Consumers, Food, Trust and Safety

The Need for Collaboration Between the Social and Natural Sciences

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"De mens lijdt het meest van het lijden dat hij vreest"

"People suffer most from the suffering of which they are afraid"

Vader Cats

1. Introduction

Mijnheer de Rector Magnificus, hooggeleerde collegae, zeer gewaardeerde toehoorders. With your permission, I will change to English, as I think this will be easier for all of us!

My lecture today will focus on how consumers perceive different food risks, and how this relates to their trust in the various actors in the food chain (including regulatory institutions and scientists involved in food production, as well as the food industry and producers). I will discuss what this means in terms of how food safety is both communicated and regulated. I will examine some emerging food issues, and discuss how an integrated approach between the social and natural sciences is the best way to address issues in the food safety area. Finally, I will illustrate the effectiveness of this approach through examples of ongoing and developing research initiatives in WUR.

Inleiding

Mijnheer de Rector Magnificus, hooggeleerde collegae, zeer gewaardeerde toehoorders. Met uw toestemming zou ik graag overgaan op het Engels, aangezien ik denk dat dit voor ons allemaal eenvoudiger zal zijn!

Mijn lezing vandaag, zal zich richten op de wijze waarop consumenten verschillende voedselrisico's waarnemen, en hoe dit zich verhoudt tot hun vertrouwen in verschillende actoren in de voedselketen (inclusief regelgevende instanties en wetenschappers betrokken bij de voedselproductie, alsook de voedselindustrie en producenten). Ik zal bespreken wat dit betekent in termen van de communicatie en regelgeving met betrekking tot voedselveiligheid. Ik zal enige voedsel gerelateerde kwesties die op dit moment in opkomst zijn onderzoeken, en bespreken waarom een geïntegreerde aanpak tussen sociale en natuur wetenschappen de beste manier is om de kwesties in het gebied van voedselveiligheid te behandelen. Tenslotte zal ik de effectiviteit van deze aanpak illustreren door middel van voorbeelden van lopend onderzoek en onderzoeksplannen

2. Public perceptions of risk and safety?

As a starting point, it is useful to consider how consumer risk perceptions may differ from those of other stakeholders involved in food production. It has been well established that people's risk perceptions determine how they react to different hazards. Some factors (for example, whether a hazard is voluntary in terms of exposure or technological in origin) predict people's responses across different hazard domains. Other factors are domain specific (for example, people may have concerns about the potential for negative effects on animal welfare in the case of BSE, or Bovine Spongiform Encephalopathy, which will not apply to other types of potential hazard). It is important to address people's perceptions in the process of risk management and communication, otherwise the activities of risk managers and assessors are likely to be considered as detached from the concerns and fears of both citizens and consumers. As a consequence, the public may distrust the motives of those responsible for assessing or managing risk.

It has been long established that people's responses to different risks are *socially constructed.* In other words it is psychological factors that are important in influencing people's responses to a particular hazard. The technical risk estimates traditionally provided by experts do not influence people's behaviours and responses. People's risk perceptions are a far more influential determinant of their

responses to different risks. For example, a risk that people perceive to be involuntary in terms of their personal exposure is more threatening than one that they choose to take, even if the probability of harm is the same, or possibly even less. For similar reasons, naturally occurring risks are less threatening than hazards that are technological in origin. People fear potentially catastrophic hazards [such as nuclear disasters] more than [for example car accidents] that affect a similar number of people, but at different times and places. Natural risks (for example, being struck by lightening) are less frightening than technological risks (for example, the toxic effects of pesticide residues; see Katsuya 2001 for examples from the nuclear area; Slovic, 1993 for examples contrasting technological and natural risk). Other concerns are very specific to particular hazard domains, and this is very much the case in relation to food (for example, see Miles and Frewer, 2001).

The fact that public risk perceptions are constructed differently to the technical risk estimates, which are usually presented in risk communication by expert communities, has been the reason why public concerns have often been dismissed on the basis of "irrationality". As a consequence, they have tended to be excluded from policy processes by risk assessors and managers. However, it is these public concerns (and people's associated behaviours, for example related to food choices) that have direct consequences for human health, food safety and security, economic expansion and international regulation.

Public risk perceptions have been shown to be particularly important determinants of public responses to activities in the agri-food area. These include, food safety (Fife-Schaw and Rowe, 2000; Verbeke, 2001; Frewer and Salter, 2002), the biosciences, (Frewer *et al*, 1997), and possible unintended negative environmental and health impacts of technology (Levidow and Marris 2001). Risk information that does not address all the concerns of the people to whom it is directed, and which does not take account of the social context in which the information is embedded, may be discounted by individuals receiving that information.

2. Public or publics?

Individual differences in risk perceptions are important, particularly under circumstances where risk exposure is perceived to be involuntary (Barnett and Breakwell, 2001). Affective or emotional factors,

such as “worry’’, may also influence perceived risk (Baron *et al*, 2000), as may personality correlates such as “anxiety” (Bouyer *et al*, 2001). Differences in perceptions of risk and benefit associated with various hazards exist between different *countries* and *cultures*, between different *individuals*, and even within different individuals at different times and within different contexts (Burger *et al*, 2001). For example, being male or female is one of the best predictors of higher risk perception for a range of health and safety issues, with women typically reporting higher risk perceptions than men (Dosman *et al* 2001).

Differential exposure of disadvantaged groups, particularly where they are not the recipients of obvious benefits (for example, children or people in developing countries) may result in a risk being evaluated more negatively than if this was not the case. For the risks of a technology to be acceptable to the public, the benefits from a technology must be perceived to accrue to people exposed to the risks, or to the environment, (Frewer, 1999) and not only to industry or producers. National and international differences in risk perceptions must be identified and incorporated into the process of risk management if the development and application of regulatory frameworks is to be harmonised in a world where trade and communication is increasingly global (Frewer et al, in press).

3. Food Safety and Risk Analysis

Traditional models of risk analysis have assumed that *risk communication* follows on from *risk management*, which, in turn, is the outcome of *risk assessment*. More recent frameworks have assumed some level of integration between these three elements of risk analysis (for example, FAO / WHO, 1998), in part a response to the decline in public trust in risk analysis practices. For any kind of integration between the different parts of risk analysis it is essential that consumers trust the involved risk communicators, managers and assessors. At the present time, there is still concern about the continuing decline in public trust in the activities of those involved in the process of risk analysis.

Much public negativity associated with the way risks are managed and regulated has been the result of risk managers, assessors and other key actors in the process of risk analysis failing to take account of the actual concerns of the public when assessing, managing, and communicating about risks. An illustrative example is found in the area of food safety, which has been the focus of much public controversy in

recent years. One consequence has been increased public distrust in the motives of regulators, science and industry in taking decisions or actions in relation to risk assessment priorities, resource allocation and risk mitigation activities (Frewer, 1999). Jensen and Sandøe (2002) have observed that, despite the creation of new food safety institutions such as the European Food Safety Authority (EFSA), the decline in public confidence in food safety continues. This may, it is argued, be partly the result of communication about food safety issues being based on scientific risk assessments alone, and failing to incorporate public concerns, values and fears into a broader societal debate (Levidow and Marris, 2002). Communication that does not explicitly address public concerns is likely to have a limited role in reassuring the public (Frewer et al, in press).

Jensen and Sandøe argue that this is because risk assessment is *presented to the public* by interested institutions as a purely objective scientific event located in the natural world, which is not influenced by societal values or subjective judgements. For this reason, risk assessment has been frequently assumed to be *"functionally separate"* from the other components of risk analysis, risk management and communication. In contrast, risk management is typically described as *political* in orientation. Risk communication is the process by which the results of both risk management and risk assessment are communicated to the general public and, thus prone to influence by risk experts who may be, as a consequence, perceived by the public to be promoting their own agendas.
Other values and preferences may be bought to bear on the risk assessment – for example, how to handle probability and variability, which assessment methods to select under which circumstances, when to adopt novel assessment processes, and at what point in time to assess risks. In addition, it is also important to communicate risk probability to all interested stakeholders, and risk variability to those most at risk (Thompson and Bloom, 2000). The values of assessors and managers may influence *how*, *when* and *if* this information is provided to risk communicators and the general public. Values may also be bought to bear in the determination of how resources are allocated in the identification of emerging hazards, and the conditions under which new assessment and risk mitigation approaches are adopted. Therefore the argument that risk assessment is an objective science and is value free cannot be automatically supported. It is therefore important to acknowledge the potential influence of values throughout the risk analysis framework.

5. The development of current risk analysis practices

The finding that lay people incorporate psychological factors into their personal assessment of the acceptability of risk was of great interest to the risk assessment management community. These findings appeared to explain why risk management decisions acceptable to expert communities (for example, regulators and scientists) were not acceptable to the general public, or at least sub-groups within the population.

Consequently, risk communication activities in the 1970s focused on changing public views on risk, with emphasis on communication directed towards risk acceptance, particularly in the area of acceptance of emerging technologies. The process of attempting to align public views with the risk analysis community has been described by Hilgartner (1990) as the “deficit model”, whereby expert and elite organisations and institutions assumed that the publics are in some way *deficient* in their understanding of risk. If the lay public could understand science and its applications, technology, then concerns about the way associated risks were assessed and managed would disappear. In other words, communicators adopted the perspective that the public was ignorant of the scientific “truth” about risk. For this reason, the goal of risk communication was to “rectify the knowledge gap” between the originators of scientific information and those receiving the information. As a consequence, when the gap is rectified public acceptance of technology implementation and commercialisation would be automatic. Despite the best efforts of the popularisers of science and technology, the lay public remained deeply sceptical of the motives of scientists, regulators and industrialists (Bauer 1995).

The next stage was to consider public trust in regulatory institutions and industry. It was reasoned that the acceptance of emerging technologies and other hazards was contingent on public trust in institutions with responsibility for regulating the associated risks. For example, Siegrist (1999) has reported that, for citizens with high levels of trust in institutions with responsibility for regulating gene technology and its products, perceived risk in the technology is decreased and perceived benefit resulting from it is increased. Citizen distrust in these same institutions has the converse effect on perceptions of risk and benefit.

Although public trust appears to be essential for risk communication, whether it is trust driving risk perceptions, or risk perceptions driving trust, is a question that remains to be answered. However, restoring trust in regulatory institutions, scientific processes, and industry appeared, to many institutional actors to be the way to take risk analysis practice forward. It was argued that, if the public trusted the institutional actors with responsibility for consumer protection, then the public would also place high levels of trust in those individuals. It was assumed that an increase in trust could be achieved by a greater emphasis on increased transparency in the process of risk analysis, in particularly risk assessment and risk management. There is some limited evidence to suggest increased transparency is a pre-condition for trust in institutional activities to develop, although transparency in itself is not a trust increasing event (Frewer et al, 1996). Lack of transparency may result in increased distrust, but trust *per se* is a result of citizen perceptions of institutional honesty, concern for public welfare, and competence. Thus it is unlikely that increased transparency in risk analysis itself will increase public trust, but reducing transparency will increase public distrust.

A second approach to developing trust focused on greater public inclusion in the process of policy development. When people feel a lack of control over their exposure to potential hazards, risks are perceived as higher, so in cases where there is a lack of control, trust in risk assessment and risk management is likely to be a particularly important determinant of public confidence in food safety. A case in point is that of genetically modified foods, where consumer concern did not focus primarily on risk *per se*, but rather on the lack of personal control on the part of the consumer over consumption (Miles and Frewer, 2001). It was reasoned by the policy community that more extensive public consultation and participation in risk management and other science and technology issues would restore public confidence in institutions with responsibility for public and consumer protection (see, for example, Renn, Webler and Wiederman, 1995; Rowe, Marsh and Frewer, 2004). This was an institutional response to the exclusion of consumers and / or citizens from the decision-making processes associated with risk analysis. This reflected institutional recognition that citizen's attitudes towards different hazards are not only dependent on an analytical assessment of risk and benefit. Other factors, such as *ethical* and *moral* considerations, were recognised as potentially influential in establishing the acceptability or otherwise of a particular hazard or societal approval of the measures put into place to contain specific risks.

One result of this institutional concern about public distrust in their activities was increased emphasis on the “functional separation” between risk assessment and risk management. Risk assessment was, as before, implicitly assumed to exist in the “natural world”, and thus portrayed as immune from influence from social values and societal priorities. Political influences and societal concerns were also assumed by decision-makers to be confined to risk management through the process of functional separation of the three components of the risk analysis framework. Risk communication was, arguably, promoted as a tool to reinforce the principal of institutional transparency rather than a mechanism for developing a direct dialogue with citizens and / or consumers.

In fact, the functional separation of the three components, and isolation of risk as an immutable truth, would naturally follow on from the assumption that science was isolated from the influence of society and its predominant values. The ways in which science and the social world are often viewed as independent of each other has been the focus of systematic study. For example, Woolgar (1996) has noted that it is useful to examine what underlines the received view regarding the assumptions of scientific “neutrality” and its portrayal. The first assumption relates to how objects in the natural world are “objective” and “real”, and have an existence *independent* of human beings. The actions and beliefs of human beings are incidental to nature (and these must be isolated from scientific “truth” in order to maintain its purity). From this, scientific knowledge (for example, risk assessment) can only be determined by understanding those objective realities found and observed in the natural world. As a consequence, investigation of scientific knowledge is *via* a unitary set of methods, the application of which is the result of consensus agreement by scientific experts and elite bodies. Finally, science is an activity, which is individualistic (rather than amenable to collectivist or consensus approaches to decision-making), and “cognitive” or ”logical” rather than “subjective” or “affective”. Risk assessment, it is assumed, is founded entirely in the “objective” reality provided by science, and must be portrayed as immune form values, preferences or investigation by different methodological variants. In contrast, risk management is assumed to be prone to influence by political judgements. The question of societal trust in risk assessment is therefore not open to question. Public trust can only vary in risk management, where value judgements can influence how decisions are made. As a consequence, it follows on that it therefore becomes necessary to separate risk assessment from risk management in order to gain public trust in the risk analysis process This assumption does not

take account of the potential influence of values on risk assessment, which will become increasingly obvious with increased transparency.

6. Some additional effects of increased transparency in risk analysis

In controversial fields such as nuclear science and biotechnology, public trust may be taken as a statement about the legitimacy of the activities that are encompassed by technological development and subsequent commercialisation of technology applications. One measure of the success of any technology innovation is the degree of public trust in analytical *and* regulatory procedures associated with the technology. If public confidence in a particular arena declines, there will be a negative impact in terms of the political exposure of the regulatory institutions, the economic vulnerability of the industrial sector concerned and the likely amplification of critical media interest in the sector overall. Scientific and regulatory authority has lost much of the credibility conferred upon it in the past. In other words, people no longer trust science to legitimise itself by *reference to the technical estimates about risk which science itself produces* (Frewer and Salter, in press).

Frewer and Salter (2002) have observed that public distrust in risk analysis (and by implication risk assessment, management and communication) may be attributable to various changes in society. This may be partly the result of the signal potential of various risk incidents to demonstrate that risk management is "out of control" (such as Chernobyl in 1986, the case of BSE in the UK in 1996, or the Belgian Dioxin crisis in 1999). A second factor relates to the increasing availability of accessible specialist information (for example, via the Internet). As a consequence, public reliance on the decisions of expert or elite groups is no longer a tenable way to conduct risk analyses, as has been the case in the past. The rise of the "*consumer citizen",* for example, means that societal disquiet with risk management and risk assessment may be expressed through consumer preference and choice in the marketplace. This may include increased sales of consumer goods that are produced using processing technologies of which the consumer approves, or which deliver a concrete and desirable consumer benefit. Such shifts in consumer preference may occur under circumstances where there is public concern about the development and commercialisation of emerging technology as has been the case with genetically modified food, and may occur with emerging technologies such as nanotechnology in the future.

Consumers may express their disquiet with risk analysis in a variety of ways. For example, consumers may switch to a different type of product (Pennings, Wansink and Meulenberg, 2002). Alternatively they may switch to highly trusted brands that they perceive to be safe because the manufacturer has a history of responding responsibly with respect to consumer welfare under circumstances where there is a food safety problem,for example, by product recall(Chaudhuri and Holbrook, 2001).

Additional communication needs may result from increased transparency in risk analysis. Public distrust in risk assessment is likely to arise under circumstances where uncertainties and variabilities in risk assessment become open to public scrutiny through increased transparency, but are not explained explicitly as part of the risk communication process (Frewer et al, 2002). (This may possibly be the result of well-intentioned institutional concerns that the public is not tolerant of, or able to even understand, uncertainty and variability, as only experts are able to understand these issues). However, both uncertainty and variability will become open to public scrutiny as a result of transparency, and proactive communication about both is a necessary precondition for the development of public trust. It is important to ensure that different types of uncertainty are communicated, as well as risks to vulnerable groups. This may require targetted approaches to communication, as well as increased knowledge about how consumers think about uncertainty, and process incoming risk messages that include uncertainty information. If the public perceives that there is an attempt by the authorities or the scientific community to conceal the limitations of scientific knowledge regarding the risk assessment process, public distrust in the actors involved and the process itself will result. In the same spirit, effective communication about associated uncertainties is also essential if the precautionary principal is to be applied, as its application in itself implicitly provides external observers with a signal that there is some uncertainty associated with the risk assessment.

In the past, expert communities have assumed that providing lay people with information about uncertainty would result in public negativity towards the whole process of risk analysis. In addition, public distrust in science and scientific institutions would increase, and panic and confusion regarding the impact of a given hazard on human health and the environment result (Wynne, 1992). Expert groups have tended to assume that lay people cannot conceptualise uncertainty in risk assessment or risk management (Frewer et al, 2002). However, scientific and policy communities appear to have

underestimated the ability of non-experts to understand uncertainty. In fact, there is evidence that it is the failure of institutional actors to communicate uncertainty that increases public distrust in institutional activities designed to manage risk.

Communicating uncertainty information associated with the assessment *decreased* risk perceptions for those expressing high initial levels of environmental concern. It is of note, however, that a *converse effect* was found for those initially unconcerned about the potential for environmental impact. Moreover, lay people do distinguish between different *kinds* of uncertainty (Frewer et al, 2003). For example, there is a lay differentiation between uncertainty associated with lack of knowledge, (for example, lack of scientific information regarding a specific risk, or conflicting scientific information or opinion), and uncertainty about the potential impact or extent of a particular hazard. Lay people also recognise that further research may be needed in order to reduce the uncertainty, and acknowledgement of this need may, in turn, be trust inducing. Indeed, the public appears more accepting of uncertainty resulting from shortfalls in scientific process than to uncertainty associated with the failure of institutions to reduce scientific uncertainty through conducting appropriate empirical investigation. This serves to confirm the National Research Council recommendation (1994) that risk communication should focus on the sources of uncertainty as well as the magnitude of uncertainty associated with a particular hazard.

Of course, other factors associated with risk assessments also influence risk management decisions (for example, the severity and immediacy of the potential risk, the cost and side effects of mitigation options, and the cost and time required for research). Uncertainty associated with risk assessments, risk management, and the link between risk assessment and risk management should be communicated to the public and other key stakeholders as well as to decision-makers if there is to be an informed public debate about how risks should be handled.

Another risk assessment issue that must be disseminated to all interested parties, including the public, is that of risk variability, when the risk varies across a population but the distribution is well known. Vulnerable groups may be identified from this information, which merit targeted communication about both assessment and management processes. Understanding variability may also have implications for the allocation of resources to risk mitigation activities (Morgan and Henrion, 1990), which may also be a

focus of public debate. Discussion of how such resources are allocated is important in development of public confidence in risk management and, ultimately, risk assessment.

At present, however, there is insufficient knowledge about how to develop best practice in risk communication about uncertainty and variability. The former is contingent on developing ways to discuss different kinds of uncertainty; the latter may entail methodological development in targeting information to "at risk" populations. Both risk uncertainty and risk variability have profound implications for decisions associated with resource allocation (for example, how research funds are distributed across hazards in order to reduce uncertainties, or how risk mitigation activities are prioritised for risks which differentially effect different sub-populations). Public trust in these processes is likely to be low unless there is informed public debate regarding both risk management and risk assessment procedures, which permits the inclusion of wider societal values and priorities into decision-making processes.

Increased transparency in the process of risk analysis, and increased emphasis on participatory democracy and citizen inclusion may increase citizen and consumer trust in the activities of risk assessors, managers and other key stakeholders. They may also increase public distrust if not approached in the correct way. Jasanoff (1990) has concluded that both increased transparency and public consultation may further undermine the credibility of government authorities, if the process of opening up legislative processes and increased public consultation is not considered carefully. In particular, asking the public what they think is likely to reduce public trust if the results of public consultation are not explicitly incorporated into the risk analysis process. The process of developing and conducting participatory exercises should be externally audited, as should the impact of participatory processes on the policy process itself (Rowe and Frewer, 2000; Rowe and Frewer, in press). Failure to take account of public views, particularly after they have been explicitly solicited, will make the process of participatory democracy appear more like a public relations exercise than an attempt to democratically reach decisions about risk assessment and management. There is a further need to examine of how to take account of the diversity of public opinion in policy decisions.

7. Some illustrative examples of recent "food scares"

With the knowledge of risk perception and the role of trust in risk communication, I will now discuss some of the causes for recent public food scares.

BSE - The peak of the Bovine Spongiform Encephalopathy (BSE) epidemic in the UK was reached in 1993 when over 1000 new BSE suspect cases were reported each week. BSE subsequently spread to other European countries, Japan, the US and Canada. The primary driver of public concern was the failure of the UK government to acknowledge the *uncertainty* about BSE as a potentially causative agent of the human form of the disease, Creutzfeldt-Jakob Disease (nvCJD), prior to 1996. Public risk perception was also affected by the failure to provide information relevant to the actual concerns of consumers about food hazards. In the case of BSE, information based on technical risk assessments ignored the drivers of public concern. These included *animal welfare issues*, (which became focused in the public view as a result of media reporting and attention on animal production processes), and institutional denial of uncertainty associated with regulatory decisions and risk assessment (Frewer and Salter, 2001)

Genetically modified foods – the case of genetically modified (GM) foods serves to illustrate that public attitudes are not dependent on an analytical assessment of risk and benefit. Other factors, such as *ethical and moral* considerations, other *values such as concern about the integrity of nature,* and *trust in the regulatory system* play a part in societal and consumer acceptance (Miles and Frewer 2001; Jensen et al 2003). Developing communication about substantial equivalence (i.e. that the content of GM foods was not substantially different to conventional counterparts) did not address consumer concerns, and was thus not relevant to consumer fears. Research also demonstrated that control over consumption of GM foods was enormously important to European consumers, necessitating the labelling of GM foods and implementation of *effective traceability systems* (Miles et al, submitted). The negative public reaction to GM foods was therefore less to do with risk, and more to do with consumer choice and the failure to deliver information about what was actually driving consumer concerns. Opaque risk analysis systems and decision-making practices were not helpful in reassuring the public. The absence of 1st generation products with tangible and desirable *consumer benefits* did little to reassure consumers about the motives of the food industry in introducing these crops.

Dioxins –The Belgian Dioxin crisis in May-June 1999 was characterised by a public perception that the Belgian ministries of public health were covering up contamination of the food chain resulting from a dioxin contamination of animal feed (Verbeke 2001). Public negativity was characterised less by the risks to public health *per se*, but was rather more related to the belief that the authorities were not telling the truth about the associated risks. In part, this was due to slow response to developing a risk communication strategy once the problem was discovered.

These recent examples show a few failures of communicating the relevant knowledge to the public. Apparently it is not so easy to determine what information has to be communicated and how that should be done.

8. The need for integrating social and natural science in the area of food safety

It is essential that social and natural scientists work together in order to address issues associated with consumers and food, in the area of safety and beyond. Issues of consumer choice encompass not only responses to food risk such as microbial contamination, toxicology, and consumer responses to food processing technologies, but also emerging concerns in the area of human health (for example, *obesity* or *unhealthy food choices*). Both developing improved food safety risk analysis and improving the basis for healthy food choices rely on adoption of a transdisciplinary perspective integrating theoretical approaches from both the social and natural science perspectives. Increased transparency in risk management means that a combined effort is needed from both risk assessors and risk communicators in identifying what to communicate, not only about what risks are known, but also about what risks are uncertain, and how they vary across populations. This may imply that it is necessary to develop communication about different kinds of uncertainties, at present an area which is not understood. An example might include distinction between outcome uncertainty *("what might actually happen and with what probability*") and assessment uncertainty *("to what extent are the results of the analysis likely to change with additional information*"; Brown and Ulvilla, 1987). Assessment uncertainty is an important factor in deciding *how* to act, i.e. whether to reduce risk (through mitigation action) or reduce uncertainty (through focused research activity). Of course, other factors also influence this decision (e.g. the severity and immediacy of the potential risk, the cost and side-effects of mitigation options, and the cost and time required for research). Developing effective communication about these different types of uncertainty is an important first step in developing a mechanism for a societal discussion about how to handle risk.

In other words, it is essential that a structured dialogue is developed to better understand key scientific paradigms underlying regulatory oversight such as scientific uncertainty, absence of zero risk, and comparative risks associated with developments in the life sciences and food safety. Such a debate will facilitate the development of international *guidelines, standards and recommendations*, based on international scientific and, of course, societal consensus.

Various research activities at the University of Wageningen and Research Centre are currently focusing on developing an integrated natural-social approach to understanding food safety. These include understanding what behaviours put consumers at risk from microbial contaminants in the kitchen environment (natural science) and the development of effective communication interventions building on attitude change models specifically targeting these behaviours (social science). This project is a direct collaboration between the social science group and RIVM (Rijksinstituut voor Volksgezondheid en Milieu). Research in the Wageningen Allergy Consortium specifically focuses on societal acceptance of allergy prevention strategies (for example, with respect to food allergens, or environmental allergens such as Birch pollen). Other issues of potential importance, such as food intolerance, quality of life, and economic impact may become a focus of social-natural science collaborative research in the future. The relationship between consumer confidence and the process of risk analysis will also investigate food safety through integrating social and natural science activity, spanning various European Union countries (SAFEFOODS, co-ordinated by RIKILT – Institute of Food Safety) and funded by the European commission). This project primarily focuses on developing public confidence in the risk management component of risk analysis. In the future, research will need to focus on the development of public confidence in the risk assessment component, particularly as risk analysis becomes more transparent. Research funded by VWA (Voedsel en Waren Autoriteit) focuses on the analysis of the impact of technical food risks on consumer perceptions, confidence and behaviours. It is anticipated that the theoretical framework that develops can be applied to other areas of science innovation in the agri-food sector, such as nanotechnology or sustainable food production systems. In conclusion, future research must certainly take full account of the need to integrate the social and natural sciences if real problems associated with human health, food safety and food security are to be addressed. A good starting point for discussion will be the Wagenigen Integrated food – safety platform, which was initiated to facilitate

discussions between scientists of different disciplines regarding the implementation of effective research in the food safety area. Future developments may focus on the role of affect or emotion in understanding how consumers handle and interpret risk information, how institutions should structure themselves in order to accommodate both technical and societal issues to do with risk assessment, and how these new theoretical perspectives can be applied to emerging areas of concern. These might include health issues related to food choice, or other areas of technology acceptance, for example in relation to the rural landscape.

Conclusions

Societal responses to food risks, or emerging technologies (such as nanotechnology, for example) may reflect increased public distrust unless institutions and organisations act to develop and maintain public confidence in their risk assessment and risk management practices. While public trust is, to some extent, contingent on institutional transparency, other factors, such as institutional responses to public concerns, are also important. To this end, there has recently been increased emphasis on involving the public in risk management, including the development of methods to include the public in the debate about risk management, communication and assessment.

Increased transparency in risk decision-making has made it apparent to all stakeholders that risk analysis is not a purely objective process as it has been previously portrayed, but is subject to value judgements. Risk assessment is not excluded from this conclusion. Increased transparency has also resulted in risk uncertainties inherent in risk assessment becoming open to public scrutiny, which will result in further challenges to the concept of “purity” of the objective reality in which risk assessment is currently confined. Participatory processes, therefore, should not only contribute to decisions about how risks are managed, but also how, and which, risks are assessed, in what time scale and geographical location, taking full account of risk variability across populations and landscapes. The latter will become more salient as knowledge about risk variability increases (for example, as more is known about individual susceptibilities to risks through advances in genomic research). Without public trust, it is unlikely that risk analysis will be effective, and public opposition to many institutional risk-related activities will continue.

Many problems related to food safety, and indeed in other areas of risk and health, can only be solved if a fully integrated co-operation between the social and natural sciences is developed and applied. To this end, it is important to develop new theoretical frameworks in order to operationalise both research ideas and the solution to problems, and to develop a language to facilitate collaboration between social and natural scientists. Only through adopting such an approach can problems in food safety be solved.

Thank you.

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