Expert group with broad expertise	Expert group geographically dispersed	Expert group with expertise focused in a specific domain	Expert group with broad expertise	Expert group geographically dispersed
Expert agreement required for policy decision-making	**High ambiguity**	**Certain**	Consensus seeking		Distant consensus seeking	Iterative scoping		
		Uncertain	Consensus seeking and boundary setting		Distant consensus seeking and boundary setting			
	Low ambiguity	**Certain**	Confirmation poll			Opinion poll		
		Uncertain	Boundary setting		Distant boundary setting	Boundary seeking		
Disagreement tolerated for policy information seeking formulation	**High ambiguity**	**Certain**	Anonymised consensus seeking			Iterative scoping		
		Uncertain						
	Low ambiguity	**Certain**	Vote			Opinion poll		
		Uncertain	Anonymised consensus method			Boundary seeking		

*The expert involvement categories are further detailed in the text.

Expert involvement methods related to decision making

Consensus seeking. In cases where expert agreement is needed to inform a decision, where there are high levels of ambiguity, but little uncertainty regarding potential impacts of the decision, it becomes important to develop consensus within the expert group. It is suggested that in order to develop consensus, an initial starting point may be the development of shared values within the expert group, enabling toleration of initial disagreements in societal perspective or stance. Thus it would be important to exchange views in an interactive way within the expert group, assuming that this is possible given pragmatic constraints such as lack of geographical dispersion. It is important that ground rules are established to enable expert acceptance of differing values within the group, as well as those which are shared (i.e. ambiguity). What constitutes shared goals also needs to be established. *The use of a workshop format may be appropriate, as this would allow the free exchange of information and points of view.*

Distant consensus seeking. In cases where agreements should lead to decisions under conditions of ambiguity, but where there is little uncertainty, *and* where the policy issue under discussion requires experts who geographically dispersed, or who cannot meet in the same physical location for other reasons, the application of workshop methodology will not be feasible. For policy issues requiring expert involvement under these circumstances, distant consensus seeking methods are recommended. *The use of Teleconference or videoconference may be appropriate, but difficulties in moderation may result in the opinions of a few individuals dominating the discussion, as may linguistic disparities under conditions where participants are internationally based. In addition, such methods may be inappropriate under circumstances where many experts are involved. Under these circumstances the use of a policy Delphi may be appropriate, perhaps used in conjunction with a smaller expert workshop to refine policy-relevant questions prior to the Delphi exercise itself.*

Consensus seeking and boundary setting / Distant consensus seeking and boundary setting. If both ambiguity regarding expert opinion and uncertainty regarding policy outcomes are relevant to the policy issue under discussion, it becomes important to set "boundaries" for whom, and under what circumstances, the information developed in the expert involvement will influence the policy process. Whilst the interactive methods identified as relevant for consensus seeking may also apply under these circumstances, additional emphasis must be placed on communicating to participants the terms of reference of the exercise, and potential limitations of the outputs on the policy process. For example, the terms of reference might indicate that the outputs of the expert involvement exercise will be used in policy considerations, together with other information relevant to the policy being developed. As part of this, policies makers will take due account of any minority views which arise, or disagreement about policy options being discussed. *Interactive methods (the workshop or Delphi methodology) are appropriate for application, assuming that terms of references are provided to experts prior to the initiation of the exercise.*

Confirmation poll. In situations of low ambiguity, low uncertainty, and where expert "buy-in" is required as an output, there is little need for interactive expert involvement. Under these circumstances it may be appropriate simply to ask experts to indicate the extent to which they agree or disagree with the policy option under discussion. *Opinion polling may be useful especially when a large number of experts need to be consulted in a short time frame.* Whilst on one hand *it may be appropriate to conduct an expert "opinion poll"* under these circumstances, there is still an important policy formulation issue regarding *who* dissents from the majority view and *why*. It is suggested here that such an approach may be used to identify who holds minority opinions and, if this is indeed the case, the reasons why can be explored through *conducting 1 to 1 interviews*. If, for example, this is due to expert misinterpretation of policy objectives, further action may not be required. If, however, minority opinions arise as a consequence of differing interpretations of available evidence, further interactive methods may be needed to resolve the emerging ambiguities at a later date.

Anonymised consensus seeking. Situations may arise where a particular policy issue is controversial (or controversial in a particular region, where local populations or environments are directly affected), or where expert opinion is required in which experts are required to provide information about their own views, rather than representing their employers or other stakeholder or institutional group. Under these circumstances, it is important to create an atmosphere where participants can express independent views. *Under circumstances of high certainty and low ambiguity, (anonymised) polling may be an appropriate tool. Under circumstances which are associated with ambiguity or uncertainty, the use of anonymised Delphi (in particular where feedback regarding opinion uncertainty is included- see Walshe and Burgman (2010)) will provide the basis for interactive, anonymised discussion.*

Vote. In cases where there is little ambiguity or uncertainty, but the potential for disagreement has been identified across experts (for example from the available scientific literature), it is unlikely that further discussion will resolve the disagreement. In some cases resolution may also be required in a short term frame (for example, in a crisis context involving an urgent policy response). In these cases, it may be that *the* *majority opinion should be identified through voting (whether anonymised or otherwise), using a simplified poll with single responses being required for each policy option under consideration.* Note, however, that the application of voting as an instrument to consult experts may result in disaffection, given that minority opinions are unlikely to be given due consideration in the policy process.

Expert involvement methods related to information gathering

Iterative scoping. In the case of iterative scoping of a policy issue which involves a large number of experts with different expertise, or who are "geo-dispersed" or associated with different expertise domains. *Remote iterative methods such as the Delphi approach may be relevant under these circumstance, assuming that this adopt unstructured or semi-structured methods of data collection to ensure that sponsor opinions do not dominate the results.*

Opinion poll. If the available evidence suggests that the policy issue under consideration is associated with low ambiguity and high certainty, *a straightforward opinion poll should demonstrate that relevant expert opinion is in line with a particular policy option. Where the results suggest that this is not the case, follow up exercises (for example linked to interviews of experts who dissent from the majority view) might be relevant if time and resources permit*.

Boundary seeking. The policy maker may wish to collate information about where the boundaries of a particular future expert consultation may lie in the case of policy development associated with low ambiguity and high uncertainty. *The most suitable methods to be applied under these circumstances will be iterative and, depending on the number of experts to be consulted and the extent to which iteration is desirable, utilise Delphi based approaches (where many different experts are to be consulted) or, more pragmatically at the early stages of the policy development process, use focus groups or 1 to 1 interviews to set the boundaries for subsequent expert involvement exercises.*

The methods described here are applicable at specific stages of the policy process. The iterative character of policy suggests the need for a multi-stage involvement method able to include the requirements of multiple stages, and preferably able to involve the same experts over multiple iterations. One of the methods described, Delphi, may provide a relevant candidate to fulfil this role. Delphi can be applied to gather both qualitative and quantitative data, can be used to establish consensus or collect opinions, allows for social interaction without bringing political or social pressure to the table, and can be applied through distant polling methods. Further investigations into the practical applicability of Delphi for policy development would be of importance to the agri-food policy domain.

2.4.2. Evaluation of policy impact

As has been demonstrated by the review, rigorous and systematic reporting of why specific methodologies were adopted, and the evaluation of the effectiveness of the quality of the consultative process has been infrequently applied, or at least reported. It is arguable that such evaluation would represent an important initial step towards demonstrating the relevance of expert involvement to policy formulation.

A major issue relates to the lack of evaluation of the effectiveness of the consultation process on policy impact. An important research question which needs to be asked following expert involvement is the extent to which policy changes have been implemented as a consequence. It is likely that this is infrequently conducted because policy translation of outputs may result at a time after research papers have been published, and the consultation phase completed. As a consequence, policy impact assessments are scarce in the published literature, but there are, from this, strong arguments to support funding of prospective analyses of policy impact in order to justify and optimise expert involvement within the policy process per se. As a *de minimis*, however, the process by which such policy outputs are anticipated to have an impact on local, national, regional or international policy should be described, both in terms of process (how is the information to be translated and delivered to decision-makers) and practice (how will the information be included practically in policy development and, if it will not be totally or partially utilised in policy decisions, how will this information be conveyed to all stakeholders). The utility of the proposed framework as a policy "tool" to facilitate the identification of appropriate methodologies may also be validated by assessment of policy impact. As a part of this, the intended "route of transmission" of outcomes to policy end-users needs to be described, together with any actionable and concrete policy recommendations which arise out of the exercise, independent of whether these are taken up into the policy process. This will allow for subsequent analysis of future impacts at a later date.

2.4.3. Quality control measure

The failure in reporting quality control measures may be a consequence of pragmatic limitations regarding the implementation of systematic (quality control) measures (e.g. time or cost). An alternative is that researchers and / or sponsors may experience anxiety regarding the reporting of poorly conducted and evaluated expert consultations, which may involve important policy outcomes or the use of public funding. Rowe and Frewer (2005) provide a similar discussion for the evaluation of public engagement.

The scarce provision of details regarding methodologies and evaluative frameworks applied to expert elicitation exercises suggest suggests a lack of appreciation for the importance of the methodologically rigorous execution of expert involvement exercises. The scientific community should aim to raise the stakes. This may be facilitated by editors of scientific journals demanding high standards of detail of methodology and assessment of quality control before a paper is accepted for publication.

Some reflections on the systematic review process are also warranted at this juncture. Although the current review identified only a few papers that would meet the proposed evaluative criteria, the authors acknowledge that the focus of this systematic review on reporting outcomes in terms of policy translation (and which were written for a specific policy end-user audience) may have inadvertently excluded methodologically rigorous papers that did not highlight policy recommendations. Furthermore, the review was limited to English language documents, and generalisation beyond Anglophone countries must be made with caution. A further potential criticism relates to how the combinations used in the search term may have introduced a bias towards certain types of expert involvement exercises. In particular, by using high level overarching terms, some of the best developed methods, may have been underrepresented in the current sample. Delphi studies, are for example, usually identifiable by the name of the method (Delphi), instead of by the used umbrella terms (expert involvement etc.) (e.g. Wentholt et al., 2010). The problems identified in the current review seem to be of less relevance to those studies, which means that in reality the quality and evaluation of these exercises may be somewhat better than reported here. However, the multitude of papers with little or no evaluation does highlight the need for the field to reconsider the quality and follow up of those procedures.

However, some omissions may result from application of systematic review methodologies in the social sciences, which have been less well developed, compared to other disciplinary areas. For example, the methodologies applied, and the structure of dependent variables, may be more diverse, and terminologies be less "precise" or harmonised across publications compared to, for example, reviews of clinical trials or epidemiological studies, (Ronteltap et al., 2011) or may have less structured abstract content or key terms which would highlight the relevance of a specific paper to a specific review (Papaioannou et al., 2010). These factors complicate the process of information retrieval (e.g. in relation to quality assessment) and may indicate that a code best practice may be needed to ensure rigor in developing and applying systematic review processes within the social sciences (Grayson & Gomersall, 2003). A criticism of the current review is that key articles may have been omitted because of these problems associated with identifying the relevant literature, and a recommendation is that best practice in this area needs to be developed and applied within the social sciences more generally.

2.5. Conclusions

Developing a more formalised approach to evaluating expert involvement exercises would contribute to establishing methodological rigour, as well as the development of standards or criteria against which individual exercises can be judged as acceptable in terms of delivering information of relevance to policy development. As a *de minimis,* salient methodological characteristics of a particular exercise need to be reported. These include the following:

- **Method selection.** How was the consultation operationalised, why was a specific methodology adopted, how did the methods selected relate to the overall objectives of the exercise.

- **Policy impact.** The intended "route of transmission" of outcomes to policy end-users needs to be described, together with any actionable and concrete policy recommendations which (may) arise out of the exercise.

- **Quality control.**

    - *Procedure.* Duration of the exercise, and if relevant, details on the information that was provided in advance of the exercise (e.g. disclosure of procedure, or purpose of exercise). Information about the proposed timescale in terms of policy adoption of the outcomes, and how this was communicated to participants, may also be useful given the long timescales involved in the process of some policy development and implementation procedures.

- *Participant characteristics.* Nature of expertise, method of recruitment, numbers of experts who were included and who declined to participate.

Greater transparency and rigor in process design, application, and reportage, can only enhance the likelihood of experts, stakeholders, and the general public exhibiting the necessary trust in the outcomes of expert involvement (and in the entities that sponsor and implement them). In the absence of a corpus of stringently evaluated studies, a number of recommendations for potential best practice in designing involvement for different research contexts have been suggested. We invite other researchers to consider, use and respond to these suggestions.

CHAPTER 3

The views of key stakeholders on an evolving food risk governance framework:

results from a Delphi study

Abstract

Evidence of a decline in public trust associated with food risk governance over recent years has called into question the appropriateness of the current dominant risk analysis framework. Within the EU-funded SAFE FOODS project a novel risk analysis framework has been developed that attempts to address potential shortcomings by increasing stakeholder (including consumer) input, improving transparency, and formally incorporating benefit and non-health aspects into the analysis. To assess the viability of this novel framework, the views of food risk experts from the EU and beyond were sought using a distributed online questionnaire process called Delphi. In this paper the main results of this survey are described, revealing varying levels of support for the key innovations of the novel framework. Implications of our results for the new and old frameworks, for the future of risk analysis, and for the policy community more widely, are discussed.

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3.1. Introduction

Food risk analysis is currently the responsibility and preserve of expert risk assessors and professional risk managers. However, recent years have seen a decline in public trust in risk governance, particularly in the food domain, related to a number of high-profile food crises (e.g. Houghton, et al., 2008). Recognition of this decline has led to moves by national and international responsible bodies (such as the European Food Safety Authority, EFSA) to attempt to increase public confidence in the risk analysis process by (for example), improving the transparency of risk analysis practices through increasing stakeholder (including consumer) input into the decision-making process. The institutionalisation of these practises has, largely been on an ad hoc basis. The impact of increased transparency and enhanced stakeholder engagement on consumer confidence has yet to be systematically evaluated (see Rowe, 2007). Additionally, there are a number of other factors not currently incorporated within the formal food risk analysis process (which focuses on risk to human health) that arguably should be taken into account. These include environmental, social, economic, and ethical impacts. By implication, the term "impact" incorporates assessment of both risk and benefit, as both are possible outcomes of many potentially hazardous events. However, the current risk analysis framework tends to focus on risks, excluding consideration of benefits[3].

The Framework VI EU-funded SAFE FOODS project (2004-2008) has aimed to develop an improved risk governance framework for foods that explicitly incorporates stakeholder consultation, public participation, and risk-benefit assessment. In addition, the framework formally considers the question of whether to include assessments related to non-human health aspects, such as environmental, socio-economic and ethical impacts. Emphasis is placed on enhanced transparency throughout the process.

In this paper we describe how, in the course of developing the food risk analysis framework, expert opinion was sought through a specific iterative, distributed method. Following elaboration on the issue of risk analysis and the potential problems associated with the dominant contemporary framework, a more integrated risk analysis framework is presented. The problems of acquiring expert opinion on such an

[3] Exceptions to this general approach can be identified. For example, the acceptability of sodium nitrate as a food preservative has been evaluated (Branen et al., 2002). Some risk assessors have concluded that the potential (but small) long-term risks of cancer from the formation of nitrosamines is outweighed by the antibacterial benefits of the use of the preservative. Similarly, the risks from some fungicides, such as the Ethylene bisdithiocarbamates, and their metabolite ethylenethiourea, have been discounted because of the presumed benefits of reduced food losses due to spoilage (Schneider & Dickert, 1993).

important issue are outlined. One particular approach for overcoming some of these difficulties, the Delphi technique, is described. The SAFE FOODS Delphi consultation process is then outlined, and selected results are presented. The views of interested actors and stakeholders regarding the advantages and disadvantages of the framework are provided, together with views on its further development, along with commentary on the usefulness and limitations of the Delphi research method.

3.1.1. Food Risk Analysis: Processes and Problems

The dominant framework of risk analysis applied in the agri-food sector (FAO/WHO, 1995) comprises of three components: food risk assessment, food risk management and food risk communication. Risk assessment focuses on the systematic and objective evaluation of all available information pertaining to foodborne hazards. Food risk management aims to optimise protection of public health by controlling risks effectively through the selection and implementation of appropriate measures. It is within the remit of risk managers to consider various legal, political, social and economic issues, such as risk acceptability and policies for risk mitigation activities, although these other issues are excluded from risk assessment (despite data being available that could potentially contribute to understanding the effects of a specific hazard on these factors). Risk communication is defined as the interactive exchange of information and opinions concerning risks and risk management activities between risk assessors, risk managers, consumers and other interested parties. Interaction occurs between all three components of the framework.

It is accepted that food control systems are highly unlikely to deliver a completely risk-free food supply (WHO, 2004). However, some observers have described the food chain in Western Europe as having been subject to a 'paradox of progress' (Fischer & Frewer, 2009). Increasingly strict standards, quality controls and monitoring procedures have been applied within the agri-food sector. This has been perceived to correspond with an increasing number of food safety incidents, which have contributed to a reduction in consumer confidence in food safety (e.g. Berg, 2004; de Jonge, et al., 2007; Eiser, et al., 2002; Frewer et al., 1996; Houghton, et al., 2008; Van Den Eede et al., 2004). Prominent examples include outbreaks of Escherichia coli in hamburgers (Tuttle et al., 1999), Salmonella in eggs and poultry (French et al., 2005; Guard-Petter, 2001), Listeria in pates and soft cheeses (Ramsaran et al., 1998), and accidental or deliberate contamination of the food chain or specific food products with toxic compounds, such as dioxin (Verbeke, 2001). The bovine spongiform encephalopathy (BSE) crisis can perhaps be singled out as the most important factor leading to revisions of food safety policy in recent years (Reilly, 1999; Smith et al., 1999). Concerns about emerging technologies applied to the agri-food sector (such as genetic modification of crops) have also resulted in problems with public confidence in food risk analysis (see, for example, Frewer, et al., 2004).

Various efforts have consequently been made to bolster societal confidence in food risk analysis. It has been argued that public trust in food safety will be facilitated by the functional (and in some instances structural) separation of components in risk analysis, particularly risk management and risk assessment (Houghton, et al., 2008). This approach has been adopted by various institutions with responsibility for food safety governance, including EFSA. The effect on consumer and stakeholder trust has, however, proven difficult to assess, other than in aggregate terms (for example, by comparing societal trust ratings in different food safety institutions).

Other approaches to increasing societal trust in risk analysis practices have stressed the need to develop effective risk communication strategies with consumers that explicitly address their information needs (Houghton, et al., 2006; Millstone & van Zwanenberg, 2000; Van Kleef, et al., 2007), or propose greater stakeholder involvement (including of consumers) in the overall process or specific stages of food risk analysis (De Marchi & Ravetz, 1999; Dreyer, et al., 2006). Greater inclusivity may reflect institutional changes developed to increase the transparency and openness of regulatory practices (Byrne, 2002; Dreyer, et al., 2006). The institutionalisation of these various strategies have been rather ad hoc, and their success (e.g. in terms of increasing public trust) has only been evaluated informally, if at all (e.g. Rowe, 2007). How best to operationalise these strategies in the case of food safety requires further analysis.

There are other potential limitations to the dominant risk analysis approach currently applied. Quality of Life parameters in risk assessment, and other legitimate factors, including societal and economic factors, tend not to be considered explicitly (Cope, et al., 2010) and have not been translated into current practice in food safety regulation. There is a more general trend in policy making within the European Commission and beyond concerning the systematic assessment of economic, social, environmental, health and ethical factors associated with monitoring provisions (Dreyer, et al., 2010). For example, in the area of health impact assessment, consumption of specific foods may have both a positive and a negative health effect. A case in point is provided by fish and seafood. Biomagnification of persistent toxicants in freshwater and marine food chains provides an important pathway for human exposure. At the same time, fish may also constitute an important source of omega three fatty acids, which provide health benefits (e.g. Gochfeld & Burger, 2005; Levenson & Axelrad, 2006). Thus, assessment of health risks and health benefits are both relevant to the governance process. Similarly, quality of life assessment can also be quantified from a risk-benefit perspective, taking into account impact on different population segments (de Blok et al., 2007). Analysis of cost-benefit issues can be made in the context of environmental, health, and safety regulation (see for example, Arrow et al., 1996). Arguments can be provided to support analysis of both ethical costs and benefits associated with particular courses of (lack of) action (Wilson, 2002).

Given the uncertainties associated with when and how to involve stakeholders, and effectively communicate with the public, the lack of institutionalised and evaluated processes for promoting transparency, and the potential for assessment to also include systematic identification of the benefits (as well as risks) associated with potential food hazards, an improved food risk analysis framework is desirable. The development of a risk analysis framework that addresses these limitations has been an objective of one particular EU-funded project, entitled SAFE FOODS.

3.1.2. The SAFE FOODS framework

One aim of the SAFE FOODS project was to develop a risk governance framework that explicitly incorporates stakeholder consultation and public participation at appropriate stages in the process. The framework formally addresses the question of whether to include risk-benefit assessments, including those relating to environmental and socio-economic impacts, as well as ethical issues, and process transparency is emphasised throughout. The intermediate SAFE FOODS framework is summarised in Figure 3.1.

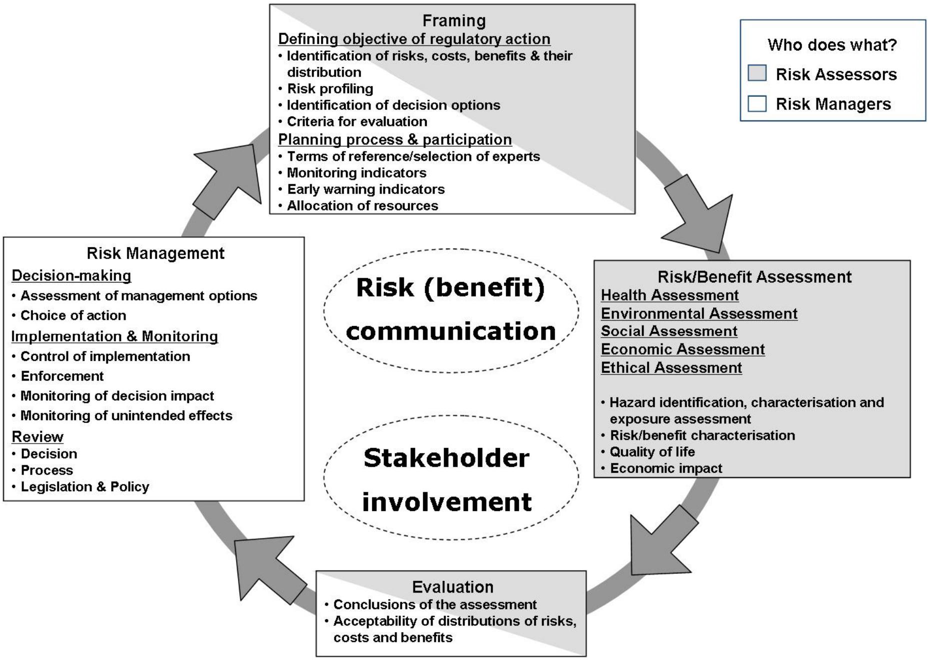

Figure 3.1. The SAFE FOODS framework as used in the Delphi surveys.

The integrated framework describes an iterative decision process with four stages: framing, risk-benefit assessment, evaluation, and risk management (König, et al., 2010). At the framing stage, interested parties, experts and officials with interests in risk evaluation and management work together to gain an initial shared understanding of the issue, objectives, and broad courses of regulatory action. Areas of general agreement and dissent are documented in order to provide the basis for planning future decisions. The assessment and terms of reference, and proposed criteria for ranking regulatory options, monitoring indicators are included. The risk-benefit assessment pertains not only to single pre-identified risks, but to health impacts in general (including health benefits), as well as environmental, economic, social and ethical impacts, and their distribution. The evaluation stage is an intermediate stage between risk assessment and management, in which interested parties, experts and officials in risk assessment and management use the assessment outcome to compare the risks, costs, and benefits and their distribution, resulting in a report with recommendations on what consequences are deemed acceptable and what risk management measures may be required, from multiple perspectives. Risk management includes decision-making, implementation, monitoring and review, and involves the definition, ranking of alternative measures, and final selection of regulatory options, taking due account of assessment and evaluation activities. Monitoring indicators are defined based on proposals at the framing stage. Review pertains not only to the impacts of the decision itself, but also to the process by which the decision is made, and the legislation under which the issue is regulated.

The three main differences to current frameworks can be described as: (1) expansion of the scope of the formal risk assessment to include distributions of benefits and costs, (2) more formal (and institutionalised) stakeholder participation, and (3) improved risk communication and publicly accessible reports at each stage of the process. The draft framework has been put out for consultation with key actors and practitioners. Integrating practitioners in the development of the framework facilitates practicability and enhances the chances of adoption.

The remainder of this article deals with the problems of stakeholder consultation, and the description of one innovative method for understanding stakeholder views. Finally, what key participants think about the SAFE FOODS framework is discussed.

3.1.3. The problem of gaining expert opinion, and the Delphi technique as a solution

The SAFE FOODS framework is intended to have widespread applicability across many countries, with implications for many types of scientists, policy makers and other stakeholders. This raises the question of how it is possible to feasibly and validly consult with these diverse and significant constituencies in order to assess their opinions (given that their good opinions are crucial for the acceptance of the framework). One way to do this is to physically bring key stakeholders together to debate the framework – and this has, indeed, been done in the context of SAFE FOODS (see Walls, et al., 2011). However, this process has major practical constraints: it is both expensive and difficult to gather in one place at one time a significant number of relevant stakeholders.

Another way to consult multiple stakeholders is through a survey. For example, key stakeholders might be sent a description of the framework and asked their views on it. However, this approach does not allow for interaction and debate. Survey methodology is likely to reveal disparate opinions, but cannot offer the prospect of resolution of differing opinions.

A third technique, the Delphi method, involves a degree of interactivity and dialogue, as found in group meetings, allied to the practicability of a survey, with its benefits in terms of cost and potential access to wider expertise than might otherwise be attainable (Linstone & Turoff, 1975). The methodology essentially involves the repeated polling of diverse and distributed experts, the opinions from whom are used as feedback on subsequent 'rounds'. The Delphi method has been widely used to establish consensus regarding many different issues, often among experts (see, for example, Avery, 2005; Childs, 1998; Padel & Midmore, 2005), as well as to aid forecasting (Halal et al., 1998). The technique has been successfully applied within the domain of food safety (Green, et al., 1993; Henson, 1997; Medeiros, 2001; Menrad, 1999).

In the study presented here, 'panellists' (the experts/ participants) were first sent a questionnaire about the SAFE FOODS framework, and then were presented with a second survey with similar questions, which they were asked to complete, reconsidering their views in the light of the opinions expressed by the other panellists on the first round.

There are a number of notable features about Delphi that need to be emphasized. First, the feedback provided is kept anonymous so that panellists do not know who said what, and are assured that their own opinions remain unattributed. This is a deliberate tactic to pre-empt the kind of social and political pressures that often emerge within groups, where decision quality can suffer as a consequence of, for example, people agreeing with authority figures so as to avoid sanction or gain some political advantage, or agreeing with majorities in order to appear part of a group rather than as a troublesome dissenter. Such processes are well documented and can lead to 'process loss' (inferior judgment and decision making compared to certain benchmarks, e.g. Steiner, 1972), and in extreme cases, to outcomes such as 'groupthink', which is the tendency for group members to try to minimize conflict and reach consensus without critically testing, analyzing, and evaluating ideas (e.g. Janis, 1972).

Second, the process aims to achieve a certain degree of consensus or at least general agreement, by collating panellists' opinions, with the average on the final round taken as the group's opinion. The final opinion is achieved by the equal weighting of all panellists' views. Again, in interacting groups, it may be that verbose or dogmatic individuals have differential input into the final decision– a bias that is not necessarily apt or beneficial. It is also important to note that consensus is not forced: the correct way to report the result of a Delphi process is to note the distribution of responses to indicate significant disagreements with the average view.

Third, there is considerable variation in how the Delphi method is implemented (Rowe & Wright, 2001). For example, there may or may not be an unstructured first round, in which the panellists are asked open questions about the nature of the topic of concern and the appropriateness of the proposed questions. The number of 'rounds' can also vary, though rarely goes beyond two or three. Delphi is also most often used to attain a quantitative representation of opinions – as in a numerical forecast or a prioritised list of options – though it can also be used for less-structured problems, where more emphasis is placed on qualitative arguments gained from iterated open questions. The nature of feedback often varies, usually comprising only the mean or median of panellists' responses to the prior round, but may also involve justifications from panellists for their judgments (Rowe & Wright, 2001).

Fourth, much is unknown about how Delphi 'works', i.e. the best way to apply it, with methodological variability largely stemming from practitioner uncertainty as opposed to being informed by empirical evidence of best practice – see Rowe and Wright (2001) for discussion. For example, regarding feedback, most published Delphi studies provide numerical averages of some sort, although feedback of rationales can lead to more opinion change than the use of statistics alone (e.g. Rowe & Wright, 1996). However, research into the application of Delphi has indicated most opinion change occurs following the first or second round, and that increased agreement (as measured by reduced variance of judgments) is a common feature of the process. There is evidence that the method does lead to improved judgmental quality when compared to interacting groups faced with the same task, and also when compared to the first round average of panellists' judgments (i.e. which would be achieved by averaging judgments from responses to a survey) (Rowe & Wright, 1999). This suggests that Delphi not only provides a practical solution to the problem of gaining the opinions from distributed experts, but may lead to 'better' decisions or judgments. For these reasons, it was decided to run a Delphi process to assess participant views of the SAFE FOODS framework.

3.2. Methods

A two-round Delphi was conducted on an initial draft of the SAFE FOODS framework with all members of the project consortium. This allowed project members to have input into the design of the framework, and provided a pilot study of the Delphi process and questions. The framework was refined following the pilot study (see

Figure 3.1). The Delphi questionnaire was revised following the pilot in terms of number of questions, wording, and emphasis.

The Delphi method was actually applied to two sets of participants: the first comprised relevant participants from within the EU; the second from outside the EU (here termed "International non-EU" participants). The participants were initially identified by a panel of SAFE FOODS project members on the basis of their personal knowledge of, and contacts with, key figures in the food safety domain. In the initial invitation letter, potential participants were informed that they would not be identified by name in any subsequent publications. Therefore, Appendix B contains a list of institutions to increase transparency of the study.

Two lists were developed, identifying an equal distribution of potential participants from four key constituencies: food risk managers, risk assessors, risk communicators (drawn from governmental institutes, academia and industry) and members of Non-Governmental Organisations (NGOs). Potential panellists received an E-mail invitation to take part in the Delphi, informing them of the purpose of the study and what it would involve.

The first round Delphi questionnaires were very similar for both sets of stakeholders (EU and International non-EU), with only a few differences in phrasing of the introduction text. The second round questionnaires, which were informed by the responses to the first rounds, diverged across the two stakeholder groups as different key issues emerged.

Whilst Delphi is often used to obtain quantitative responses to specific closed questions, the method has also been used to help elaborate policy through iterated open questions. The first round Delphi questionnaires thus comprised a combination of open and closed questions. Where closed questions were used – asking panellists specifically whether they agreed or not with some component of the SAFE FOODS process – panellists were also asked to explain their opinions. The second round questionnaire asked further questions on new issues that emerged from responses to previous open questions, plus iterated closed questions, and provided feedback on the opinions of panellists on the first round along with summaries of the written arguments given by panellists to justify their responses. Copies of each of the full versions of the questionnaires are available from the authors.

There were, in total, 36 questions in the first round. Four were related to the general framework, including questions about its comprehensiveness and structure; 16

questions asked about each of the four stages (four were about the framing stage, three about the risk assessment stage, two about the evaluation stage, and seven about the risk management stage); 16 questions dealt with a number of general features of the risk analysis concept, such as transparency and optimal stakeholder involvement. After approximately two weeks, panellists were sent E-mail reminders to complete the questionnaire if they had not already done so, repeated after another week. At approximately six weeks after the start of the process (for the EU participants - but 10 weeks for International non-EU Delphi), participants were sent the second questionnaire, along with feedback from the first round (the numbers of participants are provided in Table 3.1). After the analysis of the first round, the qualitative questions were divided into those where general agreement of opinion arose or not. General agreement was defined as occurring when more than 75% of the participants agreed with a particular issue. A question would be again asked in the second round if no general agreement arose. Responses to open questions were analysed using Atlas.ti, a software package that facilitates textual content analysis. Based on the analysis, new quantitative questions were developed for the second round.

The second questionnaire was shorter than the first, in terms of number of questions, but included considerable feedback text in the form of lists of panellists' justifications for their opinions and/or summaries of how panellists had responded (i.e. percentages of participants selecting each option). A number of new questions, based on responses to open questions, were asked to help the researchers understand panellist views. The questionnaire had fewer questions because those questions that had achieved very high first round agreement were not reiterated. In the Results section answers to a select number of the most interesting and relevant questions are discussed.

The methodology used in the International non-EU participant Delphi study was similar in process and design to that used in the EU-Delphi study. The first round questions were identical in both EU and International non-EU Delphi studies, but due to lower general agreement between the non-EU panellists the number of questions in the second round was slightly higher for this group. Furthermore, the second round questions for the latter focused more on a global, rather than EU, perspective. The Results section focuses on the levels of agreement and disagreement both within and between panellists in each of the EU and International non-EU participant groups.

3.3. Results

The most important results of the Delphi survey will be reported, in particular those directly relevant for the functioning of the SAFE FOODS framework, and those indicating disagreement between the EU and International non-EU participants.

3.3.1. Sample characteristics

Table 3.1 shows the number of potential participants identified for each Delphi panel within each constituency, as well as the number of actual participants who took part in the first and second rounds. As can be seen, approximately one-third of those invited took part in each of the two Delphi studies (i.e. the EU and International non-EU), and of these, approximately two-thirds responded to the second round questionnaires. These rates of attrition between rounds are typical of Delphi.

Table 3.1. Participants in the European and International non-EU Delphi studies.

	Invited	Round 1	Round 2
EU participants	106	33 (31%)	21 (64%)
International non-EU participants	60	19 (32%)	12 (63%)

Participant characteristics are detailed in Table 3.2. There were more male participants than female (possibly reflecting a bias in the expert population). The majority of participants had more than 10 years’ appropriate work experience, and their areas of expertise varied widely (see Table 3.2, and note that participants could select more than one area of expertise). As well, institutional affiliations of participants are provided in Table 3.2.

Table 3.2. Characteristics of the expert panellists per Delphi survey round (#).

		EU		International non-EU	
		# 1	# 2	# 1	# 2
Gender[a]	Male	21	16	13	9
	Female	12	5	4	3
Work experience[a]	Less than 5 years	1	0	1	1
	5-10 years	8	4	1	1
	10-20 years	9	9	3	1
	More than 20 years	11	8	11	8
Area of expertise[b]	Policy making	10	7	3	3
	Food	19	13	9	9
	Health	11	8	5	5
	Risk assessment	9	6	8	8
	Risk management	5	2	5	5
	Risk communication	7	4	3	3
	Agriculture	12	9	6	6
	Environment	4	1	1	1
	Other [c]	8	6	1	1
Institutional affiliation	Academics/scientists	13	10	5	3
	Industry	4	2	1	1
	International governmental body	4	2	8	4
	National governmental body				
	Non-governmental body	4	3	4	3
		5	4	1	1

[a] not all participants filled in this question.
[b] participants were permitted to respond to multiple categories to reflect their work activities
[c] e.g. economics; food safety; ethics; statistics/ epidemiology; cell biology; biotechnology

3.3.2. The structure of the SAFE FOODS framework

General agreement emerged regarding the need for change in the current processes of food risk analysis (EU: 78% agreement, 22% disagreement; International non-EU: 94% agreement, 6% disagreement). Analysis of the qualitative responses to this question of both participant groups revealed views that factors other than health should be taken into account in risk assessment. Specifically assessment of benefits is important, and that better ‘framing’ of issues is needed. International non-EU participants were of the opinion that existing processes for crisis management are inadequate, and indicated that the communicative interface between risk assessors and risk managers needs to be improved. Following on from this, there was reasonable agreement regarding the proposed order of the four stages in the framework (EU: 84% agreement, 6% disagreement; International non-EU: 74% agreement, 11% disagreement). Further analysis of the qualitative responses indicated that the role of risk communication within the framework needs to be clarified.

Less agreement was found regarding the division of the stages. Participants agreed that there should be a clear distinction between the tasks conducted by risk assessors and risk managers, though not all agreed that there should be separate framing and evaluation stages:

> “Although I agree that there should not be such a strict borderline between risk assessment and risk management, the three stages Framing, Risk/Benefit Assessment and Evaluation might […] fall under the umbrella of risk assessment.” [EU participant, round 1]

> “Evaluation does not seem like a separate step – it is merely the conclusion of the risk-benefit assessment.” [International non-EU participant, round 1]

However, some participants agreed that it is useful to have interface stages for risk assessors and risk managers to discuss the implications of risk assessments for their activities.

> “Stages where both risk assessors and managers are interactive are important and cannot be separated as shared planning is necessary and ‘carry-through’ of risk assessment to management is important.” [International non-EU participant, round 1]

3.3.3. Communication with the public

Both European and International non-EU participants agreed that uncertainties associated with risk assessment should be communicated to the public using simple and understandable language (EU: 90% agreement, 3% disagreement; International non-EU: 94% agreement, 0% disagreement). Furthermore, there was consensus that this should be done in an open, honest, and transparent way.

Disagreement arose regarding what information should be communicated, and at which stages of the risk analysis process. Although European and International non-EU participants agreed in the first round of their respective Delphi surveys that communication is a priority at the risk management stage (EU: 88% agreement, 12% disagreement; International non-EU: 90% agreement, 0% disagreement), there was considerable disagreement as to what information should be communicated at other stages. For example:

> "If we try to communicate all issues, we will dilute the messages and lose interest from the public - we need to have some sort of filter to decide what should be actively communicated and what should just be presented passively […]." [International non-EU participant, round 1]

> "There does not seem to be any clear reason why information should not be available at each stage." [EU participant, round 1]

> "The communication will make sense only when enough data are available, therefore there is no need to do so in the first three stages." [International non-EU participant, round 1]

Some concerns were expressed that providing information about risk at too early a stage in the process would result in unnecessary alarm, or establish irreversible misconceptions:

> "It might be too early to communicate on premature findings and incomplete risk assessments." [EU participant, round 1]

> "Care should be taken not to alarm the public unnecessarily." [EU participant, round 2]

However, some participants indicated that uncertainty associated with some issues should not be communicated with the public.

> "Communicating uncertainty in full and in a much too open way […] could have a negative impact [on] […] scientific new developments. It is important to pass the message that science is not black and white, evolves continuously and goes along with uncertainties." [EU participant, round 1]

> "It is worse to be caught being less than complete, not open or honest or not transparent, than be understood wrongly. The first costs you your trustworthiness, the second only your efficiency." [EU participant, round 1]

> "[The] public does not understand the scientific process, and definitely not uncertainty." [International non-EU participant, round 1]

3.3.4. What type of data should be collected in the assessment stage?

European participants were enthusiastic about collecting risk assessment data relating to environmental, social, economic and ethical impacts of potential food hazards, though there was less approval from International non-EU participants. Table 3.3 reveals that almost all participants agreed with the need to collect health impact data, as per current practice, while the majority of both EU and International non-EU participants thought that other types of data should also be collected. Interestingly, feedback of arguments on this issue in the second round led to a reduction in support for collection of the other types of data (except for environmental impact data with EU participants). By the second round, International non-EU participants who thought that social and economic data should be collected were reduced to a slight minority, while participants were evenly split concerning the collection of ethical impact data.

Participants from each group noted that, even if it is desirable to collect data in addition to health, there is a need to develop methodological innovations in order to so do.

> "Methods for analysing the first four types of impacts are fairly well-developed, although less so in the case of social impacts. However, this is not true for the last (ethical [impact]), so some specificity is required here." [International non-EU participant, round 1]

International non-EU participants indicated that, for some of the impact assessments, the issues are more relevant to the risk management stage:

> "Full social and ethical issues will not become apparent until after the implementation of any new technology, process or product. They should be dealt with afterwards as a part of risk management […]." [International non-EU participant, round 1]

> "I agree the social, economic and ethical aspect should be considered but only on a later stage. Otherwise the risk assessment might be compromised." [International non-EU participant, round 1]

It was unclear at the outset of the study as to whether participants would think it sensible to include consideration of benefits at the assessment stage. For this reason, round 1 of the survey simply asked: "Do you think that data on benefits should also be

Table 3.3. Percentage of participants agreeing to the collection of different types of risk and benefit assessment data.

Type of impact	Participant stakeholder group	Round 1[a]	Round 2	
		Risk data	Risk data	Benefit data
Health impact[b]	EU	93	100	95
	Non-Eu	100	100	58
Environmental impact	EU	90	95	81
	Non-Eu	63	58	50
Social impact	EU	73	60	55
	Non-Eu	53	42	33
Economic impact	EU	80	71	67
	Non-Eu	63	42	50
Ethical impact	EU	76	68	61
	Non-Eu	58	50	42

[a] Data on benefit assessment was only collected in the second round, based on responses of participants in the first round.
[b] Please note: the exact phrasing of the item regarding risks was: "health impact ('traditional' risk assessment)" and for benefits it was: "health impact".

collected at this stage?" Among EU participants, 84% agreed, 13% neither agreed nor disagreed, and 3% disagreed, while among the International non-EU participants, 79% agreed, 5% neither agreed nor disagreed, and 16% disagreed. The results indicated agreement with the use of such data, and so questions in round 2 (in both surveys) focused on participants' opinions regarding the use of the different types of benefits. These results suggested that there was less agreement between EU and International non-EU participants regarding whether or not data on benefits should be collected (Table 3.3). The majority of EU participants were in favour of collecting benefit data at the assessment stage (and were almost unanimous regarding the collection of health benefit data). International non-EU participants were far more equivocal. A small majority agreed with the collection of health benefit data, and participants were evenly split on whether environmental and economic data should be collected. A slight majority disagreed that social and ethical data should be collected. Among the negative arguments presented by International non-EU participants were:

> "Benefits are hard to quantify even for health aspects so it is not clear how this would be used." [International non-EU participant, round 1]

> "One should not separate risk and benefit. Those who urge doing so are perhaps suspicious of industry propaganda, and there are good reasons in the past for such suspicions. The most important thing is that the trade-offs between risk and benefit must be analysed very, very carefully. Also the distribution: those at risk, and those who benefit, can be very different." [International non-EU participant, round 2]

However, even supporters of the general concept (amongst both EU and International non-EU participants) expressed some uncertainty as to what benefit data should be acquired, when, and how:

> "In some cases it may not be necessary, or it may be too difficult or legally not possible." [International non-EU participant, round 1]

> "Benefits […] [associated with] health and environment should be considered prior to benefits towards the other aspects [i.e. Social, economic and ethical]." [EU participant, round 1]

> "It's clear from, for example, the GM debate that European consumers must benefit from a risk in order to accept it. Investigating and communicating benefits will help both policy development and public decision making." [EU participant, round 1]

> "It may be difficult to collect benefit data across all areas from an early stage and in many cases it may not be necessary; it would be more efficient (resource wise for instance) to first evaluate benefit in the 1 or 2 most obvious areas and then widen…" [EU participant, round 1]

3.3.5. What type of data should be collected in the evaluation stage?

It was also interesting to assess participants' opinions on the use of non-health types of data in the evaluation stage of the framework. In the first round, participants were asked (in both surveys) to rank the relative importance of the different types of data (with '1' being most important). The Friedman rank test indicated that there was a significant difference between the rankings of International non-EU participants ($\chi2$ (4, N = 18) = 40.6, $p < 0.001$), but not between the rankings of the European participants ($\chi2$ (4, N = 28) = 3.7, $p < 0.4$). Post hoc comparisons (Wilcoxon signed rank test for two related samples) between the International non-EU participants' data reveals a significant difference between the health impact and all other impact factors ($p = < 0.001$), indicating that health was ranked more important. The ranking of ethical impact versus social impact and economic impact were also significantly different (respectively, $p = <0.01$; $p = <0.05$), indicating that ethical impact was rated significantly lower than these factors. An overview of mean rankings of the impact factors can be found in Table 3.4.

Table 3.4. Mean ranking of priorities for different types of impact data (Delphi round 1, on a scale where rank 1 is most important).

	EU Mean Rank	Non-EU Mean Rank
Health impact	2.63	1.12 [a]
Environmental impact	2.82	3.24 [b]
Social impact	3.18	3.32 [c]
Economic impact	3.02	3.24 [b]
Ethical impact	3.36	4.09 [d]

Note: Means with the same subscript are not significantly different. Differences are significant at $p < 0.05$

> "From the consumer protection perspective health impacts are most important. But also social aspects (e.g. non-acceptance [of emerging technologies]) are from our perspective more important than environmental aspects." [EU participant, round 1]

> "All the factors should be weighed equally importantly in the evaluation... For example, any risk to health is always considered in relation to the financial and economic cost. This is of course different to specifying that a certain [protection from] risk has to be achieved no matter what the cost or other impacts. But this does not happen in reality." [EU participant, round 1]

Another issue that emerged for some is that consideration of factors in addition to health should be on a case-by-case basis.

> "Health must be no. 1 - the food must be safe, i.e., meets the community's acceptable level of risk. The ranking of the other factors will depend on the nature of the issue - in most cases, not all will be relevant…" [International non-EU participant, round 1]

3.3.6. Which stakeholders should be involved and at what stage of the risk analysis process?

Analysis of qualitative responses indicated that participants generally agreed that the most important aspect concerning stakeholder involvement within risk analysis is that involvement be "case-by-case". Specifically, the types of expertise needed and the extent and nature of stakeholder involvement will be dependent on the potential hazard under consideration:

> "Stakeholder involvement will depend on the issue and whether they have relevant data and expertise." [International non-EU participant, round 1]

In the first rounds of both the EU and the International non-EU Delphi, participants were asked which stakeholders should be involved in which stages. The results are summarised in Tables 3.5a and 3.5b. European participants were in favour of involvement of all stakeholders, including the general public, at the framing stage. A similar pattern was observed for the International non-EU stakeholders, with the exception regarding the involvement of the general public or other NGOs. Both European and International non-EU stakeholders agreed that assessment should be the responsibility of regulatory institutions and scientific experts, and that the general public, farmers and other NGOs should be excluded from risk assessment.

> "The assessment and decision making is properly the responsibility of public agencies. But they can only do their job if they are well-informed, which includes listening carefully to stakeholders." [International non-EU participant, round 2]

Table 3.5a. Which stakeholders should be involved in the risk analysis process at which stage? (EU participants, round 1).

	Agreement with stakeholder input (%)			
	Framing	Risk/benefit assessment	Evaluation	Risk management
Regulatory institutions	75	61	75	82
Scientific institutions	68	82	64	53
Consumer associations	89	46	68	50
Environmental organisations	79	54	71	57
Industry	78	57	64	50
Farmers (organisation)	68	36	50	43
Retailers, trade organisation	75	43	64	43
Other NGO	64	29	43	32
General public	71	25	46	39

The International non-EU participants suggested that other stakeholders could participate at a less "expert" level (for example, by collecting and delivering data to the expert communities with responsibility for assessment). European participants were undecided about the inclusion of the general public, farmers and "other NGOs" at the evaluation phase. In contrast, the International non-EU stakeholders emphasised the role of expertise in evaluation (regulatory bodies and scientists). Regarding risk management, European stakeholders favoured inclusion of regulatory institutions and exclusion of the general public and "other NGOs", whereas the International non-EU participants favoured a much broader range of stakeholder input into the risk management stage, and were only undecided about the inclusion of environmental NGOs in risk management.

Table 3.5b. Which stakeholders should be involved in the risk analysis process at which stage? (International non-EU participants, round 1).

	Agreement with stakeholder input (%)			
	Framing	Risk/benefit assessment	Evaluation	Risk management
Regulatory institutions	100	75	88	94
Scientific institutions	81	94	75	69
Consumer associations	75	31	50	81
Environmental organisations	63	25	44	56
Industry	75	44	50	75
Farmers (organisation)	75	25	50	75
Retailers, trade organisation	63	25	44	81
Other NGO	56	12	37	69
General public	56	12	31	75

"There should be a responsible group for risk management, and no diffusion of responsibility. In all other stages, a broad consultation process seems to be helpful." [EU participant, round 1]

"If EFSA or some other part of the EC/EU or national government is equipped to do the entire risk analysis process, that group should do the major parts of the work. Other groups have some role to play in the "framing" stage, or in reporting risk information in the risk management stage." [International non-EU participant, round 2]

3.3.7. Challenges for implementation of the SAFE FOODS framework

As one participant put it:

"All new processes are a challenge…" [EU participant, round 1]

In an open question in the first round, participants were asked to state what they saw as the main challenges to the implementation of the SAFE FOODS framework. One concern voiced was that the framework would be time consuming and labour intensive to apply (with commensurate cost issues). It would thus be important to demonstrate that the framework could operate within an acceptable time frame before regulatory uptake could occur.

> "Due to the involvement of more stakeholders/groups and more risk/benefit assessments the timing gets extended and planning is even more important." [EU participant, round 1]

> "This type of framework moves towards a much more participatory process. Many individuals involved in regulation have little experience with working in such a manner. Another main challenge will be striking a balance between having a framework and process that improves legitimacy, but that is still flexible and affordable." [EU participant, round 1]

Doubts were also raised as to whether the new framework could be operationalised to respond quickly and sufficiently if a food safety "crisis" were to occur. This is especially important given that a number of participants suggested that the framework is inappropriate for routine food risk analysis and established food hazards. Consequently there is a need to stipulate criteria for determining under what circumstances the new framework should be applied (identifying 'triggers'), and potential "candidate" hazards ought to be identified on a case-by-case basis.

> "I do not see a "fast track" procedure for crises situations where actions have to be quick e.g. a screening group that remains on the alert at all times. Transparency is very important but could be time consuming." [International non-EU participant, round 1]

The European group was particularly concerned with problems relating to hazard identification, especially under conditions where the hazard is poorly characterised. It was recognised that, within the EU, a risk-benefit communication strategy would have to be developed that was appropriate to the needs of different EU member states and the "cultural diversity" encompassed with the EU structure.

Some participants suggested that the SAFE FOODS framework is not novel, and that similar approaches are being developed elsewhere:

> "I do not think the SAFE FOODS risk analysis framework is that much different from frameworks promoted by Codex and other groups. The

> bigger challenge is where such risk analysis frameworks and (most importantly) some form of infrastructure that they need to be built on to make them effective is non-existent.” [EU participant, round 1]

However, others (especially International non-EU participants) suggested that the framework is significantly different, but that in consequence this could cause problems on account of difficulties in harmonisation with existing International non-EU frameworks.

> “It does not correspond to the Codex Risk analysis framework - will be difficult for the 165 non-EU countries in the world to understand why EU needs a special framework different from everybody else's.” [International non-EU participant, round 1]

In line with this, one participant suggested that the need to increase food safety resource allocations to operationalise the framework might also have an impact on European trading partners and developing countries if additional barriers to trade were identified.

3.4. Discussion

In this paper an improved risk analysis framework for use in the food domain has been described, along with the results of a major stakeholder consultation exercise about its perceived merits and deficits. The Delphi method used to enact this consultation was found to be an extremely useful mechanism in enabling the surveying of multiple experts from around the world who would not otherwise have been able to meet on a face-to-face basis. However, the complexity of the SAFE FOODS framework, and the number of questions that potentially could have been asked, suggest that there may have been value in having a third round of the survey to clarify views further (particularly as the first round contained many qualitative questions seeking to establish what the real issues really were). However, it was felt that this would have yielded diminishing returns, particularly in terms of expert participation. Two rounds seem ideal, though in future the method might benefit from an initial face-to-face qualitative stage (such as using a workshop with only a few experts) to clarify the major issues, which might then be focused on subsequently in a couple of largely quantitative Delphi rounds. The authors aim to look into developing such a novel method in future.

What was notable was that most of the novel concepts in the SAFE FOODS framework were acceptable to many of the experts, though EU experts seemed somewhat more positive, in general, than International non-EU experts. Thus, there was a certain support for the idea of including other aspects of risk than health in the assessment and analysis process, as well as including benefit information. There was general support for increasing the role of other stakeholders in the overall risk analysis process at specific points in the risk analysis process. One issue that arose was that the use of the different new elements proposed should be considered on a case-by-case basis. This, adds another level of complexity to the process, and perhaps needs to be explicitly considered within the framework – whether early on, or at particular stages.

This study has shown that the majority of the participants consulted in this study believe that implementing the proposed risk analysis framework amendments may result in better food risk governance and increased public trust in risk governance practices. At the same time, participants acknowledged that new tools and methods are needed to accommodate these improvements. Encouraging in this regard is the observation that governmental institutions have already started implementing various new elements as described in the SAFE FOODS framework. It is inevitable that implementation of improvements will take time and may differ in details between institutions. The outcome of the SAFE FOODS project may be helpful to identify those elements in risk analysis that will potentially benefit from international harmonisation.

3.5. Conclusions

There was considerable support for many of the new principles encompassed by the SAFE FOODS framework, but some uncertainty was expressed regarding how, in practice, these might be enacted. For example, there was some discussion regarding how stakeholders should be involved, the appropriate methodological approaches required to measure risks and benefits associated with the different impact factors (including health), and how these different factors should be weighted in the risk analysis process. The results from this survey raise further questions regarding the operationalisation of the framework, though they do suggest that it is worth persevering with. It would be naïve to expect that a 'better' framework will necessarily supplant one already institutionalised unless there is considerable stakeholder and end-user acceptance of the new approach. A final conclusion relates to the difference between stakeholder acceptance and institutional implementation and harmonisation in institutional application. It is also clear that guidance is needed regarding when to do what (for example, in the framing phase stakeholders will profile the problem hence determine what activities are needed to solve the specific problem at hand). The issue of implementation lies therefore less with regulatory acceptance, but rather with operationalising specific institutional activities.

CHAPTER 4

Effective identification and management of emerging food risks:

results of an international Delphi survey

Abstract

Early identification of emerging food risks will protect human and animal health, the environment and economy. A two-round Delphi survey identified international experts' views regarding knowledge gaps associated with the identification and mitigation of emerging food risks, and barriers to emerging risk identification and prevention. The results suggest that keeping emerging food risk on research agendas, data sharing, and international harmonisation regarding application of predictive methodologies were priorities. Capacity and capability building were required in less affluent countries. A framework for dealing with exceptions to global rules is required if deviations from international standards are to be applied locally.

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4.1. Introduction

Emerging (and indeed established) food-borne risks potentially represent a serious threat in both developing and developed countries (FAO/WHO, 2006). There is a need for early identification of such risks in order to prevent their negative consequences for human and animal health and the environment (Marvin, Kleter, Frewer, et al., 2009). Effective and timely risk identification may also contribute to the development and maintenance of consumer trust in regulatory systems and food risk analysis, as evidence suggests that consumer trust is contingent upon societal perceptions that proactive risk prevention and mitigation strategies are being applied by the responsible authorities (Smith, et al., 1999; Van Kleef, et al., 2007). Emerging food risk identification, prevention and mitigation may require harmonisation of existing knowledge and methodologies to ensure transparent and proactive assessment in the global food chain, which should arguably be an international priority, necessitating international collaboration between relevant experts (Marvin, et al., 2009). The aim of the research reported here is to identify international experts' views regarding knowledge gaps in this area, as well as potential barriers to risk identification and management.

The issue of emerging food risks is becoming more complex due to increasing globalisation of the food supply (e.g. Le Heron, 2003). That is, faster and more extensive transport networks have contributed to an increasingly globalised and complex system of food distribution. The global market has expanded to accommodate (and potentially drive) increasing consumer demand for the availability of fresh foods out of season, necessitating sourcing from a range of international locations (Jones, 2002). Consequently, expanding food chains - extending across many regions - have increased the potential for emerging food risks to negatively impact human health and the environment (Figuié & Fournier, 2008; Lindberg et al., 2005; Renner et al., 2008).

Emerging food risk can be defined as unanticipated risks that occur accidently or naturally, as well as those arising from deliberate fraud or acts of malevolence (Astier, 2009; Barnaby, 1999; Kleter, et al., 2009). A specific emerging food risk may originate in, or affect, different countries or regions to varying extents, depending upon their level of development, internal regulatory system, infra-structure and capacity relating to identification and mitigation strategies, and so forth. The impact of such risks extends beyond human and animal health and the environment, being likely to negatively affect the international economy too. Direct economic costs include those attributable to health care and time lost from employment, plus costs incurred by industry as a consequence of food recalls (El-Gazzar & Marth, 1992). Indirect costs may also be high, such as the loss of consumer confidence in types of food product or specific brands (Pennings, et al., 2002).

Emerging food risks are not necessarily *new* risks: some have always represented a threat, but have only recently been identified due to improved detection techniques (Skovgaard, 2007), while others are the result of mutations and adaptations of well-known microorganisms. In some cases, risks emerge as an unintended side effect of a deliberate control measure (for example unanticipated cumulative effects of the use of chemicals in plant protection products, Müller et al., 2009). Other risks may emerge in specific regions due to changes in external conditions, e.g. climate change may introduce tropical food safety hazards in regions with a (previously) moderate climate (Zhang et al., 2008). The extent to which global risk management can be effective will thus be contingent on localised regulation, socio-cultural factors, the environment, and the quality of food safety enforcement. Local factors may determine whether a food risk emerges in the first place, and whether it can be identified and managed. Table 4.1 summarises the likely relevant factors.

This research applied Delphi methodology to collate international expert opinion on current food safety systems regarding emerging food risk identification, including addressing gaps in international research activities and knowledge, in order to provide input for the development of a common research portfolio.

Table 4.1. Some examples of factors potentially influencing global emerging food risks.

Issue	Description	See e.g.
Globalisation related to food trade	Transporting animals, plants, and their products acts as a vector for diseases and pathogens.	(Newell, et al., 2010)
	Increased transportation increases the demand on energy and CO2 exhaust.	(Jones, 2002; Saunders & Barber, 2008)
Population growth	Increased food demand threatens food security.	(Demirbas, 2008; Peters & Thielmann, 2008)
International treaties and supranational governmental organisations	International agreements take prevalence over local legislation. Regulatory standards not tailored to local capacity and capability.	(Ramaswamy & Viswanathan, 2007; Schillhorn van Veen, 2005)
Culture and religion	Cultural traditions influence the acceptability of food products or production methods.	(Meyer-Rochow, 2009)
Technological innovations	May introduce unforeseen hazards.	(Skovgaard, 2007)
	Genetically modified organisms may result in horizontal gene transfer or the introduction of novel allergens.	(Paparini & Romano-Spica, 2004; Van Den Eede, et al., 2004)
	Nanotechnology applications may have unintended consequences (for example, nanosilver applied as an anti-microbial agent may affect the environment after disposal).	(Chaudhry, et al., 2011)
Infringements and violations of food safety standards and regulations	Fraudulent practices harming food safety may result from economical motives (for example, melamine was added to mask the watering of milk).	(Astier, 2009)
	Malevolent actions, such as bioterrorism (for example, deliberate contamination of food products, or the introduction of animal diseases) may occur.	(Hartnett et al., 2009)
	Conflict and war may result in lower food security due to pillaging of fields or loss of labour force, or reduced food safety as a consequence of the collapse of regulatory systems.	(Creusvaux et al., 1999; Guha-Sapir & Ratnayake, 2009)
Climate change	Climate change may result in emerging food risks, such as increased prevalence of mycotoxins or water shortages.	(Kéfi et al., 2007)
	Climate change may lead to natural migration of species (animals/plants) or diseases (causative agents).	(FitzGerald et al., 2008)

4.2. Methods

Identifying emerging food risks involves expertise drawn from many countries and actors, including scientists from different disciplines and policy makers. Therefore, views of experts from all regions of the world need to be collated to inform the identification of international research priorities on this topic.

The inclusion of international expertise demands the use of a methodology that makes it feasible to consult with disparate experts. International workshops, whilst facilitating the interactive exchange of opinions, may incur prohibitive costs and raise pragmatic problems in terms of time and travel. Furthermore, such events can generally only involve a small number of participants, and their outputs may be constrained by social and political processes that often result in sub-optimal decision-making (e.g. Rowe, et al., 1991). Questionnaires allow the surveying of diverse and numerous experts in different geographical locations at reasonable costs, while eliminating group interaction and thus pre-empting problematic social and political processes (e.g. the group's position being overly swayed by dogmatic or high-powered individuals). However, surveys do not provide for interaction and debate. As a consequence, though a survey is useful in scoping different opinions, it cannot offer the prospect of conflict resolution.

Delphi methodology (e.g. Linstone & Turoff, 1975) was used to investigate the views of international experts from disparate geographical regions. This methodology involves the repeated polling of experts, whose answers are used as feedback in subsequent rounds. By providing feedback from the answers of others, Delphi creates interactivity and dialogue, as may be achieved in group meetings, while at the same time allowing for the benefits of a computerised survey, in terms of cost and access to more participants and a wider distribution of experts than might otherwise be possible. Specifically, Delphi methodology is characterised by having at least two rounds in which opinions are recorded and fed-back to participants – who remain anonymous to one another so as to pre-empt some of the potentially negative processes previously discussed (i.e. removing indicators of power, reducing conformity pressures, enabling opinion change without fear of 'losing face'). Often there is an exploratory round, in which key issues are identified, followed by one or more rounds of focused, quantitative questions. At the end of the process, the 'group's' position is indicated by the average response to the particular questions – though the extent of agreement/disagreement is also noted (Delphi generally aims to acquire a consensus position, though – importantly -the process may instead help to establish that there are fundamentally un-reconcilable positions too). Beyond these basics there is considerable variation in how Delphi surveys are implemented, such as in terms of the nature of feedback provided, the size of sample chosen, and the number of rounds used. Generally, pragmatic factors influence how any Delphi is implemented. For example, in real-world applications there are rarely more than two structured rounds since experts tend to be busy and unprepared to contribute beyond these.. However, research suggests that most change of opinion takes place over the first two rounds anyway, so that further rounds are unnecessary (i.e. there are insignificant degrees of change over subsequent rounds – see Rowe, et al., 1991). Pragmatic factors also tend to influence the numbers of respondents used, although there is no clear evidence for any particular sample size being better than another. In terms of feedback used, there is some, limited, evidence that feedback of rationales for decisions allows better discrimination of estimate/forecast quality on subsequent rounds than does feedback of statistical information alone (e.g. Rowe & Wright, 1996). In this study, rationales for experts' stated judgments are collected for use of feedback. Regardless of the way in which Delphi is implemented, however, empirical research has generally shown that the method (in its various forms) leads to better (e.g. more accurate) judgments and forecasts than regular interacting groups (Rowe & Wright, 1999). Delphi has also proven to be a useful method for eliciting international expert opinion within the domain of food safety (Wentholt et al., 2009).

4.2.1. Design

Initially, an exploratory (primarily qualitative) study was conducted to explore the views of a small group of experts on emerging food risks regarding priority topics for inclusion in the main survey. The results of this were used to inform the design of the first round of the Delphi questionnaire. This survey was more quantitative, although it also contained open questions. A second round provided feedback (average responses and opinions) to the same set of participants, asking for further reflection on the same questions.

The exploratory study was implemented using an interactive web-site in English. In rounds 1 and 2 of the main Delphi survey, the questionnaires were translated into four languages to increase the international response rate (English, French, Spanish and Portuguese). Surveys were translated and back-translated by native language speakers and/or professional translators. To further increase survey accessibility, participants with limited internet access could download a Word version of the questionnaire in their preferred language, which could be completed off-line and returned by e-mail, fax or post to the researchers.

Invitations to participate in the survey were generated and sent electronically. A response "window" of three weeks was allowed for the exploratory study, and the subsequent two rounds of the Delphi study proper. E-mail reminders were sent to participants who had not yet responded a week prior to the response deadline, on the deadline itself, and a week after the deadline. Two weeks after the deadline the database was closed and further entries were excluded.

4.2.2. Sample and procedure

For the main Delphi survey, a database of 1931 relevant experts was constructed. This comprised personal contacts of partners involved within the Go-Global project, plus public lists provided by organisations with interests in emerging food risk identification. The database was analysed to determine whether there was sufficient global coverage of participating experts. Where necessary, participants from under-represented areas were added through asking contacts in these regions to provide relevant names (the "cascade" approach). In this way an international experts' database was constructed, with efforts made to include representation from less-affluent countries in South America, Africa and Southern Asia. Nevertheless, affluent countries were over-represented, which might have been due to the larger commitment in these countries to assessing/ managing emerging risks (i.e. there were more experts available), or because of the greater of involvement of experts from affluent countries in global decision committees (and these two elements may be related).

4.2.3. Exploratory study

The exploratory study intended to scope relevant issues. It comprised 20 questions. Initially participants were asked to describe important global changes currently taking place, and how these affected national and international issues relevant to the safety of the food chain. A second set of questions focused on food risk identification. Participants were asked to identify "What methods do you currently use for food hazard identification in your country?" (open-ended response), whether "these methods have changed in the last 5 years?" ("yes", "no", "no opinion"), and were asked to explain their responses in an open-ended format. Subsequent open-ended questions focused on methodologies available to identify and predict emerging food risks, both nationally and internationally, and what additional methodologies might be needed to fill knowledge gaps.

4.2.4. Main rounds

In the main rounds, participants were asked to rate the importance of different barriers to emerging food risk identification and management identified in the exploratory study. Participants rated the importance of the different barriers on a 5-point scale (anchored by 1= "no barrier" and 5= "very important barrier"). Subsequently, participants rated how influential different changes in the world would be regarding emerging food safety risks on a five-point scale (anchored at 1= "not influential" to 5= "very influential"). For these questions participants could also choose a "don't know" option (coded as a missing variable). Additionally, participants were asked whether they considered each change to have positive or negative effects on emerging food risks. In round 1, participants were asked whether international harmonisation of regulations should occur ("Yes", "No", "Don't know", "No opinion"), and whether countries should be allowed to apply national standards to deal with emerging food risks ("Always", "Never", "Only in specific circumstances", "Don't know", "No opinion"), and they were asked to comment on their responses. Based on these comments special circumstances identified were subsequently rated in round 2 on a 5-point scale (anchored by 1= "not at all acceptable" to 5= "totally acceptable".)

Also in round 1, participants were asked to rate predictive methods on 12 attributes (Armstrong, 2001) on a 5-point scale (anchored by 1= "very bad/low" and 5= "very good/high"), and to rate how familiar they were on 5-points scales (anchored by 1= "not at all" and 5= "very much"). In round 2, participants were asked to rank the methods on the same attributes.

The full versions of the questionnaires are available from the authors upon request. Feedback from round 1 was provided with the related question in round 2 in the form of qualitative summaries of the comments, supplemented with percentages (choosing various options) where applicable.

4.3. Results

Forty nine experts participated in the exploratory study. In the first main round 421 experts provided usable data (22% response rate); of whom 113 participated in the second round (27% response rate). An overview of the respondents is given in Table 4.2. A large proportion of respondents worked for government agencies or academia, with relatively few for industry and NGOs – which largely reflects the ease with which we were able to identify experts, in addition to the experts' willingness to respond.

Table 4.2. Sample characteristics[1]

Region	Number of responses[1]		Gender ratio (% female)	Response language				Primary employment of participant				
				English	French	Spanish	Portuguese	Government	Academia	Industry	NGO	Other
Delphi Survey round 1												
Round 1 totals	281[1]		39%	245	16	17	3	136	82	21	12	21
Europe	201	(70%)	37%	179	12	8	2	89	65	16	6	16
of which EU	*170*	*(59%)*	*38%*	*102*	*6*	*5*	*1*	*77*	*56*	*11*	*6*	*12*
North America	19	(7%)	32%	19	0	0	0	11	5	2	0	1
Latin America	12	(4%)	58%	2	0	9	1	8	1	0	1	0
Africa	8	(3%)	63%	4	4	0	0	2	1	0	0	2
Asia and Oceania	41	(14%)	35%	41	0	0	0	23	8	2	5	2
Delphi Survey round 2												
Round 2 totals	108		32%	102	1	4	1	45	38	10	6	9
Europe	81	(78%)	63%	81	1	1	0	32	33	9	3	6
of which EU	*69*	*(61%)*	*33%*	*65*	*1*	*0*	*0*	*29*	*27*	*4*	*2*	*4*
North America	6	(6%)	17%	6	0	0	0	3	1	1	0	1
Latin America	4	(4%)	40%	0	0	3	1	3	0	0	1	0
Africa	2	(2%)	67%	2	0	0	0	2	0	0	0	1
Asia and Oceania	13	(12%)	23%	13	0	0	0	6	4	0	2	1

[1] Only participants who provided all demographic data.

4.3.1. Barriers to managing and predicting global emerging food risk

From the exploratory study, five main barriers against effective management and identification of emerging food risks were identified: “insufficient access to data”, “no access to international networks”, “insufficient human resources”, “unwillingness of experts to share data and information”, and “prohibitive cost associated with application of predictive technologies”. From open-ended responses obtained from round 1, two additional barriers were added in round 2: “the lack of available methods to make predictions” and “the lack of political urgency to promote global predictions”.

Even the lowest score derived from averages responses in round 2 (insufficient access to relevant networks M=2.74) was close to the scale midpoint of 3. Thus, experts thought all of the barriers were of some importance. The perceived magnitudes of the barriers significantly differed both in round 1 and 2 (repeated-measures ANOVA[4], $F(4,254)=33.09$; $p<0.001$; $\eta^2=0.34$ [5]; repeated-measures ANOVA, $F(6,62)=4.61$; $p<0.001$; $\eta2=0.31$, respectively). Subsequent *post hoc* comparisons indicated that *access to networks*, and to a lesser extent *access to data*, were considered less serious problems in emerging risk prediction than *willingness to share data* and *lack of political urgency to implement appropriate research programmes* (the most highly rated barrier – figure 4.1).

[4] ANOVA, or Analysis of Variance, provides a statistical test of whether or not the means of several groups are all equal.

[5] $\eta2$ refers to the strength of the effect of the independent variable. The value of $\eta2$ varies between 0 and 1. $\eta2$ assumes a value of 0 when the independent variable has no effect on the dependent variables, and 1 when all variance associated with the dependent variables is explained by the independent variables.

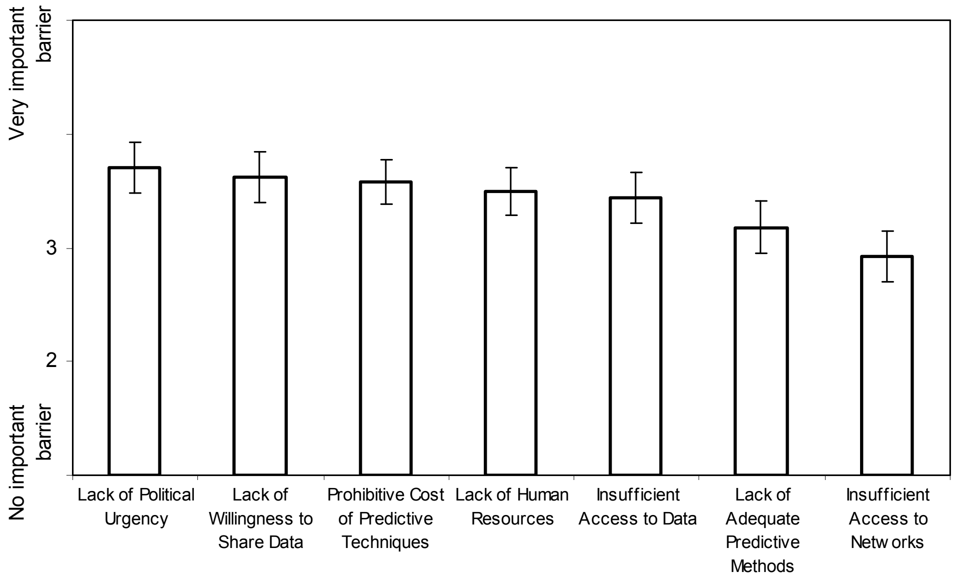

Figure 4.1. Delphi round 2 averages in importance for the 7 identified barriers (error bars indicate 95% confidence interval).

Regional differences were investigated in the first round of the main Delphi study only (round 2 had fewer participants, and in some regions the statistical power was insufficient for further analysis). Five "supra-regions" were identified (Europe, Northern America, Latin America, Africa and the combination of Asia and Oceania[6]). A MANOVA[7] showed that an expert's region affected the perceived importance of the barriers ($F(5,239)=8.42$; $p<0.001$; $\eta 2=0.15$). Subsequent post-hoc tests indicated that, on average, experts from Asia and Oceania tended to rate most barriers as less important than participants from other regions, whereas experts from Latin America tended to rate many barriers as *more* important than experts from most regions (Games-Howell corrected for multiple comparisons with different group, which does not assume equal sample sizes and variances across the groups being compared - see Figure 4.2 and Table 4.3). Experts from Africa were more concerned about the *high cost* of emerging risk identification and management, and gaining the *access to relevant data*, while

[6] As Oceania had too few participants to be included as a separate category.

[7] MANOVA, or Multivariate Analysis of Variance is a specific form of ANOVA which is applied to identify whether the effect of (changes in) the independent variable(s) has an effect on multiple dependent variables.

experts from North America reported that willingness to share data represented an important barrier to emerging risk identification.

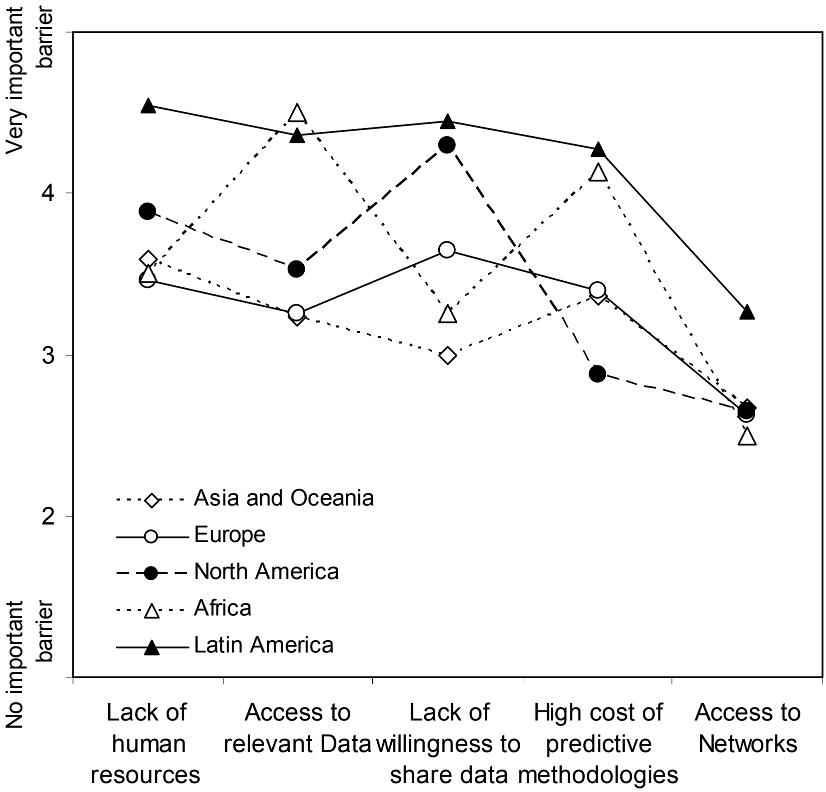

Figure 4.2. Importance of barriers by region (round 1).

Table 4.3. Comparison of barriers between geographic regions.

	N	Lack of human resources	Access to relevant Data	Lack of willingness to share data	High cost of predictive methodologies	Access to Networks
Asia and Oceania	39	3.59[a]	3.23[a]	3.00[a]	3.36[ab]	2.67[a]
Europe	170	3.46[a]	3.26[a]	3.64[b]	3.40[ab]	2.63[a]
North America	17	3.88[ab]	3.53[ab]	4.29[bc]	2.88[a]	2.65[a]
Africa	8	3.50[ab]	4.50[b]	3.25[ab]	4.13[ab]	2.50[a]
Latin America	11	4.55[b]	4.36[b]	4.45[c]	4.27[b]	3.27[a]

Means associated with the same superscript character are not significantly different between regions. The post hoc means comparisons have been applied within barrier type in order to compare regions (α=.05 Games-Howell corrected).

4.3.2. Future global developments affecting emerging food risks

From the exploratory study, five global changes likely to affect food safety were identified: “climate change”, “increased disease prevalence”, “technology development”, “war and terrorism”, and “economic recession”. Three additional drivers were added in round 2, consequent of open-ended responses from round 1: “globalization”, “migration” and “population growth”.

The (absolute magnitudes) of these influences significantly differed both in round 1 and 2 (repeated-measures ANOVA, $F(4,362)=63.54$; $p<0.001$; $\eta 2=0.41$; repeated-measures ANOVA, $F(7,98)=22.48$; $p<0.001$; $\eta 2=0.62$, respectively). Subsequent pairwise comparisons (Sidak corrected) showed that *war and terrorism* was considered least important, with the *development of new technologies, globalisation, climate change* and *economic recession* being of greater importance (Table 4.4). There were no differences between the rounds in how influential the changes were thought, with the exception of the impact of the economic recession, which was rated as being slightly more negative (unsurprisingly, as the economic crisis had started) (0.2 scale point on a 5 point scale; $t(175.1)=-2.13$, $p=0.034$ no equal variances assumed – Table 4.4).

In both rounds 1 and 2, the participants generally agreed that *increased disease* (Round 1 95%, Round 2 95%), *climate change* (Round 1 93%, Round 2 83%), *war and terrorism* (Round 1 96%, Round 2 91%), and *economic recession* (Round 1 96%, Round 2 93%)

would have a negative influence on food safety. Many participants in round 2 indicated that *migration* (67%), *population growth* (67%) and *globalisation* (62%) would negatively influence food safety. In both rounds 1 and 2 there was agreement that the *development of new technologies* would improve food safety (Round 1 92%, Round 2 95%). A decrease in the proportion of experts who thought that climate change would be negative for food safety was observed between round 1 and 2 ($\chi 2(df=1, N=393)=5.45$; $p=0.02$).

In general, average responses were consistent between rounds, with the exception of an increased in the perceived influence of *economic crisis* on emerging food safety, and decrease in perception that *climate change* would be negative for emerging food safety (Table 4.4).

Table 4.4. Mean influences of global developments on food safety for round 1 and 2.

	Round 1	Round 2	Difference between round 1 and 2
	N=288	N=113	
War/terrorism	3.01^{a}	2.87^{a}	t(190.8)=1.20, p=.23
Population growth		3.36^{b}	
Migration		3.65^{bc}	
Increased disease	3.64^{b}	3.65^{bcd}	t(173.5)=-0.57, p=.95
Economic recession	3.71^{b}	3.93^{cde}	t(175.1)=-2.13, p=.03
Climate change	4.00^{c}	3.95^{de}	t(200.2)=0.60, p=.55
Globalisation		4.05^{e}	
Technology development	4.12^{c}	4.18^{e}	t(195.7)=-0.57, p=.57

Same superscript character means that there is no significant difference between categories in the same Delphi round sharing the character (α=.05 Sidak corrected).
Degrees of freedom for a t-test without assumed equal variances are estimated for each test individually, resulting in fractions of degrees of freedom.

In response to the open questions, several participants linked the effects of global developments to potential barriers for the global management of emerging food risk. For example, problems arising from climate change, and environmental and funding problems due to the economic crisis, were associated a lack of political urgency:

> "…Issues concerning the environment, natural resources, and food security are strongly inter-related, and their implementation will depend on political will…" [Kenya]

> "…An area of concern is that appropriate research funding may be reduced due to the financial crisis and insufficient support of governments…" [The Netherlands]

The rationale for the consensus view that technology development would benefit food safety appears to originate in the expert conviction that technology will help solve many of humanities problems:

> "Technology development is the only solution to filling the energy gap, battle global warming, fight new emerging diseases, build new jobs, provide food for growing populations…..." [Germany]

> "[A country] sensitive to public health should continually review its [research and development] infrastructure and identify gaps based on existing technology for continual improvement and mitigation…" [Kenya]

However, some critical remarks were also made regarding how technology could also play a negative role in relation to emerging food risks:

> "I think *overall* technology development will probably benefit people, though some unforeseen risk may accompany this…" [Japan]

4.3.3. International collaboration: harmonisation of regulations

In round 1, participants agreed reasonably strongly that international harmonisation of regulations *should* occur (73% in support, 16% against, 11% don't know); this majority point of view was therefore not further explored in round 2. There was, however, less agreement about whether countries should be allowed to apply national standards to deal with emerging food risks if foods were intended for local consumption but not for export (32% agreed that this was, in general, acceptable, 20% indicated that this was unacceptable, and 48% indicated that this would be acceptable only in specific circumstances). Analysis of open responses identified several domains where differential application of standards might be more or less acceptable. These were under circumstances where *Products are destined for global trade, Products are destined for local use, Products are destined for specific market sectors* (e.g. fair trade or organic), and for *Products that may cause local protests* (e.g. the use of genetically modified organisms in food production). Participants were also asked in round 2 if different regulations were acceptable if products had differential health effects on different subpopulations, or for countries that do not have sufficient capacity to uphold certain regulations. Participants tended to agree that differential applications of food safety standards and regulations were acceptable except under circumstances where products were destined for global trade ($F(5,79)=7,49$; $p<0.01$; $\eta 2=0.09$, Table 4.5).

Table 4.5. Mean Acceptability of special rules (5 = highly acceptable).

	Mean
Products for global trade	2.18^{a}
Lack of local food safety capacity	2.65^{b}
Socially desirable products	2.68^{b}
Product that may cause unrest	2.90^{b}
Product that affect subpopulations	2.96^{b}
Product for local use only	3.10^{b}

Means sharing the same superscript character do not differ significantly (.α=.05 Sidak corrected).

4.3.4. Prediction of emerging food risks

The exploratory analysis illustrated that many experts in the study had only limited awareness of the predictive methods available.

> "Prediction of unforeseen food safety incidents is extremely difficult. If such events were predictable they would not be unforeseen unless relevant data were not collected." (Australia, exploratory analysis).

Nevertheless, the exploratory survey revealed six methods that may be used to predict emerging food safety hazards: early warning systems, risk profiling, risk trending, foresight, vulnerability assessment, and horizon scanning (with the *caveat* that early warning systems and risk profiling may be better classified as rapid responses to food safety incidents than predictive methods *per se*). These are defined in Table 4.6. The experts showed high consistency in their ratings over all attributes for the same method (Principal component analysis: one factor, first three Eigen values 6.04, 1.00, 0.94 which explained 50% of the total variance). Experts tended to prefer methods with which they were most familiar ($r=0.10$; $p<0.01$). Participants preferred "horizon scanning" least of all the methods presented. "Vulnerability assessment" was rated as less preferable than the most preferred method, "early warning systems". No significant differences were found between early warning systems, risk profiling, risk trending and foresight (pairwise comparisons, Tukey HSD).

To study the differences between methods in more detail, participants in round 2 were asked to assign a unique rank for each of 12 attributes for the different methods. Repeated measures MANOVA shows that the attributes were differently ranked over methods ($F(12,368)=21.96$; $p<0.01$; Tables 4.7 and 4.8).

Table 4.6. A short description of each of the predictive methodologies used in the study.

Predictive methodologies
Foresight: expert groups explore future scenarios that are related to emerging risks, and evaluate how these may effect early warning, hazard identification and policy.
Vulnerability assessment: experts identify critical points in the food production–consumption chain that are sensitive to emerging hazards.
Horizon scanning: public consultations with experts and stakeholders to identify future risks and prioritise them, in order to develop mitigation measures before problems occur.
Risk profiling: predictive risk assessment used to identify potential hazards that may occur at critical points in the food production–consumption chain. Risk mitigation is started when the hazard exceeds the threshold level.
Risk trending: retrospective analysis of food hazard or health outcome data to detect long-term trends in various steps of the food production–consumption chain.
Early warning systems: centralised electronic database of hazards or health risk outcomes, which allows the rapid identification of food risks through networks of experts, organisations, and public health authorities.

Table 4.7. Mean rank (SD) (higher is less preferred) across the 12 attributes for the 6 predictive methods.

Attribute	Predictive method						
	Early warning	Risk profiling	Risk trending	Vulnerability assessment	Foresight	Horizon scanning	Test statistic on mean rank per attribute
Accuracy	3.04 (1.83)	2.95 (1.49)	3.42 (1.71)	2.92 (1.58)	4.03 (1.69)	4.11 (1.72)	F(5,92)=10.19; p<.01
Timely identification	2.64 (1.87)	3.40 (1.54)	3.89 (1.62)	3.26 (1.52)	3.38 (1.77)	4.06 (1.40)	F(5,92)=8.53; p<.01
Improved decisions	3.27 (2.04)	2.83 (1.54)	3.52 (1.79)	3.29 (1.53)	3.61 (1.82)	3.62 (1.85)	F(5,92)=2.93; p=.01
Cost reductions towards risk issue	3.04 (1.84)	3.37 (1.48)	3.64 (1.55)	3.22 (1.71)	3.53 (2.04)	3.64 (1.78)	F(5,91)=2.30; p=.04
Easy to interpret	3.18 (1.93)	3.03 (1.59)	3.20 (1.60)	3.22 (1.57)	4.28 (1.69)	4.09 (1.44)	F(5,85)=7.68; p<.01
Flexible	3.98 (2.02)	3.51 (1.58)	3.9 (1.50)	3.42 (1.51)	2.88 (1.76)	3.28 (1.64)	F(5,85)=4.36; p<.01
Useful	3.10 (1.92)	3.58 (1.59)	3.88 (1.53)	3.56 (1.43)	3.01 (1.81)	3.86 (1.77)	F(5,84)=3.39; p<.01
Good use of available data	2.68 (1.88)	3.26 (1.58)	3.02 (1.56)	3.44 (1.44)	4.38 (1.68)	4.20 (1.45)	F(5,84)=12.02; p<.01
Easy to use	2.89 (1.91)	3.50 (1.70)	3.24 (1.43)	3.49 (1.51)	3.83 (1.86)	4.00 (1.59)	F(5,79)=4.03; p<.01
Incorporates expert judgement	4.22 (1.87)	3.80 (1.55)	4.35 (1.37)	3.04 (1.41)	2.35 (1.47)	3.22 (1.67)	F(5,80)=16.48; p<.01
Reliable	2.92 (1.82)	3.07 (1.61)	3.18 (1.48)	3.27 (1.49)	4.09 (1.74)	4.48 (1.53)	F(5,81)=10.30; p<.01
Cost to use method	3.99 (1.95)	4.07 (1.36)	3.51 (1.62)	3.15 (1.53)	3.09 (1.80)	3.22 (1.67)	F(5,79)=4.57; p<.01

Table 4.8. Selection table for the methods based on most important attribute.

	Early Warning	Risk Profiling	Risk Trending	Vulnerability assessment	Foresight	Horizon Scanning
Accuracy	Y	Y	O	Y	N	N
Timely identification	Y	O	O	O	O	O
Improved decisions	O	N	Y	O	O	O
Cost reductions towards risk issue	O	O	O	O	O	O
Easy to interpret	Y	Y	Y	Y	N	N
Flexible	Y	O	Y	O	N	O
Useful	O	O	O	O	O	O
Good use of available data	Y	Y	Y	Y	N	N
Easy to use	Y	O	O	O	O	N
Incorporates expert judgement	N	N	N	Y	Y	Y
Reliable	Y	Y	Y	Y	N	N
Cost to use method	O	N	O	Y	Y	Y

Y: Recommend to use the method if attribute is important.
N: Avoid the method if attribute is important.
O: Neither recommended or avoid the method if attribute is important.

4.4. Discussion

Experts agreed that the lack of political urgency to identify and manage emerging food safety risks represented an important barrier to effective global food safety management. Additionally, the lack of willingness to share data by industry was seen as problematic. Hence it is the socio-political context, rather than the technical basis of risk assessment, which was rated as being the most significant barrier to this issue. This conclusion is reinforced by other results. For example, other barriers rated as highly relevant focused on lack of resources (prohibitive cost, lack of human resources, lack of data), while methodological issues (lack of predictive methods and lack of access to relevant networks) were considered to be the *least* important barriers.

Some regional differences in the importance of the different barriers were also identified. Experts from Latin America were most concerned about all of the different potential barriers, including lack of access to available international networks. North American experts perceived that willingness to share data between industry and risk assessors in government and academia represented a major barrier, possibly due to the regulatory framework prevalent in the USA. Experts from Africa were most worried about the high cost of predicting emerging food risks and lack of available data. Presumably improved sharing of data would improve this to some extent, but there is still an issue relating to the resources required for collecting primary data. This suggests that international effort directed towards capability and capacity building may facilitate the local and international identification and mitigation of emerging food risks, an issue which needs to be placed on the agendas of international organisations and development programmes.

Several global developments were identified as potentially negative for food safety. Globalisation, climate change and economic recession were considered the most important, while increased disease prevalence, migration and population growth were considered less important; and war/terrorism was considered least important of the factors identified. The development of new technologies was considered a likely positive influence on emerging food risk identification and management, although this may reflect the pro-technology bias in the participant sample. Interestingly, it was also observed that participants recognised that advances in technology might also result in emerging food risks - though this view was almost certainly based on specific cases of technology being applied to, or contaminating, food chains, rather than as an assessment of technology overall.

To improve international harmonisation of the identification and management of emerging food risks, experts agreed that agreed rules and safety standards are needed for products intended for the global market. Under special circumstances, experts tended to agree that different rules may be acceptable for local application. This extended to special rules for pro-social products (e.g. fair trade, organic), products that may raise societal protest (e.g. the use of genetically modified organisms in food production), and emerging food risks that have the potential to differentially affect specific subpopulations (for example, contamination of products with milk derivatives, which may affect lactose intolerant populations). There was also some acceptance that specific rules might be acceptable if a country lacks capacity to enforce the global rules. Given the conclusion that capacity and capability need to be improved in regions where this is required, this result might be interpreted as a temporary or interim conclusion which needs to be addressed internationally.

Although not considered the most limiting barriers, predictive methodologies remain elusive, and several participants remarked that totally effective prediction may never be possible. Overall, participants favoured the use of early warning systems (though this is not technically a predictive methodology, but a rapid response system activated once a risk has been identified). Risk profiling and risk trending were also relatively well liked by participants, but their international application is potentially limited by resources.

An important limitation of the study relates to linguistic issues. The exploratory study was conducted only in English. Given that the Delphi survey was developed from this, important views of experts not fluent in English may have been excluded. Although the subsequent rounds of the study included versions of the questionnaire in other languages (including some limited open-ended responses, which enabled further identification of key issues and subsequent participant rating in round 2), the absence of questionnaires in many languages might have limited expert input. It is recommended that in the future resources be allocated to the development of the questionnaire in other major languages, like Chinese, Japanese and Russian.

A second possible limitation concerns the sampling. As can be seen from Table 4.2, a large proportion of respondents worked for government agencies (or in academia), with relatively few from industry or NGOs. As such, it is possible that there was a bias in responses towards those already 'within' the food risk governing system, as opposed to those outside the system with potentially alternative views. Unfortunately, conducting any exercise such as this will result in some form of bias, largely consequent on the ease of access to (or readiness to respond of) certain stakeholders. On top of logistical difficulties of access, there are also theoretical difficulties in terms of stipulating what is an appropriate sampling policy. For example, what percentage of NGO respondents ought to have been sought? What proportion of experts work in the different occupational domains? And should, perhaps, certain respondents/ stakeholders be privileged with over-representation in an exercise such as this – perhaps because they comprise those most likely to influence or implement policy (e.g. governmental employees) or because they are likely to have more radical ideas with greatest scope to enhance future policy making (e.g. NGO or industry representatives)? There are no clear answers to any of these questions – though the reader should at least be aware that these are pertinent questions to consider. What is clear from this discussion, however, is that it is important not to underplay 'extremist' views, as these might potentially lead to solutions to long-held problems. Although the method employed seeks to attain a degree of consensus, its proponents also highlight the need for appropriate analysis to indicate and explain, where possible, extreme or outlying views (e.g. Rowe, et al., 1991). Future users of the method need to bear this in mind.

One potential criticism of the study relates to the development of consensus, which, through application of the Delphi methodology, may tend to aggregate more extreme views into the consensus. However, more extreme opinions may be more portentous insomuch as they indicate where real problems or opportunities may lie. In the research presented here there was, by-and-large high levels of agreement on many of the topics under consideration. Where outlying responders were identified, they were not particularly informative regarding their reasons for holding contrary views, and so respondent reasons for these views were of limited value in terms of providing feedback.

Finally, it is arguable that the results provoke ‘no surprise’, in-so-much that the conclusions are not totally unexpected. This at least suggests a certain ‘face validity’ to the study. The issue of emerging food risks is an important one, the policy aspects of which, it is arguable, are under-researched. However, if the relevant political/scientific/academic community is to make policy decisions it should do so on the basis of clear evidence gained from the international community of relevant actors, which is the case in the current study.

4.5. Conclusions

A number of topics are relevant to the identification and management of emerging food risks were identified. Political will to engage in emerging food risk identification and management may be problematic, and there is a need to keep the issue on international and national research agendas, perhaps through effective stakeholder engagement. The efficient sharing of data pertinent to emerging food risks across stakeholders in expert communities needs to be supported, perhaps through the intervention of intergovernmental organisations. Capacity and capability regarding emerging food risk identification and management needs to be included in development agendas for donor countries and institutions. A formal framework for dealing with exceptions to global rules needs to be developed. Deviations from global rules may be acceptable for products destined for local use – e.g. via a tiered systems of approval for local compared to global use of food products. However, the principal of equity of food safety would suggest that international resources be directed towards capacity and capability building in this regard.

CHAPTER 5

Defining European preparedness and research needs regarding emerging infectious animal diseases:

results from a Delphi expert consultation

Abstract

Emerging and major infectious animal diseases can have significant international impact on social, economic and environmental level, and are being driven by various factors. Prevention and control measures should be prepared at both national and international level to mitigate these disease risks. Research to support such policy development is mostly carried out at national level and dedicated trans-national research programmes are still in its infancy. This research reports on part of a process to develop a common strategic research agenda on emerging and major infectious diseases of livestock in Europe, covering a 5 to 15 year time span. A two round online Delphi study was conducted to explore the views of experts on issues relating to research needs on emerging infectious diseases of livestock in Europe. Drivers that may influence the incidence of emerging infectious animal diseases in both the short (next 5 years) and medium term (10-15 years) were identified. Drivers related to regulatory measures and biological science developments were thought to decrease the incidence, and socio-economic factors to increase the incidence of emerging infectious animal diseases. From the first round a list of threats to animal health was compiled and participants combined these threats with relevant drivers in the second round. Next to identifying threats to animal health, also possible mitigatory actions to reduce the negative impact of these threats were identified. Participants emphasised that interdisciplinary research is needed to understand drivers of emerging infectious animal diseases, as well as to develop prevention and control measures which are both socio-economic and technical. From this it can be concluded that interdisciplinary research combining both natural and social research themes is required. Some of the European member states research budget needs to be allocated so that effective prevention and mitigation strategies can be developed.

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5.1. Introduction

Emerging infectious animal diseases may cause negative social, economic and environmental impacts locally, nationally, regionally and internationally. These impacts are driven by various factors. For example, climatic, biophysical, and other anthropogenic factors, such as socio-economic influences, potentially influence contact rates between host, pathogens, and their vectors and reservoirs, ultimately shifting the (animal) disease burden to a regional level and beyond (De La Rocque et al., 2008). A foresight exercise was conducted which aimed to identify Europe's regional and trans-national short and medium-term needs regarding preparedness and research focused on preventing and mitigating emerging infectious animal diseases, in order to support timely policy development.

The spread of infectious animal diseases, including zoonotic and vector-borne diseases, is driven by many factors (Reperant, 2010). For example, translocation of people and their livestock, and as a consequence (increased) contact between wild animals, livestock and people (Gummow, 2010). Historically, physical barriers, such as oceans, deserts, or mountain ranges, prevented human movement and thereby the spread of vectors and pathogens (De La Rocque, et al., 2008). Industrialisation and economic development may have resulted in increased incidence of emerging infectious diseases. For example, current increases in globalisation, manifested through modern international trade and transport activities, may expedite the spread of disease. Anthropogenic and demographic changes, in particular increase in human population density have been shown to be a significant independent driver of emerging infectious zoonotic diseases, due to, for example, industrialisation, politico-economic aspects or immigration dynamics (Alexander & McNutt, 2010; Cascio, et al., 2011; Jones, et al., 2008). As well agricultural development, for example intensification of production systems and movement of livestock, have resulted in steadily increased disease threats to the livestock industry over the past decades as a result of these drivers (King, 2004; Morse, 2004). At the same time, these increased threats have had negative consequences for society in general through negative economic affects, transport bans and travel restrictions, as well as on livestock populations (e.g. the 2007 Q-fever outbreak in the Netherlands).

The multifactorial and transnational nature of drivers related to emerging infectious animal diseases, makes it difficult to enforce effective control and mitigation measures (Reperant, 2010). In order to identify, prevent and moderate the spread of emerging infectious animal diseases, epidemiological vigilance, appropriate diagnostic capacity, risk assessment and regulatory measures are required at both the national and international level. In contemporary society, prevention of, and response to, emerging infectious animal diseases relies heavily on risk assessment and scientific developments. Research is required if effective new disease prevention, control, and policy tools are to be developed, and translated into concrete risk management measures and policies.

Research on prevention and control is often conducted at national level, although it has been noted that, if the (lack of) knowledge about emerging infectious animal diseases is to be managed effectively, more effective and harmonised international research programming may be needed. Networks between research fund providers have been set up with the aim of improving coordination across Europe to create an adequate, and less fragmented research infrastructure.

To increase transnational cooperation and coordination of research programmes in Europe on emerging infectious diseases of production animals (including zoonoses), a network of national research funders in Member and Associated States of the EU was established (EMIDA ERA-NET). Its aim is to work towards a common strategic research agenda on emerging and major infectious diseases of livestock, covering a 10 to 15 year time span. An important objective is to initiate and coordinate jointly funded programmes and ultimately support European policy development regarding the management of emerging infectious animal diseases (for more information see: www.emida-era.net/). The scope of the EMIDA project is to examine existing research activities, and gaps in knowledge, associated with emerging and major infectious diseases of production animals, including fish and bees and those conditions that pose a threat to human health. A literature review of relevant foresight studies in the animal health area conducted by the Foresight and Programming Unit of the EMIDA project was a first step in the identification of drivers for emerging infectious animal diseases as well as threats to animal health in order to establish a common strategic research agenda (EMIDA - Work Package 4 Foresight & Programming Unit, 2009).

In order to meet the objectives of EMIDA Workpackage 4 [8], Delphi methodology (Linstone & Turoff, 1975) was adopted as it delivers the practicability of a survey, with benefits in terms of availability and potential to systematically include a broad range of experts from appropriate disciplinary backgrounds.

[8] http://www.emida-era.net/index.php?page=workpackages&

The Delphi method essentially involves the repeated polling of experts using anonymous questionnaires. Responses are used in subsequent rounds as controlled feedback, and the final round responses are used to produce a group judgement (Linstone & Turoff, 1975). The literature indicates substantial variations of the method exist, in terms of whether two or more rounds are used, whether or not the first round is structured (quantitative) or unstructured (qualitative), whether the process takes place using paper-and-pencil questionnaires or 'online', whether the process is synchronous or asynchronous, and so on (e.g. Gordon & Pease, 2006; Rowe, et al., 1991). The aims of the approach may also vary, and Delphi may be used in order to gain expert consensus or identify dissensus where this exists (for example, in the case of a Policy Delphi, Turoff, 1970). In the area of agrifood policy, research has typically used larger samples, in order to include experts covering the range of geographical dispersion and interdisciplinary expertise required to develop appropriate policy strategies (Frewer, et al., 2011; Wentholt, et al., 2010; Wentholt, et al., 2009). Other applications of Delphi across a diverse range of areas have been reported, for example, in the optimisation of European manufacturing (Armbruster et al., 2007), optimising the economics of biotechnology in agricultural production (Menrad, 2000), or pharmaceutical innovation relevant to diseases of poverty (Coles et al., in preparation). For an up-to-date review, see Rowe and Wright (2011).

There is considerable variation how Delphi surveys may be implemented. Empirical research has shown that the method (in its various forms) leads to better (e.g. more accurate) judgements and forecasts than interacting groups (Rowe & Wright, 1999, 2001). Delphi methodology has been applied in the area of animal health (Ine et al., 2002), to map future dynamics of disease transmission (Suk et al., 2008), and the evaluation of the expert perception of determinants of equine welfare (Collins et al., 2009).

The study presented here utilised an online Delphi survey applied to the collation of international expert opinions relating to emerging infectious animal diseases. The objectives were to systematically identify major disease drivers of, and threats associated with emerging infectious animal diseases so that (pan-European) future research priorities can be set. The time frame was on research in the short term (the next 5 years), and potential changes required to this research strategy in the medium term (the next 10-15 years). In addition, participants' views on Europe's current status with regard to preparedness for emerging infectious animal diseases were collated in order to verify the need for change to existing research portfolios.

5.2. Methods

A two round online Delphi study was conducted to explore the views of different experts on issues related to emerging infectious diseases of production animals in Europe in the short term and in the medium term. The outcomes of the study would provide elements upon which a common EU strategic research agenda focusing on infectious animal disease identification, control and prevention in Europe could be developed. Only experts within the European research area were consulted as study participants, as the objective was the development of an integrated and harmonised European research agenda regarding the management of emerging infectious animal diseases.

5.2.1. Study participants

As part of the activities within EMIDA, a review of foresight studies was conducted prior to initiation of the Delphi (EMIDA - Work Package 4 Foresight & Programming Unit, 2009). This study facilitated the identification of a range of disciplines relevant to the management of emerging infectious animal diseases. Subsequently, a database of 217 relevant European experts was constructed (see Table 5.1). All partners involved in the EMIDA consortium were requested to submit names of possible participants based on the different disciplines identified ("cascade" methodology). The database was checked to determine whether there were sufficient participants across disciplines and European member states. Where necessary (and where possible), participants from under-represented areas were added to the participant list through a request to EMIDA partners to provide additional participant names.

All participants who had been invited to take part in the first round were subsequently invited to participate in the second round.

5.2.2. Design

Questionnaire development was conducted by a group of EMIDA members (whom had earlier reviewed relevant foresight studies on emerging animal diseases (EMIDA - Work Package 4 Foresight & Programming Unit, 2009)), together with two researchers familiar with the development, and application of Delphi surveys, as with the interpretation of resulting data (Wentholt, et al., 2010; Wentholt, et al., 2009). Initially, two small workshops were held. The aim of the first meeting was to discuss the topics to be included in the first round of the Delphi study, after which a subset of the members developed a draft questionnaire. During the second meeting, the draft questionnaire was discussed by all group members and further refined.

To test the first questionnaire, a pilot study was conducted (October 2009). Participants in the pilot study (n=13 experts) were collected via the research team, and were invited via E-mail to respond to the survey within one week. Reminders were subsequently sent to those participants who had not responded. The E-mail invitation explained their role as a pilot participant, and potential pilot participants were asked to respond to the survey as if completing it in the main study, and were requested to note the time spent on completing the survey. In addition to the questionnaire, participants were asked to provide feedback on the clarity of the questions, difficulty level of the written language, completeness of the questionnaire with regard to topics and the appropriateness of the time period required. In addition, space was provided to allow pilot participants to make additional comments if needed. Following the pilot study, some minor changes in wording were made, and, where relevant, questions were formulated to encompass both time frames rather than just one.

The literature review on existing foresight studies (EMIDA - Work Package 4 Foresight & Programming Unit, 2009) revealed various definitions of both ‘drivers’ and ‘threats’. Therefore, within the Delphi study, a standardised definition of these was provided to ensure all participants were using the same definitions.

> *Driver*: a driver or driving force is an external condition acting on a large scale (climate, energy, technology, social events), which has the potential to directly or indirectly influence animal and human health (in this case the (re)-emergence of infectious diseases).
>
> *Threat*: a threat is a hazard that affects directly (or indirectly) animal and / or human health, like a pathogen, pathogen-carrier or a (bio)terrorism event.

5.2.3. Survey development

The Delphi study was implemented using an interactive web-site. All questionnaires were presented in English. To increase survey accessibility, participants could obtain a Word version of the questionnaire via the survey team, which could be completed off-line and returned by E-mail, fax or surface mail to the researchers. Six participants used this approach in the first round and one participant in the second round.

For the main Delphi surveys, participants from the database received an E-mail invitation to participate in the online survey and were subsequently given 3½ weeks to respond to the survey (round 1 conducted in November / December 2009 and round 2 in February / March 2010). E-mail reminders were sent to participants who had not yet responded a week prior to the response deadline. Four days after the deadline had passed the database was closed. Their responses were analysed using quantitative and qualitative methods as appropriate.

In the first round questions primarily addressed a qualitative response, mainly consisting of open-ended items. Only the first survey initially provided an introduction about the objectives of the EMIDA project and the aims of the Delphi study. The second round survey included, where applicable, feedback from the first round responses, primarily in terms of newly developed questions or statistical averages. Full versions of the questionnaires are available from the corresponding author upon request. Both rounds included questions on three major topics:

Preparedness for emerging infectious animal diseases. Participants were asked their opinion on European preparedness regarding the identification, control and prevention of infectious animal diseases (ratings on 5-point scales, anchored by 1=”completely agree” to 5=”completely disagree” and “no opinion”). Responses were statistically summarised (in percentages) and provided as graphical feedback in round 2. In the second round, participants were asked whether they agreed that European capacity to identify emerging infectious animal diseases is stronger than European capacity to control them. In addition, participants were asked whether they agreed that European capacity to prevent emerging infectious animal diseases is stronger than European capacity to control them. For both these questions, responses were collected through the following categories: “agree”, “disagree”, or “no opinion”. Besides these questions, participants were asked in the first round whether existing predictive methodologies were adequate. From the literature review (EMIDA - Work Package 4 Foresight & Programming Unit, 2009) four predictive methodologies currently used within the area of animal health were selected: these included the literature review, scenario study, horizon scanning, and workshop (see Appendix C1). The methodologies were rated on a 5-point scale (anchored by 1 = 'completely agree' to 5 = 'completely disagree' and 'no opinion').

Drivers of future threats to emerging infectious animal diseases. Participants were asked in the first round to identify which drivers of animal diseases and (emerging) threats to animal health they expected to be important in the short term (the next 5 years) and the medium term (the next 10 to 15 years). In the second round, these drivers were coded into superordinate categories, and participants were asked to rate whether each driving force would increase or decrease the incidence of infectious animal diseases in Europe in both short and medium term (rating scale items: "increase incidence of infectious animal diseases"; "decrease incidence of infectious animal diseases"; "no effect on incidence of infectious animal diseases"; in addition, a "no opinion" response option was provided). In addition, a condensed list of 34 threats to animal health was developed from the first round qualitative responses, and participants were asked to rate their importance in the second round, again in both the short and medium term. These threats were divided into five related groups: 'disease agents'[9]; 'complex infections'; 'specific animal diseases'; 'route of transmission'; and 'other emerging threats[10], (Appendix C2). These classifications were agreed by the researchers involved in developing the survey. The extent to which these threats were estimated by participants to pose an important threat to animal health was rated by participants on a five point scale (anchored by 1="very important" to 5="very unimportant", with a "no opinion" option). Following completion of these ratings, participants were asked to select the three most important threats and to link these three threats to the drivers which were also included in the second questionnaire, in order to investigate participant opinion regarding the driving forces related to the most important threats.

Future research topics relating to emerging infectious animal diseases. In the first round, qualitative questions inquired after what future research topics need to be addressed at the European level, in both the short and medium term. In the second round, these responses were coded and ordered, and participants were asked to rate the extent to which they agreed or disagreed whether each issue should be prioritised. Ratings were made on a 5-point scale (anchored by 1="completely agree" to 5="completely disagree" and "no opinion").

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[9] The item was phrased in the questionnaire: "family of agents".

[10] The item was phrased in the questionnaire: "epidemiological situation".

Background information. At the end of the first round, some background information about the participants themselves was gathered, such as gender, age, and area of expertise. In addition, space was provided to allow participants to make additional comments if needed. Participants who did not return information about their background in the first round also received these additional questions in the second round.

5.3. Results

5.3.1. Sample characteristics

In the first round, 217 experts were invited to participate in the Delphi survey. Of these, 143 (66% response rate) participated in the first round of which 108 (76% response rate) also participated in the second round. Participants were predominantly male (77% in round 1 and 80% in round 2). In both rounds, most participants were over 46 years old and held more senior positions within their organisations throughout Europe (Table 5.1 and Table 5.2).

With respect to their main area of expertise, participants from *animal diseases, zoonoses* and *veterinary medicine* were over-represented in comparison to the other areas of expertise. This may be a consequence of the use of cascade methodology to access personal contacts of the EMIDA consortium, as well as the topic of the research (Frewer et al., 2011).

Table 5.1. Sample characteristics of Delphi study[a].

Characteristics	Round 1		Round 2	
Invited	217		143	
Participated	143		108	
Gender				
Female	33		22	
Male	107		86	
Age group				
20 – 35 years	8		7	
36 – 45 years	26		20	
46 – 55 years	73		56	
56 – 65 years	32		25	
66+ years	1		0	
Relevant work experience				
< 5 years	14		10	
6 – 10 years	22		20	
11 – 15 years	19		18	
16 – 20 years	32		25	
21+ years	46		37	
Area of expertise[b]	*Main*	*Additional*	*Main*	*Additional*
Animal diseases, zoonoses (incl. antimicrobial resistance)	46	28	36	25
Veterinary medicine (in general)	41	29	33	21
Epidemiology	23	29	16	24
Risk assessment	22	36	22	35
Immunology / vaccinology	17	20	15	18
Risk management	14	36	14	36
Bacteriology	13	23	11	21
Virology	12	24	9	20
Animal welfare	10	19	9	16
Public health	9	27	6	24
Parasitology	7	16	7	15
Wildlife	5	20	3	15
Risk communication	3	15	3	12
Mathematics (incl. modelling)	2	14	1	12
Other[c]	39	58	31	48

[a] Not all participants filled in these questions.

[b] Participants were asked to select one main area of expertise and select – if appropriate –additional area(s) of expertise. Some participants provided multiple responses to 'main area of expertise'.

[c] Other, including: Agro-economy, Entomology, Animal genetics, Communication, Criminology (including Fraud, Terrorism), Demography, Food / Feed, Ecology / Nature conservation, Meteorology / Climate, Sociology.

Table 5.2. Response rates and distribution across EU member states.

Geographical location		Number of responses	
Region*	Country	Round 1	Round 2
Atlantic		**53**	**36**
	Belgium	7	4
	France	21	14
	Ireland	2	2
	Netherlands	14	9
	United Kingdom	9	7
Continental		**26**	**21**
	Austria	3	3
	Czech Republic	6	5
	Germany	11	8
	Switzerland	6	5
Mediterranean		**27**	**23**
	Israel	4	4
	Italy	18	16
	Spain	5	3
Nordic/Baltic		**32**	**27**
	Denmark	9	9
	Finland	5	4
	Lithuania	3	2
	Norway	5	4
	Sweden	9	7

* This regional division reflected the assumed influence of climate zones on emerging diseases and epidemiological factors such as proximity to other areas where animal diseases were emerging (European Environment Agency).

5.3.2. Preparedness for emerging infectious animal diseases

European preparedness regarding the management of emerging infectious animal diseases. In the first round, participants were requested to rate Europe's preparedness regarding the management of emerging infectious animal diseases, specifically with regard to their identification, control and prevention. About half of the respondents (49%) thought that the European capacity to identify emerging infectious animal diseases is adequate, against 33% of whom thought it is inadequate, Figure 5.1. In contrast, a slight majority of participants (56%) disagreed that the European capacity to prevent emerging animal diseases is adequate (21% agreed). Regarding the adequacy of European capacity to control the occurrence of infectious animal diseases, participants were ambivalent (Figure 5.1). Overall, participants indicated that further development of research in regard to risk management activities is required, in particular with regard to preventive measures.

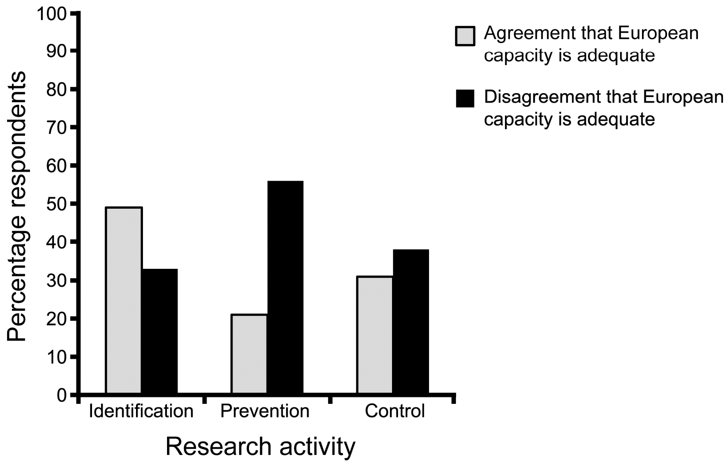

Figure 5.1. Opinions of experts regarding EU capacity to identify, prevent or control emerging infectious animal diseases. *The level of agreement was measured with a 5-point scale. 'Agreement' is aggregated from the categories 'completely agree' and 'agree', and 'disagreement' from the categories 'completely disagree' and 'disagree'. 'Neither agree nor disagree' is omitted from this figure for ease of interpretation.*

Efficacy of predictive methodologies. The four predictive methodologies were all rated as useful and only slight differences were observed in the ratings: workshop (80% agreed usefulness, 3% disagreed); horizon scanning (75% agreed usefulness, 5% disagreed); scenario study (73% agreed usefulness, 9% disagreed); and literature review (70% agreed usefulness, 14% disagreed). In addition, participants were asked to suggest additional methodologies, of which different modelling approaches (e.g. epidemiological modelling, mathematical modelling, and quantitative predictive modelling) were suggested as appropriate, together with applications of holistic systems and applying a combination of methods.

5.3.3. Drivers of future threats to animal health

Driving forces on the incidence of infectious animal diseases in Europe in the short and medium term. Increased globalisation of trade, increased transportation of animals or animal products, and increased contact between animals, and between humans and animals, were perceived to result in an increase of the incidence of emerging infectious animal diseases (Figure 5.2). Against this, drivers related to regulatory and control measures (including improved risk management and novel prevention strategies) were perceived as resulting in potential decreases in the incidence of infectious animal diseases.

Disagreement between the expert participants regarding the direction of impact of some drivers was also observed. These related to differentiation between international and European animal health regulations, and increased food production (Figure 5.2).

Future threats to animal health. In the first round threats to animal health in both the short and medium term were identified qualitatively. For the second round, the responses were collated and divided into five groups according to the type of threat. All threats were rated 'important', though the threats within the groups 'Disease agents', 'Complex infections', and 'Route of transmission' were regarded as being slightly more important in the short term than in the medium term (MANOVA, comparisons between short and medium impacts by threat, respectively, $F(1,42)=4.85$; $p=.03$ and $F(1,58)=4.99$; $p=.03$ and $F(1,71)=5.17$; $p=.03$).

Driving forces	Increase in incidence		Decrease in incidence		No effect on incidence	
	short	medium	short	medium	short	medium
Increased movement of animals	97	96	1	0	2	4
Increased globalisation of trade	94	87	1	2	5	11
Increased emergence of novel infectious animal diseases	89	87	4	9	7	4
Increased interaction between wildlife and production animals	87	84	1	2	12	14
Increased trade in animal products	86	81	0	2	14	18
Climate change	77	89	0	1	23	10
EU Expansion	79	72	3	9	18	19
Increased movement of humans	74	71	0	3	26	26
Increased trade in food	63	64	0	2	37	34
Intensification of agricultural production systems	53	54	12	12	35	34
Increased European (EU) differentiation in animal health regulation	45	41	24	37	31	22
Increased food production	44	50	3	2	53	48
Increased international differentiation in animal health regulation	42	55	16	23	43	22
Increased surveillance and monitoring	17	9	71	84	12	8
European (EU) regulatory harmonisation in the area of animal health	11	5	64	76	25	19
Increased control measures, in the EU	9	9	80	83	11	9
International regulatory harmonisation in the area of animal health	8	5	71	81	21	14
Novel vaccine development	4	6	75	89	21	5
Increased control measures, outside of the EU	4	6	81	87	15	7

Majority over 80%
Majority between 50-80%
Minority over 20%
'Lack of consensus', between 20-50%
Minority below 20%

Figure 5.2. Effect of driving forces on the incidence of infectious animal diseases in Europe in the short and medium term. *N.B. Increased globalisation of trade implies that driving forces other than just animal movement are relevant, for example, feed-borne and vector-borne disease which can be exported and imported across increasingly broad geographical and economic regions.*

Participants were asked to select the three most important threats, and to link these to the drivers already identified. In order to identify the relation between the threats and drivers, majority agreement is suggested for those items when more than two-third of the participants selected the driver. These results are summarised in Figure 5.3 [11]. The threats 'Introduction of exotic diseases in Europe', 'Emerging unknown / novel pathogens', 'Emerging & re-emerging agents', and 'Zoonoses' were most frequently connected to drivers related to the increase or decrease in incidence of emerging infectious animal diseases (in the short and / or medium term).

[11] From the rated drivers (see also Figure 5.2), only those drivers that were selected by ≥75% of respondents to either increase or decrease the incidence were selected for Figure 5.3. The selected threats each had at least one driver connected to them that was combined 15 times or more in one of both time frames.

Drivers	Selected threats							
	Threat of introduction exotic diseases in Europe	Emerging unknown / novel pathogens	Emerging & re-emerging agents	Zoonoses	Arboviruses	Virus	Vector-borne diseases	Antibiotic resistance
Increase in incidence								
Increased movement of animals	○ ●	○ ●	○ ●	●	○ ●	○ ●	○	
Increased globalisation of trade	○ ●	○ ●	○ ●	○ ●				
Increased trade in animal products	○ ●	○ ●	○	○ ●				
Climate change	○ ●	○			○ ●		○ ●	
EU expansion	○ ●		○ ●	○ ●				
Increased emergence of novel infectious animal diseases	●	○ ●			○ ●			
Increased movement of humans	○			○ ●				
Increased interaction between wildlife and production animals		○		○ ●				
Decrease in incidence								
Increased surveillance and monitoring	○ ●	○	○ ●	●	○	○		●
Novel vaccine development	○	○	○			○	●	
Increased control measures, in the EU	○	○	○	●	●			●
Increased control measures, outside the EU	○ ●		●					
International regulatory harmonisation in the area of animal health	○			●				
European (EU) regulatory harmonisation in the area of animal health				●				

Figure 5.3. Relation between threats and drivers to emerging infectious animal diseases. *The white circles indicate when the majority of participants agreed that there was a strong relation between drivers and threats in the short term, and the black circles when there was majority agreement in the medium term. When both white and black circles appear in a cell, the majority of participants agreed that the relationship existed in both the short and medium term.*

○ = *majority agreement in short term (i.e. more than two-thirds agreed).*

● = *majority agreement in medium term (i.e. more than two-thirds agreed).*

5.3.4. Future research topics relating to emerging infectious animal diseases

A long list of participant suggestions was obtained regarding potential research topics focusing on emerging infectious animal diseases which will need to be addressed at the European level (in both the short and medium term). These were allocated into superordinate categories, each of which was rated regarding its importance as a European research topic in the second round and have been divided into research priorities and research disciplines (Table 5.3). Participants rated all future research topics as important. In addition, no significant differences were found between any of the topics, regarding whether they were short or medium term priorities.

Table 5.3. Future research topics as included in the second round questionnaire split over research priorities (topical) and research disciplines.

Research priorities	Research disciplines
Emerging diseases	Biology
Host-pathogen interaction	Climatology
Improve surveillance (diagnostics)	Ecology
Improve/develop early warning systems	Economics, related to animal health
Improvements in emergency preparedness	Entomology
Improvements in emergency response	Epidemiology
Resistance of pathogens to, e.g. anti-microbials	Immunology
Vaccine development	Risk analysis
Vector related research	Virology
Zoonoses (in general) and zoonotic pathogens	

5.4. Discussion

From the first, mostly qualitative, round, one theme appeared from the responses as being very important: preparedness for emerging infectious animal diseases. This theme appeared not only within the questions polling management of emerging infectious animal diseases, but also when identifying research priorities, and drivers for these diseases. Participants identified various drivers relating to regulatory and control measures. With respect to European preparedness in regard to prevention, identification and control of emerging infectious animal diseases, participants indicated that further development of research into risk management activities are required and that their current status is not adequate. In general, current knowledge and disease control tools are not adequate within Europe. This result provides empirical support for the conclusion that greater investment in preparedness has to be an essential component of resource allocation.

Part of the identified future research priorities dealt with the need to improve (or develop) systems relating to surveillance, early warning, emergency preparedness and emergency response. The identified research priorities focused as well on biological science developments, such as research relating to vaccine development and identification of vectors or emerging pathogens. In addition, participants identified several research disciplines that are relevant to research on emerging infectious diseases. They identified both disciplines from biological science (for example, epidemiology or virology) as well as socio-economical disciplines (such as economics, risk communication and risk management).

The results suggested that socio-economic drivers, such as movement of animals, international trade, globalisation, interaction between wildlife and production animals, climate issues, and EU expansion, would increase the incidence of emerging infectious animal diseases. Furthermore, participants indicated that improved regulatory, policy and natural science developments, such as novel vaccines, may help to reduce the incidence of such diseases. From this, one might conclude that interdisciplinary research which addresses both natural and social drivers of emerging infectious animal diseases needs to be developed if effective prevention and mitigation strategies are to be operationalised.

The predictive methodologies included in the Delphi survey (literature review, scenario study, horizon scanning, and workshops), were all confirmed as useful when applied to the area of animal health and emerging infectious animal diseases. The methodologies suggested by participants mainly consist of different types of data modelling, which provides a relatively simple platform to test in theory (possibly) complex real-world issues. In addition, data modelling allows for validation of scenarios which are similar to those found in the field, and therefore may save resources, either immediately or in the future. Furthermore, participants suggested that using a 'combination of methods' (in other words, triangulation of results from different data streams) may facilitate the effectiveness of prediction. Integrating this with earlier reported outcomes, the use of triangulation of data might be to apply different interdisciplinary research approaches to provide information relevant to the prevention and mitigation of emerging infectious animal diseases.

All threats identified by participants in round 1 were rated to be of importance in the second survey round. The threats were combined with the drivers to obtain a more clear association of how these threats might spread or be moderated. The 'threat of introduction of exotic diseases in Europe' and 'emerging unknown or novel pathogens' were thought to be possibly reduced in the *short* term through increased surveillance and monitoring, novel vaccine development, increased control measures, and international regulatory harmonisation. In addition, these same factors were thought to possibly decrease the incidence of zoonoses in the *medium* term. With regard to a possible increase in incidence no clear relationship was identified. When comparing the different outcomes of the survey, zoonoses and vector-borne diseases were not just identified as important threats but also identified as future research priorities, indicating their significance. The drivers that were most frequently related to these significant threats were 'increased movement of animals' and 'increased need for surveillance and monitoring'.

Delphi methodology is often applied to the development of consensus across an expert group regarding an issue or policy option. The Delphi study presented was employed at an exploratory stage of research, and will contribute to the development of a common strategic research agenda on emerging and major infectious diseases of livestock. The strength of this study is that implicit research priorities have been made explicit through empirical analysis, which not only reflects and aggregates the views of disparate experts, but may also test assumptions which have not hitherto been questioned. The outcomes are presented as aggregated or averaged responses. It is also important to note that "outlier" opinion may be of importance, but the relatively low level of interdisciplinarity in expertise may have resulted in a bias towards homogeneity in initial responses, and so potentially “outlier” responses could not be rated by the participants in round 2.

The differences between the short and medium term time frames were not marked. A broader differentiation between times might have provided a more distinct difference (e.g. Suk et al., 2008). However, several participants noted that it was difficult (if not unfeasible) to foresee the future, regardless of a specification of time frames.

There was lack of consensus across the participant group regarding the (direction of) impact of some potential drivers of emerging infectious animal diseases. If this study aimed for consensus of opinions, then ideally, these issues would have been further investigated in a subsequent round (or rounds) including feedback from the previous round. However, the study aimed to report research priorities as suggested by the respondents, which were obtained within these two survey rounds. In addition, given that the results from this Delphi study, including those where consensus did not occur, were presented to the participants of the subsequent consensus workshop, it may be assumed that further discussion regarding participant disagreement was discussed by workshop members in the subsequent consensus workshop (Ooms, et al., 2010). Alternatively, lack of consensus might indicate the participants’ uncertainty whether or not a specific issue was relevant, or uncertainty in the extent to which participants were certain of their answer. Uncertainty analysis as described by Walshe and Burgman (2010) might help determine whether this was indeed the case, and may provide a solution when applied to future exercises. It is of relevance to note that a number of ‘economic’ quantitative modelling techniques (as far as they concern the allocation of resources to different disease-control strategies) have been used to provide information to help decision makers choose appropriate livestock health and disease-control strategies. These include mathematical programming, network analysis, decision analysis, simulation and cost-benefit analysis all have been applied to livestock disease-control decisions (for reviews see Bennett, 1992; for examples of application see Harvey et al., 2007). Such approaches might usefully be applied to the context of emerging infectious animal diseases given the economic importance of the animals affected.

An important result is that more emphasis should be given to prevention and control measures, as opposed to mitigation. The prioritisation is acknowledged by many risk managers active in this area, and other European activities have led to the same conclusions. For example, the European Technology Platform for Global Animal Health and the associated EU project DISCONTOOLS have identified the need for developing effective tools for controlling infectious and contagious animal diseases, for example through more effective epidemiological assessments, economic evaluations and risk analysis and, in the longer term, breeding for resistance (European Technology Platform for Global Animal Health[12]). The fact that similar results have been reached through application of different methods lends support to the robustness of the overall conclusions, as well as the need for an interdisciplinary approach to animal disease management.

Finally, a bias in responses may have been associated with the type of sampling used. Although a sampling frame which focused on multiple areas of expertise has been applied to select experts, most participants reported their area of expertise to lie within animal diseases, veterinary medicine and epidemiology. The use of cascade-methodology may have affected the participant list as more experts in certain areas of animal health were recruited because more experts in these areas were originally involved in the EMIDA network. In addition, the use of this methodology within this network may have resulted in a bias towards participants from the Atlantic region. Therefore, a comparative analysis based upon these four regions, which could have identified research priorities specific to a region or threats more predominant in certain regions, has not been performed. While every effort was made to include a range of expertise from individuals with a range of disciplinary backgrounds with an interest in the area of infectious animal diseases, the sample was dominated by participants indicating that their main interest was in animal diseases, veterinary medicine and epidemiology. It is suggested that this reflects a bias in the institutional recruitment of expertise to the study of infectious animal diseases, as well as the differential regional resource allocated to the area of research across Europe. Therefore a criticism of the study was that recruitment was not assessed against a "European map" of interested expertise, although, to our knowledge, this information is not accessible at the current time. The use of co-nomination (where respondents are asked to identify suitable participants to be additionally included in the study, whilst at the same profiling their own expertise), may represent a useful approach to identifying additional experts in foresight studies whilst at the same time facilitating the "mapping" of relevant expertise (Nedeva et al., 1996) and should be considered in future research of this type. As a consequence, the division into regions was incorporated in the subsequent consensus workshop providing outcomes on both pan-European as well as the four regional levels, although it should be noted that the workshop involved fewer

[12] http://www.etpgah.net/ (accessed 8 August 2011)

participants than were included in the Delphi survey owing to logistic limitations and availability of participants (Ooms, et al., 2010).

It is possible that a "bias" in the summarised Delphi summaries might arise because of the differential weighting of experts with different types of expertise. Arguably statistical comparison of the opinions and views of different experts would enable identification of such biases, although it is difficult to obtain a sample totally representative of all relevant expertise, or indeed establish relative weights regarding the inputs of different experts into the final conclusions. In the research reported here, the domination of experts identifying a dominant expertise in the area of animal disease zoonoses and veterinary medicine reflects the issue under discussion. Whilst meaningful statistical comparison between experts in these domains and other types of expertise regarding opinions and priorities is not practical in the current study, given the very low numbers of participants in the latter categories, this may be a comparison which is relevant in future studies where the distribution of different types of expertise is more equal across expertise domains.

5.5. Conclusions

Within this study, drivers related to regulatory and control measures were perceived as resulting in a potential decrease, as the more socio-economic drivers would increase the incidence of emerging infectious animal diseases. The drivers 'movement of animals' and 'increased need for surveillance and monitoring' were the principal drivers to which the threats were connected. More specifically, the first driver was identified as potentially increasing the incidence of threats, and the latter driver may reduce the incidence. The most frequently related threats were: 'threat of introduction exotic diseases in Europe', 'emerging unknown / novel pathogens', 'emerging and re-emerging agents', and 'zoonoses'.

Participants within this study have not only identified threats to animal health, but also identified possible mitigatory actions to reduce the negative impact of these threats. In order to control emerging infectious disease threats, resource allocation should increasingly focus on the development of effective policy measures regarding emergency preparedness. Furthermore, resources are needed to fund natural sciences development that support these risk management measures, such as research relating to disease agents (e.g. host-pathogen interaction), route of transmission (e.g. vector-borne diseases). Participants have emphasised that socio-economic research is needed to understand drivers of emerging infectious animal diseases, as well as to develop control measures which are both socio-economic and technical. Therefore, resources are needed to study socio-economic factors which may be relevant to the prevention and mitigation of emerging infectious diseases. Examples include supply chain management, risk communication and risk management systems, and economic drivers. Participants also identified that an interdisciplinary approach is required in the future if the mitigation and prevention of infectious animal diseases is to be optimised.

CHAPTER 6

General discussion

The agri-food domain is complex and is associated with diverse interests held by multiple stakeholders and agencies. Globalisation of the food supply chain makes agri-food policy development a dynamic and continuously changing area. Adjustments in this dynamic process are needed to assess and manage (emerging) food risks, which are associated with different drivers. Timely identification, prevention, and mitigation of risks is needed to make transparent decisions while incorporating the complexities of the agri-food domain and the interests and priorities of all stakeholders. As part of the process of developing effective risk governance, it is important to access expert opinion across a broad range of domains in order that food risk policy is based on the best evidence available. Developing best practice in soliciting expert views, locally, nationally, regionally, or globally is therefore a priority. Therefore, it is important to understand how best to execute such exercises and to guide researchers by providing best practice methodological approaches to soliciting expert opinion.

This thesis has discussed how best to involve experts in policy development, specifically within the agri-food domain, where inclusion of diverse expertise, large numbers of geo-dispersed experts, and uncertain or ambiguous policy issues are of relevance. Following a systematic review of the published literature, it was determined that Delphi methodology appeared to be an appropriate methodology to elicit expert opinion and gather evidence in the complex policy domain associated with risk, food and agriculture. To this end, three Delphi cases in agri-food policy development were conducted.

This final chapter concludes this thesis by providing an overview of the main findings of this thesis. In addition, the contributions this research has made to theory and practice are discussed; methodological implications and implications for agri-food policy development are provided. To conclude, the limitations of current research are addressed and recommendations for future research are made.

6.1. Main findings and conclusions

C*hapter 2* of the thesis provided an overview of current expert involvement practice in the policy domain through application of a systematic literature review. A total of 101 papers were included in the systematic review. These papers addressed research that predominantly originated in the domain of environmental and health sciences, and the agri-food sector. The analysis of the contents of these papers identified three main issues of relevance to developing best practice in soliciting expert opinion. These were the need to identify the optimal method for soliciting expert opinion, the lack of evaluation of exercises (both of the process of expert involvement and in terms of policy impact of the results), and the lack of quality control measures relating to reporting processes and outcomes.

The systematic literature review showed that it is important to consider the objectives of a specific expert involvement exercise in order to make an informed choice for an appropriate expert involvement methodology. A framework to support the identification of appropriate methodologies was presented (Table 2.6.), based on the characteristics of the policy issue under consideration. Specifically, the framework suggests methodologies for different levels of agreement, ambiguity and certainty associated with the policy question, as well as the goal of the exercise (i.e. decision making or information gathering) and characteristics of contributing expert groups. In addition, methodology selection is dependent on whether experts are recruited from a broad or narrow expertise base, or from geographically dispersed areas (for example, in the case of policy development that affects a broad region, or with a global level of impact). Evaluations regarding the effectiveness of the process and/or policy impact were infrequently reported. It was recognised that policy translation or measuring the effectiveness of the process may take place after the involvement phase is completed or research papers have been published. It was suggested that, as a *de minimis*, authors should describe how the outputs are *anticipated* to have an impact on policy, even if the research was completed before the policy translation and implementation stage. Some limitations relating to the need to adopt consistent reporting practices regarding participant characteristics were also identified. Of particular concern was the issue of how experts were recruited. From the 159 studies included, 81 reported the sample selection method used to recruit participants, 5 studies described the selection method in insufficient detail to allow replication, and the remaining 73 studies did not provide any details. Delphi was shown to be a method that is flexible enough to deal with the diversity in policy situations and experts involved in the agri-food domain. This property makes Delphi a relevant choice to study expert involvement practice in the context of agri-food policy.

In Chapters 3-5, three Delphi case studies were presented which all focussed on different policy issues within the European and global agri-food domain. Their sequential execution allowed for the uptake of insights and methodological improvement into the subsequent Delphi study. An overview of study characteristics for these three Delphi studies is provided in Table 6.1.

Delphi study 1

In the first case study, reported in C*hapter 3*, a "global" Delphi exercise was conducted. The Delphi study was part of an integrated project called SAFE FOODS, which focused on developing a more effective and inclusive food risk governance framework (König, et al., 2010). To assess the viability of this novel framework, food risk experts from the EU and internationally (non-EU) were consulted through the application of a two-round online Delphi survey. The outcomes of the study suggest that there was considerable support for many of the new principles suggested by the novel framework, but some uncertainty was expressed regarding how, in practice, these might be enacted in the context of food risk governance.

More important in the context of this thesis, this first Delphi study examined the feasibility of Delphi when applied to large groups of geo-dispersed experts. The study demonstrated that the Delphi method was a useful mechanism for consulting a large and diverse group of experts from around the world who would not otherwise have been able to meet on a face-to-face basis. Delphi thus helped in overcoming resource constrains for both the experts (in terms of time and disparate geographical location) as well as in relation to pragmatic limitations (primarily financial, which would have prohibited the implementation of a physical workshop).

Although the experts were recruited in order to align with specific profiles regarding expertise (i.e. risk assessment; risk management; risk communication) and employment (i.e. industry; government; NGO), most respondents were risk assessors. This may have resulted in an (unintended) bias relating to the disciplinary domain of the experts included in the study. Participants were recruited using cascade-methodology through project members, although a brief exploration of the nature of participants showed that they were more likely to respond if they were involved with, or had close links with, the network or the researchers involved in the SAFE FOODS project. As a consequence of participants not proportionally representing all relevant stakeholder constituencies, it was concluded that participant recruitment needed further attention in subsequent Delphi studies. In addition, retention of experts for inclusion in round 2 was limited, and subsequent Delphi exercises focused on developing additional methods to retain experts across all Delphi rounds.

Furthermore, it was concluded that future Delphi studies are likely to benefit from an initial, exploratory, qualitative stage to clarify key issues in advance, which would facilitate the construction of (primarily) quantitative subsequent rounds. The amount of time needed to respond to quantitative, rather than qualitative, surveys is likely to be less, which may increase participant retention across subsequent rounds. In addition, and perhaps even more important in international studies, non-native English experts – who may be less comfortable in expressing their views in English – benefit as a predominantly quantitative questionnaire would require less qualitative writing in a language other than their first.

Delphi study 2

Chapter 4 describes a two-round Delphi survey, which was conducted following an initial qualitative exploratory study. The Delphi polled international experts' views to identify knowledge gaps associated with the identification and mitigation of emerging food risks, and barriers to emerging food risk identification and prevention. The research was funded as part of the EU funded GO-GLOBAL project, which had the objective of developing a common global research portfolio and capacity building agenda regarding emerging food risk identification. The results suggest that keeping emerging food risk on research agendas, data sharing, and international harmonisation regarding application of predictive methodologies were priorities for the experts involved. In addition, capacity and capability building regarding emerging food risk identification assessment and mitigation were identified as being relevant in less affluent countries.

As suggested by analysis of the results of the first Delphi study, this Delphi was preceded by an "exploratory" study to ensure more focus on the policy questions of relevance. Sampling of experts was again conducted through personal contacts of the researchers (e.g. authors and some project members) using expertise profiles and through a food safety expert database. This may once more have resulted in some bias towards experts already inside the food risk governance system who shared common institutional values. The global food safety experts were provided with Delphi questionnaires in four languages (English, French, Spanish, Portuguese). Experts could request email or postal return of questionnaires. The limitation of translation to western languages was pragmatic and was determined by the linguistic skills of the researchers involved in the study, with English as the dominant language. Translation into French was intended to encompass sub-Sahara Africa; translation into Spanish was intended to encompass Latin America, and into Portuguese to encompass Brazil. The omission of some important non-western languages used by experts relevant to the policy question (e.g. Chinese, Japanese or Russian) may have had an effect on participant responses that needs further investigation. A total of six in round 1 and six in round 2 of non-English questionnaires were returned, suggesting that the availability of languages other than English resulted only in slightly increased response rates. It was concluded that English is potentially the main language used to discuss emerging food risks in expert groups. With the possible caveat that the experts in the researchers' network were more likely to be fluent English speakers. Although Spanish and Portuguese questionnaires were provided, no responses from South America were received. Similarly, most responses were obtained through the online Delphi questionnaires, with only a few experts using other means to respond (three responses were received *via* email, post or fax), suggesting that internet connections were adequate for the majority of the participants. It must be noted that respondents were predominantly from Europe (70%), therefore, firm conclusions regarding the need for additional language options and actual internet access issues could not be made, and need further research.

Delphi study 3

The research reported in C*hapter 5* was part of a process aimed at developing a common strategic research agenda regarding mitigation of emerging and major infectious diseases of livestock in Europe, covering a 5 to 15 year time span, by EMIDA ERA-NET (the European Research Area Network of European research funders). Preceded by a qualitative scoping stage, a two-round online Delphi study was conducted to explore the views of experts on the prevention, mitigation and control of emerging infectious diseases of production animals in Europe. Participants emphasised that interdisciplinary research (involving both the natural and social sciences) is needed to understand the identified drivers of emerging infectious animal diseases, and the development of effective preventative and control measures needed to combine both socio-economic and technical policy measures.

Again the Delphi study was preceded by a qualitative exploratory study. This time, two preparatory workshops were used to define relevant research questions, and to comment on the draft questionnaire. The experts for the Delphi study were recruited through cascade-methodology using project members and an "expertise matrix", detailing type of expertise (i.e. risk assessment; risk management; risk communication) and employment (i.e. industry; government; NGO). Project members were instructed to populate the matrix with candidate participants and to obtain initial participation commitment from the experts, making sure that experts agreed to follow the procedure (e.g. through making personal contact with them). The intention was to reduce expertise bias regarding participant representation as much as possible, as well as increase participant cooperation through the use of personal contacts. The results of the

Delphi study were used to contribute to the development of a Strategic Research Agenda to be utilised by European research funders. This provided the experts with a clear incentive to participate as the suggested topics are likely to result in future research funding from which they may benefit in the future. Both the method used to recruit experts, and the opportunity perceived by participants to directly influence policy may have enhanced response rates in comparison to the two previous Delphi studies. It is, however, unclear as to whether (reduced) linguistic problems, and easier access to the internet based survey availability increased participation by experts. As was the case for the first Delphi study, the language used in the Delphi surveys research instruments was English (a consequence of the low take-up rate on non-English options in the second survey). As for the second study, off-line options (e.g. word-document) were provided although hardly used.

Table 6.1. Overview characteristics Delphi studies.

Study characteristic	Delphi study 1 (*Chapter 3*)	Delphi study 2 (*Chapter 4*)	Delphi study 3 (*Chapter 5*)
Policy issue	Novel food risk governance model	Global emerging food risk identification	Emerging infectious animal diseases in Europe
Relation to policy development	Indirect through objectives European funded research project	Indirect through objectives European funded research project	Contribution to strategic research agenda for European research funders
Methodological design	-2 predominantly quantitative pilot Delphi rounds -2 predominantly quantitative Delphi rounds	-qualitative exploratory study -2 predominantly quantitative Delphi rounds	-2 qualitative workshops developing Delphi items -pilot round 1 -2 predominantly quantitative Delphi rounds
Surveying methods	Online (email or postal/fax return optional)	Online (email and postal/fax return optional)	-Workshops: face-to-face -Delphi: online (email and postal/fax return optional)
Language Delphi questionnaire	English	-Pilot: English -Delphi: English, French, Spanish, Portuguese	English
Relevant stakeholder population	European and Global food risk experts (separate groups)	Global food safety assessment and management experts	European animal health experts
Participant recruitment	Cascade-methodology through project members using expertise matrix	-Food safety expert database -Cascade-methodology through project members using expertise matrix	Cascade-methodology through project members using expertise matrix, plus participation commitment
Invited	-EU: 106 -International: 60	1931	217
Response Round 1 (response rate)	-EU: 33 (31%) -International: 19 (32%)	421 (22%)	143 (66%)
Response Round 2 (response rate, *to round 1*)	-EU: 21 (64%) -International: 12 (63%)	113 (27%)	108 (76%)

6.2. Lessons learned: implications

6.2.1. Methodological implications

The research conducted in this thesis has several methodological implications. Given that the application of Delphi methodology is labour intensive, it is important to recognise that Delphi methodology requires sufficient resources to ensure participant recruitment, provide quick analysis of results, provide feedback to participants, and allow adaptation of the survey in the subsequent survey rounds. This may be particularly the case when using heterogeneous participant groups. Inclusion of a large number of participants, while increasing the representativeness of the expert sample, will increase resources needed to analyse data, particularly if this is qualitative. In addition, if a Delphi study is focused on exploring policy issues, it may need to cover a broad range of issues and types of evidence that may need to be investigated. Hence, each – subsequent – survey round needs to be carefully designed, ensuring all relevant views and issues are included. From this can be concluded that it is important to create procedures facilitating best practice, and to find the right balance between pragmatic possibilities that are available in terms of resources and a "methodological gold standard." The analysis of the application and results of the three Delphi studies included in this thesis have provided information upon which best practices for the use of Delphi in policy development can be based. The sequential application of the three Delphi cases allowed for the lessons learned from each study to be incorporated in subsequent studies, and facilitated consideration of the strengths and weaknesses throughout the process of Delphi application.

Inclusion of scoping stage in advance of predominantly quantitative Delphi rounds

The Delphi studies included in this thesis demonstrate that large scale Delphi studies, including those involving large geo-dispersed participant groups, are best conducted by including predominantly quantitative questions for several reasons. First, quantitative questionnaires, consisting of mainly closed questions, are more straightforward to complete for participants and take less time than qualitative questionnaires. Recognition of this is important for ensuring participant commitment. Second, closed questions may be relatively less burdensome than open questions for experts whose native language is different to that used in the questionnaire, but whose opinion is required to synthesise evidence for the policy question under consideration.

This would encourage participation of all relevant stakeholders and, to some extent contribute to reduction of the inequalities in formulating responses experienced by non-native speakers of the language(s) used in the study. Finally, closed questions are in general easier and faster to analyse, which is important given the need to analyse the initial rounds quickly to provide feedback for the subsequent rounds, which may be compromised given that resources are not infinite if the surveys utilise predominantly qualitative methodologies. This in turn ensures expert commitment and provides a more manageable project workload.

Against this, a potential disadvantage of quantitative questionnaires is that expert opinion can only be solicited regarding policy issues or evidence defined *a priori*. To ensure that the relevant issues are included in the quantitative phases of the Delphi study, an initial qualitative inquiry of the policy issue using a small sample of relevant experts may be helpful. The utility of this approach has been demonstrated in the thesis through, for example, use of qualitative questionnaires (Chapter 4) and expert workshops (Chapter 5). It is suggested that an important step in improving Delphi methodology for policy development is the addition of a qualitative scoping phase with a smaller, but representative participant sub-sample. By including a scoping stage, the researcher can focus the main rounds of the Delphi on the policy issue at hand, or, if needed, on more controversial issues. This in turn makes better use of the time and knowledge of both the experts involved and the project researchers.

In the current thesis, the scoping methods have been fairly straightforward (an online qualitative survey in Chapter 4; expert workshops in Chapter 5). It is important that the method used in the scoping stage is transparent in its use. Until further research on the use of a scoping stage in advance of a Delphi study has provided guidance on selection and execution of relevant methods, methodological transparency can be achieved by clearly reporting the methodologies applied, and the results of the study, which should be carefully transcribed or recorded for future reference.

The three Delphi studies in this thesis included both quantitative as well as qualitative questions, the latter mostly being utilised to clarify the responses or for quantification in the next round. By including both types of questions, these Delphi studies allowed the experts to remotely and anonymously share arguments (beyond mere judgements) through their responses. Although inclusion of qualitative responses may increase the work load of researchers, it is nevertheless recommended that, if possible, future Delphi studies include both qualitative and quantitative questions because this helps to understand the motivation of, and rationales applied, by experts to answer the closed questions. In addition, qualitative questions allow new topics to emerge that were either overlooked in the scoping round, or could not be realistically predicted at that time as the emergence of new information changed the "framing" of the study, either as a consequence of eternal events or because of the impacts of the Delphi process itself. Chapters 4 and 5 have shown that the qualitative scoping round and derived extensive closed options limited the need for the amount of qualitative input, which kept the workload manageable even with large numbers of participants.

Expert recruitment and retention

Identification and recruitment of relevant expert participants is an important, yet difficult, part of an expert study, which is often underrated and, as a consequence, underreported. The results from the systematic literature review (Chapter 2) have shown that almost half of the papers included (46%) did not report details on the participant selection procedure. Lack of these details makes replication of a study impossible, and assessment of potential biases in expert samples is difficult without this information. Difficulties in expert identification and recruitment may also be an issue in expert involvement; this thesis demonstrated difficulties with obtaining expert samples equally distributed across expertise domain or geographical regions. For example, more participants were recruited from Western Europe in the Delphi reported in Chapter 5. As a result regional comparisons could not be made (although response differentiation was expected). This may have been a consequence of the recruitment strategy used (through the networks of the researchers involved in the project, who tended to be, but were not exclusively, Western European themselves). In the Delphi reported in Chapter 4, regional differences in responses between Delphi participants were sufficiently high in the first round for geographical comparisons to be made, despite a greater proportion of participants originating in Western Europe. However, participant attrition between rounds resulted in insufficient statistical power for further analysis in the subsequent round. This latter example illustrates an additional difficulty for iterative studies such as Delphi, namely, the challenge of keeping experts involved across the whole of an intensive, multi-round process (see also Rowe & Wright, 2011).

The studies reported in this thesis use a person-to-person "cascade" methodology (where study participants themselves are asked to supply the names of possible further recruits). Rowe and Wright (2011) suggest also the exploitation of publically available bibliographic information to identify potential experts (in terms of interests directly relevant to the topic of interest), which may facilitate participant retention across studies. If those responsible for recruitment also stress the potential policy impact, this may further improve participant retention over Delphi rounds (as demonstrated in Chapter 5, and see also Rowe & Wright, 2011). In the third Delphi study (Chapter 5), participants were identified through cascade methodology using an expertise matrix (e.g. a matrix listing disciplines, stakeholder groups and institutions), which was completed using information supplied by the researcher partners involved in the project consortium. While these initial steps were similar to those used in previous Delphi studies, the research partners were also asked to confirm commitment of the potential expert participant regarding their potential participation in the wholes study. This latter action proved important, as first round response rates were higher in comparison to the previous studies (Table 6.1.). This could be as interpreted as a consequence of social pressure to participate from peers within the experts' own professional network, combined with pre-commitment, representing a more successful strategy compared to an invitation from an anonymous researcher (or a researcher unknown to the expert). It should be noted, however, that experts who had already declined participation (in the initial expert acquisition stage) were not included in the initial invitation list, and thereby excluded from the first round response rate statistics. Hence, first round response rates are not fully comparable across the three studies. Second round response rates indicate that expert participants who potentially had a low stake in the study (Chapter 4) are least likely to be retained in subsequent rounds, while participants with high stake in the study (Chapters 3 and 5) are more likely to be retained, and it appears that pre-commitment (Chapter 5) further increased this.

Enhancing methodological rigour in expert involvement methods

In methodological designs that do not incorporate quality control measures, the quality of expert involvement exercises cannot be assessed, and this should be regarded as a methodological fault (Chapter 2). This also suggests a lack of appreciation for the importance of methodologically rigorous execution of these exercises and decreases (research) transparency. Rowe and Frewer (2005) provide a similar discussion in the domain of public participation exercises and suggest that the lack of quality control measures may be the result of pragmatic limitations (e.g. time and cost). Developing a more formalised approach to reporting expert involvement exercises contributes to establishing methodological rigour and promotes (research) transparency. Methodological features proposed in Chapter 2 (e.g. reporting of research limitations, participant characteristics, and procedure) require further development and need to be tested in terms of their practical applicability. In addition, criteria need to be developed against which expert involvement exercises can be evaluated in order to judge their methodological rigour. In addition, the impact of their results on policy also needs to be assessed. Without such standards currently available, reporting methodological details (including policy impact) will be a good start.

The Delphi method is often criticised for its *lack* of methodological rigour (Hasson & Keeney, 2011). This is mainly due to the many variations that exist in the application of Delphi (e.g. Hasson & Keeney, 2011; Rowe, et al., 1991; von der Gracht, 2012). A generally agreed definition of what a Delphi is, in terms of methodology adopted, is needed to be able to classify research as a true Delphi and to judge the quality of the research in terms of rigour, reliability and validity against a standard for a good Delphi (Hasson & Keeney, 2011; Rowe & Frewer, 2005).

To develop a standardised definition of Delphi, the characteristics to which the method should adhere need to be defined. In the literature, four essential characteristics can be identified regarding the definition of Delphi methodology: anonymous participation, iteration, the use of controlled opinion feedback, and statistical aggregation of group response (Hasson & Keeney, 2011; Linstone & Turoff, 2011; Rowe & Wright, 1999; von der Gracht, 2012). In addition to these fixed characteristics, there are other, more adaptable, characteristics that define Delphi. The adoption of these characteristics may vary depending on the specific policy issue at hand. Throughout this thesis, suggestions have been made to improve the Delphi method to facilitate its application in the complex area of agri-food policy development (Table 6.2.). First, a more structured first round was advocated as it helped increase expert responses (in particular making it easier to respond to for international experts). To achieve this, a qualitative scoping stage was suggested, such that the study topics were explored in advance allowing for more quantitative questions in the first main Delphi round. Second, a combination of quantitative feedback (e.g. statistical summary of group response), and feedback using qualitative responses (taken from rationales) have both been used in the studies reported in this thesis. This combination was demonstrated to be important as it allows for more detailed explanation of responses, as well as anonymous expert interaction, and transparency within the Delphi process.

Table 6.2. Overview of adaptable Delphi characteristics as applied within this thesis.

Delphi characteristic	Identified requirement	Suggested application
Structuring of first round	Adding a scoping study (with a limited subsample) helps to define questions to be asked and issues to be explored in the first formal round of the Delphi that follows.	Include qualitative scoping stage in advance of Delphi.
	A structured, predominantly quantitative, first round has proven useful as it helped increase expert responses (being easier to respond to for international experts).	Design first round with predominantly quantitative items.
Type of feedback*	A combination of quantitative and qualitative feedback allowed a more detailed explanation of (summarised) participant responses.	Combination of quantitative feedback (e.g. statistical summary of group response), and feedback using qualitative responses (providing explanations (rationales) of individual responses).

* To be included in subsequent rounds.

In addition to these characteristics, the three Delphi studies all explored the policy issue under consideration by measuring levels of agreement between experts regarding which policy issues were important, and what evidence was needed to support policy development in these areas. However, Delphi may also be useful as a methodology to be applied in policy decision making, for example in terms of developing consensus across a policy making group. In the case of agri-food policy development, the usefulness of Delphi is broadly applicable throughout the policy process, from identifying drivers of existing and emerging food risks, through to risk assessment and risk management, and developing effective communication strategies. Further research might usefully examine how this integrated Delphi methodology could be applied across other stages of the policy development process, potentially utilising experts (and other stakeholder) views at different policy stages.

The combination of Delphi with other techniques may also be considered, resulting in a more broadly based decision making process (Rowe & Wright, 2011). By triangulating results from different data streams, a more comprehensible set of policy recommendations can be developed, as different methods may be more relevant to identifying different policy solutions, or solving different "pieces of the puzzle."

Although not adopted in this thesis, the outcomes of the third Delphi study (Chapter 4) were included in this type of approach (EMIDA-FPU, 2011). The Delphi study, together with a literature review of relevant publications and documents, and the conclusions of a consensus workshop, each generated input into the strategic research agenda to optimise health of production animals within Europe in the next 10-15 years. Combining Delphi with other techniques may appeal to participants and enhance their commitment and could be part of enhancing methodological rigour of the overall process (Rowe & Wright, 2011).

6.2.2. Implications for agri-food policy development

The multi-stage cyclic policy development process includes formulation of the policy issue (exploration of topic), information gathering (quantification of data), decision making, implementation and evaluation of policy (FAO/GESAMP, 1996; IRGC, et al., 2005; Klinke, et al., 2006). Each of these stages requires a different type of outcome, and thereby needs a specific methodology able to deliver each specific outcome. In addition, transparency, resource accountability (i.e. money well spent) and independence of data gathering (or independence of researchers) are other important requirements within the policy domain that need to be met. Therefore, it is important to select the appropriate expert involvement method, taking these requirements into account. The proposed framework to identify expert involvement methods in policy development (Chapter 2) aims to facilitate this need as it takes both policy and expert involvement characteristics into account, enabling both researchers and policymakers to select the most appropriate method or combination of methods for their specific policy question.

This thesis has focused on the Delphi method as applied to elicit expert knowledge, which can be utilised at different stages in agri-food policy development. This thesis has focused on the use of Delphi primarily within the earlier parts of the policy development process (i.e. formulation of policy issues and information gathering), although there is no reason to assume that it cannot also be used at later stages of policy-related decision-making in the agri-food sector. As all activities and data gathered during a Delphi exercise can be recorded and audited, Delphi methodology can deal with the increased need for accountability and transparency within the policy domain. This will facilitate assessment of the impact the Delphi results and recommendations had on final policy development, as well as the extent to which the resources allocated to the expert or stakeholder analysis were appropriate. Furthermore, evaluation can demonstrate whether the exercise was conducted in a fair manner, i.e. if the exercise was run independently of the research 'sponsor' (see also Rowe & Frewer, 2000).

To maximise the value of expert or stakeholder involvement exercises, the most appropriate experts need to be included in the involvement exercise. Motivating busy experts to participate in such exercises may be problematic. The research reported in this thesis has studied topics that required participation of agri-food experts from a variety of disciplines, as well as geographically dispersed expert communities. This is related to the need to apply interdisciplinary expertise to the resolution of problems in the agri-food domain, and the international focus of agri-food policy issues. The Delphi method has been shown to be successful in soliciting the expert opinions of experts from diverse disciplinary backgrounds, and from different geographical locations. Furthermore, Delphi facilitates inclusion of large numbers of (diverse) experts, which may strengthen the certainty that the broader constituency of interested experts and/or stakeholders has been consulted.

Perceived influence on the policy development process, and the final policies that are developed, motivates experts to participate in expert consultations. Within the third Delphi study (Chapter 5), experts had a clear incentive to participate as they were able to influence the research topics to be included in a European strategic research agenda, which in turn would benefit the experts as the research agenda will determine future European research funding in the area of infectious animal diseases. However, against this, the impact of the expert consultation on policy development may not always be obvious from the perspective of the experts themselves, either because of perceived lack of evidence that this has occurred in the past, or because the policy consultation was funded by a sponsoring body which was not perceived to be relevant to local policy development (for example, a research project funded by the European Commission may not appear relevant to an expert working outside of the EU). Therefore, it is important to make clear to experts what they gain or how they contribute by participating in the exercise at the outset. In addition, evaluation of the exercise may contribute to demonstrating impact by showing how expert views were taken into account in the development of policy. Both types of information can be used to incentivise experts to engage in future consultation activities.

6.3. Moving forward: recommendations for future research

This thesis has provided insights into carrying out expert involvement exercises. This section identifies two important lines of future research, based on the results of this thesis.

Evaluation of expert involvement exercises

Although the relevance of policy impact *assessment* as part of the evaluation process associated with expert consultation was acknowledged, the actual policy impact could not be assessed in the research reported in this thesis. In all of the cases, the research project ended before policy developed from the results could be implemented, and consequently evaluation of policy impact was not possible. It is suggested that adequate resourcing and time be factored into future expert involvement activities to enable policy impact to be assessed, although it is recognised that this is not always pragmatically possible. Having evaluation as an integral part of the project makes it part of the process and thereby ensures execution of the evaluation activity (Boaz et al., 2009). As well as demonstrating the value of the process itself in policy development to potential funders, expert participants are likely to be more motivated to take part in future exercises. In addition, the whole process of expert consultation and policy making becomes more transparent to external stakeholders, including the general public. As a consequence, it is important that policy makers and researchers are made aware of the importance of rigorous and standardised evaluation. Arguments for evaluation are: 1. The need to increase *transparency* in decision-making (Houghton, et al., 2008; König, et al., 2010); 2. The need to demonstrate *accountability* in terms of resource utilisation; 3. The need to *evaluate "performance"*, i.e. decide if the objectives were met; 4. To *learn* from past exercises about how to *improve* future expert involvement activities; 5. To *enhance* policy process, from the perspective of future efficiencies (Boaz, et al., 2009). To date, the development of evaluative frameworks has largely been confined to public participation rather than expert of stakeholder involvement (for example: Reed, 2008; Rowe & Frewer, 2000, 2005). Following the development and validation of criteria to evaluate exercises, a comprehensive framework should be created, built on these criteria, to evaluate expert involvement exercises in terms of the efficacy of both process and outcomes (e.g. policy impact). Reviewing available literature on relevant evaluation criteria, and case studies may inform possible other criteria and provide real world feedback. An evaluation protocol, describing in detail how the evaluation should be conducted, should be created and validated against real world expert involvement exercises. Finally, the practical applicability of the guideline needs to be tested, by conducting additional case studies and evaluating these, allowing for adaptations where needed. Once the validity of the guideline and protocol has been demonstrated, it should be shared with the wider community, allowing for more generalised uptake and application.

Informed choice of expert involvement methodology

The framework developed to identify and select expert involvement methods (Chapter 2) has provided an important first step in developing insight into expert involvement – within the agri-food governance and policy making domain. Subsequently, this thesis has examined only one expert involvement method in detail. Therefore, further research should focus on validating the identification framework in other areas of application. First, the framework needs to be validated. Through applying the framework in practice (i.e. employing case studies), all relevant characteristics can be identified. Second, investigation is needed to examine whether additional methods for expert consultation, perhaps through case study analysis including evaluation of the relevance of the method to (different types of) policy development. Third, more research is needed to develop guidance on executing expert involvement exercises in general. This thesis focussed on the Delphi method, and some recommendations on adjusting the Delphi method to accommodate agri-food policy making were made. Guidance for other expert involvement methods is needed also, perhaps through exploration of (sequential) case studies investigating their applicability to policy development. Furthermore, this thesis focussed on the earlier stages of the policy development, guidance for later policy stages should be investigated also, including the use of the Delphi method.

6.4. Final conclusions

This thesis has provided insights into the development of best practice regarding the implementation of expert involvement exercises within the context of agri-food policy development. The three Delphi studies provide applied examples on how to apply Delphi in the agri-food policy domain, drawing on diverse expertise and large numbers of geo-dispersed experts. The outcomes of this thesis offer a good starting point to the further study of expert involvement methodologies, and their application to diverse policy domains. Although this thesis has focused on the Delphi method, the need to develop methods to assess the process and impact of different forms of expert involvement has been identified. Furthermore, this thesis has initiated guidance on selecting appropriate expert involvement methods, provided recommendations for evaluating expert involvement methods and has introduced some practical suggestions regarding the reporting of these exercises. Use of these recommendations will contribute to greater transparency of policy development research, as well as increasing methodological rigour and developing criteria against which exercises can be judged as acceptable, transparent, and relevant to policy development.

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Appendices

Appendix A. Publications included in systematic literature review

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Appendix B. Institutional affiliations of participants in the study (divided over the EU participant group and non-EU participant group)

EU participants
Agricultural Economics Research Institute (LEI)
AgroBioInstitute
College of Agriculture Food and Rural Enterprise (CAFRE)
Confederation of the Food and Drink Industries of the EU (CIAA)
Dutch Food and Consumer Product Safety Authority (VWA)
Dutch Ministry of Agriculture, Nature and Food Quality (LNV)
European Food Safety Authority (EFSA)
ESRC - Centre for Genomics in Society
EuroCommerce
EuroCOOP
European Association of Craft, Small and Medium-sized Enterprises (UEAPME)
European Commission - DG Enterprise and Industry
European Commission - DG Research
European commission - DG SANCO
European Food Information Council
Finnish Farmers' and Forest Owners' Union (MTK)
International Life Sciences Institute (ILSI Europe)
Juelich Centre
Karolinska Institutet
Ministry of Agriculture of Latvia
Nestlé
Norwegian National Committee for Research Ethics in Science and Technology (NENT)
Ospedale Luigi Sacco University
Research Institute Organic Agriculture (FiBL)
Royal London Hospital
Unilever
University College Dublin
University of Reading
Wageningen University
Agricultural Economics Research Institute
AgroBioInstitute
College of Agriculture Food and Rural Enterprise (CAFRE)

Non-EU participants
Bayer CropScience
Canadian Food Inspection Agency
Centre for Food Safety (Hong Kong)
Food and Agriculture Organization of the United Nations (FAO)
Food Standards Australia New Zealand
Ibaraki Prefectural University of Health Science
Joint FAO/IAEA Division (AGE)
National Food Research Institute - Slovakia Republic
New Zealand Institute for Crop & Food Research Limited
Organisation for Economic Co-Operation and Development (OECD)
PRIMAFF
South Africa National Consumers Union
Universidad de Chile
University of Ottawa
World Health Organisation (WHO)
Zhejiang University

Appendix C. Definitions and categorised future threats as included in the Delphi questionnaires

Appendix C1. Definitions of predictive methodologies as included in the Delphi study

1. Literature review

Providing an overview of (published) study results (information or data sources) regarding a specific topic of (future) interest. The review may follow a specific type of structure for collating and analysing the relevant literature. Such studies may vary in terms of timescale, domain, topic, literature/information used. In addition, the aim of the literature review may vary. For example, such aims may include performing a "gap analysis" for priority setting.

2. Scenario study

Involves bringing together (expert) stakeholders in order to get people to map possible outcomes of a particular future scenario. Scenarios are stories that represent some future event. Such studies may vary in terms of timescale, domain, topic, and presence/absence of structured guidelines (e.g. for the storyline), and by whether the scenario is created by the researcher or the participants. Scenarios can help to get people to consider what they would do given an unfavourable forecast, as well as that scenarios can be used to gain acceptance of forecasts.

3. Horizon scanning

Consideration of future risks based on information from any source in order to identify priority areas and develop short-term projects (such as desk studies and expert workshops) to mitigate potential risks. Such 'horizon scans' may vary in terms of timescale, domain, topic, and methodology, but they are similar in the sense of scanning for information and extrapolating the results to the future. They may involve exploring novel and unexpected issues, as well as persistent problems or trends relevant to the topic.

4. Workshop

Can be used for future plans, solving problems, or fact-finding (gathering knowledge). It is a meeting in which the selected stakeholders (participants) are the primary resource. Stakeholders are selected based upon their knowledge or relevant experience regarding the topic. A workshop is usually structured (through an agenda). A workshop differs from the methods defined above, by having a pre-defined topic set by the organiser.

Appendix C2. Categorised future threats to animal health, divided into five groups according to the type of threat, collated from round 1 responses

1. Disease agents

Arboviruses
Non-zoonotic diseases
Pestiviruses
Virus
Zoonoses
Bacterial agents
Parasites
RNA virus
Virus, endogenous

2. Complex infections

Complex/multifactorial disorders
Infectious abortigenic agents
Mastitis
Reproductive disorders
Digestive system disorders
Locomotory system diseases
Production diseases
Respiratory disease complexes

3. Specific animal diseases

Aquaculture diseases, (fish, molluscs)
Other animal diseases
Bee diseases

4. Route of transmission

Airborne infections
Food borne agents
Vector borne diseases
Direct contact zoonoses
Rodent borne diseases
Water borne agents

5. Other emerging threats

Antibiotic resistance
Emerging and re-emerging agents
Endemic diseases in Europe (threat of dissemination in Europe)
Opportunistic diseases
Bioterrorism
Emerging unknown/novel pathogens
Increase in virulence
Threat of introduction exotic diseases in Europe

Summary

Agri-food policy is a complex web of interactions and is associated with diverse interests held by a wide range of sectors, multiple stakeholders and agencies. The domain involves stakeholders at multiple governmental levels, which makes regulating agri-food issues a challenging task. Globalisation has expanded the global food market to accommodate increasing consumer demands. A larger food chain is more vulnerable to unintended contamination or deliberate acts of fraud, resulting in the potential for many people being adversely affected. A comprehensive framework is needed to develop appropriate policies, however, this is difficult due to the multi-factorial, multi-sectorial, multi-disciplinary and transnational nature of the agri-food domain. Policy development contains different stages, including formulation of the policy issue, information gathering, decision making, implementation and evaluation of policy. These stages require continuous improvement through iteration of the process. Complex multi-level policy processes are required in which experts are used to inform policy if explicit (empirical) data are unavailable, if there is lack of consensus, or if expertise from a diverse disciplinary perspectives is required. The characteristics of the policy issue influences the type of expertise and type of expert involvement method needed at a certain policy stage.

The decline of public trust in risk management and subsequent (institutional) changes, have resulted in wider inclusion of stakeholder views in policy decisions as it has been assumed to restore societal trust in risk management. Given the importance of expert involvement exercises, it is imperative that these are properly executed. Insight into appropriate application of expert consultation methodologies is essential, both in order to evaluate the robustness of the recommendations made by such exercises and their salience to the evolving policy under consideration, as well as to improve policy uptake. Therefore, the aim of this thesis is to develop insight into optimal expert involvement practice within the agri-food governance and policy making domain. Following a systematic review of the published literature, it was determined that Delphi methodology appeared to be appropriate to elicit expert opinion and gather evidence in the complex policy domain associated with risk, food and agriculture. To this end, three Delphi studies in agri-food policy development were conducted.

In *Chapter 2*, a systematic literature review was conducted on current expert involvement practice in the policy domain, the included manuscripts predominantly originated from environmental and health sciences, and the agri-food sector. Three main issues of relevance to developing best practice in soliciting expert opinion were found: 1. The need to identifying the optimal method for soliciting expert opinion; 2. The lack of evaluation exercises (both of the process of expert involvement and in terms of policy impact of the results); 3. The lack of quality control measures relating to reporting processes and outcomes. In line with these findings, a framework to support the identification of appropriate methodologies was presented. Furthermore, some criteria for future reporting of expert involvement processes in the future are suggested.

Delphi was shown to be a method that is flexible enough to deal with the diversity in policy situations and experts involved in the agri-food domain. This property makes Delphi a relevant choice to study expert involvement practice in the context of agri-food policy.

In Chapters 3-5, three Delphi case studies were presented which all focussed on different policy issues within the European and global agri-food domain. Each of the three studies attributed to gain insight into best practices in expert involvement in agri-food policy development. Their sequential execution allowed for the uptake of insights and methodological improvement into the subsequent Delphi study.

C*hapter 3* reports on a "global" Delphi exercise eliciting expert views on a novel food risk governance model. This first Delphi study examined the feasibility of Delphi when applied to large groups of geo-dispersed experts and demonstrated that the Delphi method was a useful mechanism for consulting large and diverse groups of international experts. The study also addressed expert sampling and retention issues. Finally, it was concluded that future Delphi studies are likely to benefit from an initial exploratory qualitative stage to clarify key issues in advance. This would facilitate the construction of (primarily) quantitative Delphi rounds, likely to result in increased participant retention of non-native English experts (as a predominantly quantitative questionnaire would require less qualitative writing in a language other than their first).

Global emerging food risk identification was the topic of the two-round Delphi survey included in *Chapter 4*. Taking up insights from the previous case study, the Delphi was conducted following an initial qualitative "exploratory" study to ensure more focus on the policy questions of relevance. Sampling of experts was again addressed and executed using cascade methodology through project members using expertise profiles and a food safety expert data base. This Delphi survey was offered to the experts in four languages (English, French, Spanish, Portuguese). Most experts returned the English version, with only few experts responding in one of the other languages. This suggested that English is potentially the main language used to discuss emerging food risks in expert groups.

The research reported in C*hapter 5* contributed to a strategic research agenda for European research funders. The Delphi elicited expert views regarding mitigation of emerging and major infectious diseases of livestock in Europe, covering a 5 to 15 year time span. The Delphi was preceded by a qualitative scoping stage, consisting of two qualitative workshops. The experts for the Delphi study were again recruited through cascade-methodology using project members and an "expertise matrix", detailing type of expertise and employment. In addition, project members were instructed obtain initial participation commitment from the experts. Both the method used to recruit experts, and the opportunity perceived by participants to directly influence policy may have enhanced response rates in comparison to the two previous Delphi studies.

In *Chapter 6*, this thesis integrated these insights into recommendations on how best to involve experts in policy development, specifically within the agri-food domain, where inclusion of diverse expertise, large numbers of geo-dispersed experts, and uncertain or ambiguous policy issues are of relevance. Given that application of Delphi methodology is labour intensive, it is important to recognise that it requires sufficient resources to ensure participant recruitment, provide quick analysis of results, provide feedback to participants, and allow adaptation of the survey in the subsequent survey rounds. More important in the context of this thesis, this thesis identified several important features relevant to a Delphi to be conducted in the agri-food policy domain. First, the recommendation to include a scoping stage in advance of predominantly quantitative Delphi survey rounds. Second, expert recruitment and retention need to be carefully considered and reported. Part of this process is to make clear to experts what they gain or how they contribute by participating in the exercise at the outset. In addition, evaluation of the exercise may contribute to demonstrating impact by showing how expert views were taken into account in the development of policy. Third, a standardised definition of Delphi should be developed, stating to which characteristics the method should at least adhere to, and perhaps define adaptable characteristics relevant to the specific policy issue.

Enhancing methodological rigour should be adopted to all expert involvement methods. Developing a more formalised approach to reporting expert involvement exercises contributes to establishing methodological rigour and promotes (research) transparency. Both topics are important for evaluating the impact of expert exercises on policy. Without such standards currently available, reporting methodological details (including policy impact) will be a good start. Each policy stage requires a different type of outcome, and thereby needs a specific methodology able to deliver each specific outcome. The proposed framework in *Chapter 2* to identify expert involvement methods in policy development is an example of how to facilitate this need as it takes both policy and expert involvement characteristics into account, enabling both researchers and policymakers to select the most appropriate method or combination of methods for their specific policy question.

In conclusion, this thesis has provided applied examples on how to apply Delphi in the agri-food policy domain. Combining the outcomes of the three cases with the systematic literature review, this thesis offers a good starting point to the further study of expert involvement methodologies, and their application to diverse policy domains. The use of the recommendations provided in this thesis will contribute to greater transparency of policy development research, as well as increasing methodological rigour and developing criteria against which exercises can be judged as acceptable, transparent, and relevant to policy development.

Samenvatting

Agri-food beleid is een complex web van interacties waarbij rekening moet worden gehouden met de belangen van diverse sectoren, verschillende belanghebbenden en instanties. Het domein omvat belanghebbenden op verschillende bestuurlijke niveaus, waardoor het reguleren van agri-food onderwerpen een uitdaging is. Globalisering heeft geleid tot uitbreiding van de wereldwijde voedselmarkt om te kunnen voldoen aan de toenemende vraag van de consument. Langere voedselketens zijn kwetsbaarder voor onbedoelde verontreiniging of opzettelijke fraude, waardoor mogelijk meer mensen dan voorheen nadelige gevolgen kunnen ondervinden. Een allesomvattend kader is nodig om passend beleid te ontwikkelen, maar dit is moeilijk vanwege de multifactoriële, multi-sectorale, multi-disciplinaire en het internationale karakter van het agri-food domein. Het ontwikkelen van beleid bestaat uit verschillende fasen, waaronder: de formulering van de beleidskwestie, de verzameling van informatie, besluitvorming, uitvoering en evaluatie van het ontwikkelde beleid. Door dit proces te blijven herhalen ontstaat verbetering van zowel het ontwikkelde beleid en van het proces zelf. Wanneer er geen empirische gegevens beschikbaar zijn, indien er geen consensus kan worden bereikt of wanneer kennis uit diverse disciplinaire invalshoeken is vereist worden regelmatig deskundigen ('experts') gebruikt als informatiebron voor het ontwikkelen van complexe beleidskwesties. De kenmerken van de beleidskwestie beïnvloeden de vereiste kennis en de benodigde werkwijze.

Afname van het consumentenvertrouwen in risicomanagement en de daar opvolgende (institutionele) veranderingen hebben ertoe geleid dat standpunten van belanghebbenden meer betrokken worden bij beleidsbeslissingen, omdat wordt aangenomen dat dit het maatschappelijke vertrouwen kan herstellen. Gezien het belang van het gebruik van deskundigen bij beleidsontwikkeling, is het noodzakelijk dat deze consultaties goed worden uitgevoerd. Inzicht in de juiste toepassing van expertconsultatiemethoden is essentieel voor zowel de evaluatie van de verkregen aanbevelingen als de implementatie hiervan binnen de beleidskwestie. Het doel van dit proefschrift is om inzicht te verkrijgen in het optimale gebruik van deskundigen binnen het agri-food domein voor bestuur en beleidsvorming. Na een systematische review van relevante gepubliceerde literatuur, werd vastgesteld dat de Delphi methode geschikt bleek voor het verkrijgen van deskundig advies en het verzamelen van argumenten in het complexe beleidsdomein over risico, voedsel en landbouw. Naar

aanleiding hiervan zijn drie Delphi-studies over de beleidsontwikkeling binnen de agri-food sector uitgevoerd.

In hoofdstuk 2, is een een systematische literatuurstudie uitgevoerd naar de huidige betrokkenheid van deskundigen in het beleidsdomein. De literatuur was voornamelijk afkomstig uit de milieu- en gezondheidswetenschappen, en het agri-food domein. Drie belangrijke bevindingen voor de ontwikkeling van goede expertconsultatiemethoden waren: 1. De noodzaak om de optimale methode te identificeren voor het verkrijgen van deskundig advies; 2. Het ontbreken van evaluaties (zowel van het consultatieproces, als de invloed van de verkregen resultaten op het beleid); 3. Het ontbreken van kwaliteitscontrolemaatregelen met betrekking tot de rapportage van processen en resultaten. In lijn met deze bevindingen werd een kader voor het vaststellen van de passende methoden gepresenteerd. Bovendien werden enkele criteria voor de rapportage van evaluaties voorgesteld.

De Delphi methode bleek flexibel genoeg om om te gaan met de beleidsdiversiteit en de diversiteit aan deskundigen betrokken in het agri-food domein. Dit maakt Delphi een goede keuze om expertconsultatie in de praktijk van het agri-food domein te bestuderen.

In hoofdstukken 3, 4 en 5, worden drie Delphi-case studies gepresenteerd gericht op verschillende beleidsaspecten binnen het Europese en mondiale agri-fooddomein. Elk van deze drie studies droegen bij tot het verkrijgen van inzicht in best-practice voor expertconsultatie in het agri-food beleidsdomein. Het achtereenvolgens uitvoeren van de studies maakte het mogelijk om verkregen inzichten en methodologische verbeteringen van de ene studie in de daaropvolgende Delphi-studie op te nemen.

Hoofdstuk 3 rapporteerde een mondiale Delphi-studie over een nieuw "food risk governance model". Deze eerste Delphi-studie onderzocht de haalbaarheid van de Delphi methode bij toepassing op grote, geografisch verspreide groepen experts en toonde aan dat deze methode een nuttig instrument hiervoor is. Daarnaast identificeerde deze studie problemen omtrent de selectie en het behoud van experts gedurende het proces. Tot slot werd geconcludeerd dat toekomstige Delphi-studies kunnen profiteren van een eerste verkennende kwalitatieve fase om belangrijke kwesties op voorhand te verduidelijken. Dit draagt bij aan de ontwikkeling van (voornamelijk) kwantitatieve Delphi rondes, die kunnen leiden tot een verhoogd behoud van deelnemers welke Engels niet als moedertaal hebben (aangenomen dat er minder geschreven hoeft te worden in een voornamelijk kwantitatieve vragenlijst).

In hoofdstuk 4 was een Delphi-studie (twee-rondes) uitgevoerd met betrekking tot de mondiale identificatie van "emerging food risks". De verkregen inzichten van de vorige case studie hebben er toe geleid dat er eerst een kwalitatieve "verkennende" studie is uitgevoerd om meer duidelijkheid te verschaffen omtrent de relevante beleidsvragen. De identificatie en selectie van deskundigen werd uitgevoerd met behulp van de "cascade-methode" door leden van het projectteam met behulp van vooraf samengestelde kennis-profielen en met gebruik van een databank met voedselveiligheidsexperts. De Delphi-enquête werd aangeboden aan de deskundigen in vier talen (Engels, Frans, Spaans, Portugees). De meeste deskundigen beantwoordden de Engels versie, met slechts enkele experts die gebruik maakten van een van de andere talen. Dit suggereerde dat Engels potentieel de belangrijkste taal is die gebruikt wordt door deskundigen om "emerging food risks" te bespreken.

Het onderzoek beschreven in hoofdstuk 5 droeg bij aan een strategische onderzoeksagenda voor Europese onderzoeksfinanciers. Deze Delphi ontlokte standpunten van experts over de beperking van opkomende en de belangrijkste besmettelijke ziekten van vee in Europa, voor een tijdspanne van 5 tot 15 jaar. De Delphi werd voorafgegaan door een kwalitatieve "verkennende" studie bestaande uit twee workshops. De experts voor de Delphi-studie werden opnieuw geworven via de "cascade-methode" met behulp van projectleden en een samengestelde "deskundigheids matrix" met details omtrent expertises en dienstbetrekkingen. Daarnaast kregen leden van het projectteam de opdracht om toezeggingen van de experts te verkrijgen voor deelname aan de studie. Zowel de methode die werd gebruikt om deskundigen te werven, als de geboden mogelijkheid om direct invloed uit te kunnen oefenen op het beleid (via de Delphi studie), leken de mate van participatie te verbeteren in vergelijking met de twee voorgaande Delphi-studies.

In hoofdstuk 6 van dit proefschrift integreer ik de verkregen inzichten in aanbevelingen voor de beste manier om experts in de ontwikkeling van het beleid te betrekken. Met name in het agri-food-domein waar de samenkomst van diverse expertises, het gebruik van grote aantallen geografisch verspreide experts en de onzekere of ambigue beleidskwesties een grote rol spelen. Gezien het feit dat de toepassing van de Delphi-methode arbeidsintensief is, is het belangrijk te zorgen voor voldoende middelen voor de werving van deelnemers, een snelle analyse van de resultaten, het geven van feedback aan de deelnemers, en de aanpassing van de enquête in daaropvolgende onderzoeks rondes.In dit proefschrift worden enkele belangrijke punten geïdentificeerd voor de uitvoering van een Delphi binnen het agri-food beleidsdomein. Allereerst, de aanbeveling tot het houden van een verkennende kwalitatieve fase en aansluitend voornamelijk kwantitatieve Delphi vragen rondes. Ten tweede, de selectie en het behoud van experts gedurende het proces moet zorgvuldig worden overwogen en gerapporteerd. Onderdeel van dit proces is om aan het begin van de studie duidelijk te maken aan deskundigen wat deelname hen kan opleveren en waaraan zij precies een bijdrage leveren. Bovendien kan een goede evaluatie van een studie demonstreren wat het verkregen effect is door te laten zien hoe standpunten van de deskundigen werden gebruikt in de ontwikkeling van het beleid. Tot slot moet een gestandaardiseerde definitie voor Delphi worden ontwikkeld, waarin staat aan welke kenmerken de methode ten minste moet voldoen. Daarnaast zouden ook enkele aanpasbare karakteristieke eigenschappen kunnen worden geïdentificeerd voor de specifieke beleidskwestie.

Het toepassen van de methodologische validiteit zou gebruikt moeten worden bij alle expertconsultatie methoden. Het ontwikkelen van een meer gestandaardiseerde aanpak voor het rapporteren van expertconsultatie studies draagt bij tot methodologische validiteit en bevordert daarnaast (onderzoeks) transparantie. Beide onderwerpen zijn ook van belang voor de evaluatie van de impact van expert studies op het beleid. Aangezien dit soort criteria momenteel niet beschikbaar zijn, zou het rapporteren van methodologische gegevens (inclusief de impact op het beleid) een goed begin zijn. Elke beleidsfase vereist verschillende typen resultaten, en heeft daarmee een specifieke methodologie nodig om representatieve resultaten te genereren. Het voorgestelde kader in hoofdstuk 2 voor het identificeren van de juiste expertconsultatiemethode gerelateerd aan de beleidskwestie houdt rekening met zowel de karakteristieken van de beleidskwestie als de karakteristieken van de expertconsultatiemethoden. Hiermee worden zowel onderzoekers als beleidsmakers geassisteerd bij het selecteren van de meest geschikte methode of combinatie van methoden voor hun specifieke beleidsvraagstuk.

In conclusie, dit proefschrift presenteert toegepaste voorbeelden over het gebruik van Delphi in het agri-food beleidsdomein. Door het combineren van de resultaten van drie case studies met systematisch literatuuronderzoek, biedt dit proefschrift een goed uitgangspunt voor verdere studies naar expertconsultatiemethoden, en hun toepassing op andere beleidsdomeinen. Het toepassen van de aanbevelingen uit dit proefschrift zal bijdragen tot een grotere transparantie van onderzoek naar beleidsontwikkeling, evenals tot het verhogen van methodologische validiteit en het ontwikkelen van criteria waaraan deze studies kunnen worden beoordeeld als acceptabel, transparant, en relevant voor beleidsontwikkeling.

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About the author

Meike Wentholt obtained an MSc. in Nutrition & Health with a specialisation in Food Safety from Wageningen University in the Netherlands (2005). Prior to her MSc., she graduated from the University of Applied Sciences of Arnhem and Nijmegen (HAN), in the Netherlands where she obtained a BSc. in Nutrition and Dietetics. In May 2006 she started as researcher at the Marketing and Consumer Behaviour Group at Wageningen University, the Netherlands. She was involved in the development of strategies for effective expert involvement within the agri-food governance domain. Her areas of research included, investigating stakeholder opinions on the SAFE FOODS Risk Analysis Framework via the Delphi method and investigating opinions of a diverse group of stakeholders on Risk Benefit Assessment (RBA), and their possible interest, needs and preferences regarding RBA, for the RBA tool developed by the EU-project QALIBRA. Subsequently she was involved in a Delphi study eliciting expert opinions on issues associated with creating a research agenda for emerging food risks on a global level (GO GLOBAL project). Her fourth Delphi project elicited expert opinions to gain insight in and developing of research needs and capacity building regarding emerging and infectious diseases of production animals (EMIDA ERA-NET project). While finalising her thesis she participated as an expert on application of Delphi studies with the EFSA Working Group on ‘Guidelines for expert knowledge elicitation in food and feed safety risk assessment’.

Completed Training and Supervision Plan

Name: Meike Wentholt
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Wageningen School of Social Sciences

Name of the activity	Department/ Institute	Year	ECTS
I. General part			
Scientific writing	Centa	2006	2.1
Research methodology 1: from topic to proposal	MGS/CERES	Feb/April 2009	4
Project and Time Management	WGS	March/April 2009	1.5
Writing PhD proposal	-	2009	2
II. Mansholt-specific part			
Mansholt Introduction course	MGS	Feb 2009	1.5
Mansholt Multidisciplinary Seminar	MGS	2011	1
PCST-10 Bridges to the future, "Assessing impact public engagement in science"	Malmö, Sweden	25-27 June 2008	1
Participated in multiple workshops (research projects)	SAFE FOODS QALIBRA GO-GLOBAL EMIDA	2006-2011	4
III. Discipline-specific part			
Theories and Tools of Narrative Inquiry	MGS/CERES	December 2008	1.4
Food Risk Analysis	MGS	November 2009	3
Systematic Review Course	Oxford	May 2010	10
MCB PhD series on "Consumer Behaviour"	MCB	September – November 2009	1
IV. Teaching and supervising activities (optional)			
<u>Lecture</u>: Stakeholder engagement in practice: use of the Delphi technique to involve stakeholders in revision of the SAFE FOODS framework. *Course*: Governing food safety in international trade	Wageningen International	15 April 2009	1
<u>Supervision student:</u> "Analysis post-questionnaire for QALIBRA-tool"		September – October 2009	1
TOTAL (min. 30 ECTS)			**34.5**

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