Field: Agribusiness

Economics of agro-food safety and international market for agro-food products and legislation

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1. Introduction

What's about Economics of Agro-Food Safety and international market for agro-food products and legislation

In recent years, there have been heightened concerns about food safety, not only amongst scientists with an interest in food toxicology or microbiology, for example, but also economists and other social scientists that focus on the wider socio-economic issues associated with the safety of a country's food supply. In part this reflects the real incidence of food-borne illnesses world-wide, and in part consumer concerns about the safety of the food they consume, particularly in industrialized countries, often fuelled by media attention. An added dimension is the impact of food safety regulations on global trade in agricultural and food products. In some ways there is a stark contrast between industrialized and developing countries, although in both contexts the incidence of food borne diseases (in particular those associated with microbial pathogens) is acknowledged to be considerable.

In industrialized countries, whilst food supplies are generally considered to be safe, evidence suggests that food-borne illnesses are prevalent and that the incidence of certain food-borne pathogens is increasing. For example, more than 40 different food-borne pathogens are known to cause human illness. Significant incidents of contaminated meat, dairy products, salads and canned goods, although relatively infrequent, send signals to consumers that the food they purchase is not risk-free. In many cases only small groups of consumers are directly affected by the events, yet publicized food scares create an environment, through a process of 'social amplification', in which food safety is an increasingly widespread and pressing concern.

2. Section 1

What is food safety?

Food safety refers to the potential hazards associated with food that can cause ill-health in humans. Certain of these hazards are naturally-occurring (for example aflatoxins in groundnuts), whilst others occur through contamination (for example pesticide residues in fruit). The potential hazards associated with food include the following:

• **Microbial pathogens** are micro-organisms that occur naturally in humans, animals and/or the environment. Examples include *Salmonella*, *Campylobacter* and *E. coli*. Microbial pathogens are associated with diarrheal diseases.

• **Zoonotic diseases** are transmitted from animals to humans through food products, for example tuberculosis and brucellosis.

• **Parasitic organisms**, in particular intestinal worms, can be transmitted through contaminated food and water.

• **Physical contaminants and adulterants** can occur in food through normal modes of contamination or deliberate addition. Examples include glass, metal animal faeces etc.

• **Naturally-occurring toxicants** occur in food naturally or enter through normal biological processes. Many are virulent toxins associated with enhanced risk of chronic disease in humans and in certain cases acute ill-health. Examples include mycotoxins, alkaloids, lectins etc.

• **Agro-chemical and veterinary drug residues** can occur in food as a result of the purposeful use of these substances in agricultural production. Residues of some substances, for example pesticides, are associated with an elevated risk of cancer.

• **Prions** such as the agent causing bovine spongiform encephalopathy (BSE) are associated with human disease, for example new variant Creutzfeldt-Jakob (vCJD). Humans are exposed through consumption of meat from infected animals.

• **Persistent Organic Pollutants** are compounds that accumulate in the environment and the human body. Known examples are Dioxins and polychlorinated biphenyls (PCBs). These can contaminate food through pollution of air, water and soil. Dioxins are unwanted by-products of some industrial processes and waste incineration. Exposure to persistent organic pollutants is associated with a wide variety of adverse effects in humans, for example cancer.

• **Heavy metals** such as lead and mercury cause neurological damage in infants and children. Exposure to cadmium can also cause kidney damage, usually seen in the elderly. These can contaminate food through pollution of air, water and soil.

• **Genetically-modified organisms** may contain allergens or toxins that are not found in conventional foods.

Some of these hazards cause acute illness, for example microbial pathogens. Others may increase the risk of chronic diseases such as cancer, for example pesticide residues. Across all of these hazards, the impact on an individual reflects a range of factors including age, prevailing health status, genetic constitution etc.

The recorded incidence of food-borne illness is increasing world-wide for a variety of reasons including changes in eating patterns and food production and handling practices, the enhanced geographical movement of people, animals and plants, and emergence of new pathogenic organisms. Further, whilst less well documented, it is evident that the incidence of food-borne disease is greatest in developing countries due to the presence of a wide range of pathogens. Indeed, the high prevalence of diarrheal diseases in many developing countries suggests major underlying food safety problems.

Whilst the entire range of potential food-borne hazards are of concern world-wide, relative risk and perceived importance differs according to a range of factors including levels of economic development, climatic conditions, cultural and social norms, prevailing infrastructure etc. Thus,

certain risks are greater in developing countries, for example because of poor sanitation and/or inadequate access to potable water.

Food safety is of particular concern in a developing country context not only because of the high prevalence of food-borne illness and other hazards associated with food, but also because of the considerable economic and social costs that, in turn, reflect prevailing levels of economic development. Thus, for example, a child that contracts diarrhea from consuming contaminated food may not be able to gain access to the required medical care and may suffer more adverse consequences as a result. Further, the considerable and rapid economic and social changes associated with processes of development, for example urbanization, changes in systems of food production and shifts in food consumption patterns can enhance risks and/or challenge prevailing systems of control.

The importance of food safety as a global public health concern has been recognized internationally. For example, the Rome Declaration on World Food Security (1996) clearly stated that all people have the right to safe food whatever the level of their effective demand. At the international level, the promotion of food safety is the joint responsibility of both FAO and WHO. Food safety has long been a main-stream activity of FAO, including technical assistance program aimed at enhancing food safety control capacity. In the case of WHO, the 53rd World Health assembly requested that the Director-General give greater emphasis to food safety and establish a global strategy for surveillance of food-borne diseases and to initiate a range of other activities on food safety and health.

Often, there is the need to measure the incidence of a certain disease or a food-borne disease. One summary measure of the losses associated with premature mortality and morbidity associated with human disease is the Disability Adjusted Life Year (DALY). For any condition i:

$$DALY_i = YLL_i + YLD_i$$

Where:

$DALY_i$ = Loss of disability-adjusted life years associated with condition i.

YLL_i = Years of life lost associated with condition i.

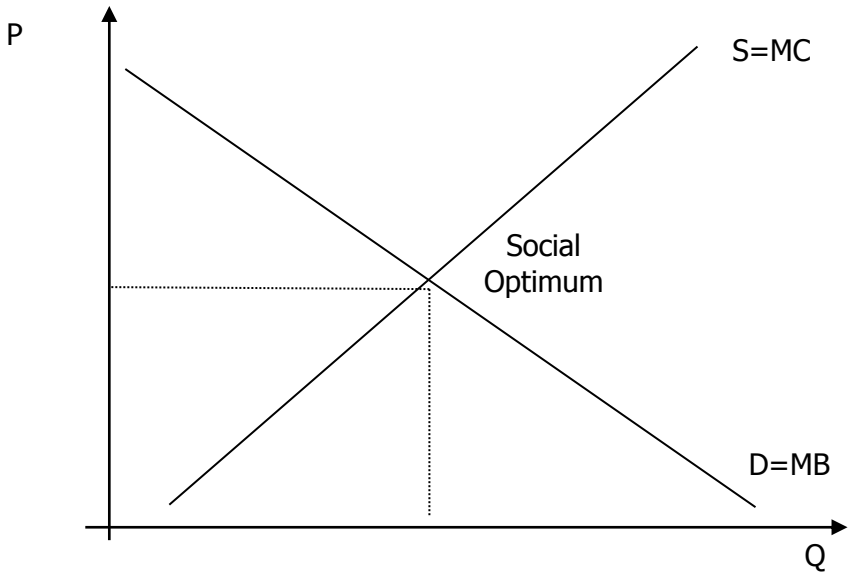
YLDi = Years lived with disability associated with condition i.

The YLL is a measure of the loss of life due to premature mortality, calculated using standard expected years of life lost and an appropriate discount factor. The YLD is time lived in health states worse than perfect health, weighted by a preference factor for each health state. Time lived with disability is also age-weighted and discounted in the same manner as YLLs.

3. Markets for food safety and the role of government

One of the key issues from an economist's perspective is whether markets for food products will operate efficiently, that is whether the quantity and types of foods supplied and consumed and the prices paid by consumers are 'acceptable' in terms of the level of risk. In general, economists make reference to the concept of the 'social optimum' when assessing whether markets are operating efficiently and use this as a benchmark when assessing the need for government intervention. The social optimum is the point at which the net economic value of the good in question is maximized.

Economists represent markets as the inter-play between demand and supply functions for the good or one of its attribute, in this case food safety (Figure 1). The demand function (D) reflects the marginal benefits (MB) of the good to consumers – it is expected that the benefit of an additional unit of the good declines as more is consumed at any point in time. The supply function (S) reflects the marginal costs (MC) of producing the good – the cost of producing an additional unit of the good is expected to increase as more is produced at any point in time. Where the demand and supply functions intersect, the marginal benefits to consumers and marginal costs to producers are equated and net economic value is maximized. At this point, the market price and quantity are at the 'social optimum'.



This very simple market model is used as a starting point to assess whether markets in practice are likely to operate efficiently - they are likely to maximize the net economic value of the good/attribute in question. Economists have identified a number of conditions required if markets are to achieve the 'social optimum'. The term 'market failure' is used to refer to situations where these conditions are violated:

- All of the economic costs associated with the good, including those borne directly by the seller and by society as a whole, must be reflected in the supply function.

- All of the economic benefits associated with the good, including those derived directly by the buyer as well as by society as a whole, must be reflected in the demand function.
- Buyers and sellers must be sufficiently well informed about the good in question and its characteristics in order to make appropriate decisions.
- Buyers and sellers must be able to analyze and apply the information available to them in such a way as to make 'appropriate' decisions.
- There must be a sufficient number of buyers and sellers of the good and opportunities for relatively free entry and exit from the market to ensure market transactions are competitive.
- There should be limited costs of making and carrying out market transactions, including gathering and evaluating information and assessing the outcomes of the decision.

Having established this checklist it is now possible to explore the nature of food products with respect to their safety and the markets in which they are purchased and sold, to identify any potential 'market failures'. In turn, this will provide some indication of the nature and extent to which markets are likely to operate efficiently within the context of food safety.

Externalities:

In the case of food products, there are potentially significant externalities associated with the impact on human health. In turn, these health effects will be dependent on the safety of the product on the one hand and any potential beneficial effects on health (for example the nutritional value of the food) on the other. The key issue here is the extent to which the costs associated with human disease, for example health care and loss of productivity, are borne by society as a whole rather than the individual consumer. To the extent that these costs are borne by society, it is unlikely that the supply and demand functions will fully embody the economic consequences of the consumption of the food. If the product increases the incidence of human disease, and in turn disease-related costs, the market is likely to under-estimate their value and the established market supply of food safety will be less than the 'social optimum'.

Supply of information:

In order that consumers are able to make effective decisions regarding the purchase and consumption of products they must be adequately informed about their characteristics and the associated costs and benefits. In many markets, the amount of information made available to consumers is insufficient and/or of poor quality. In such situations, consumers are likely to make sub-optimal decisions.

Consumers are best informed and make the most effective decisions where the performance of a product can be directly observed prior to purchase or immediately following consumption. The physical appearance and taste of food fall into these categories, as do any acute health effects. However, consumers face considerable difficulties where the experience of a product does not

reveal clearly its performance. These are termed credence characteristics. Clearly, the longer-term health effects of foods fall into this category. On the one hand, consumers may not be able to observe directly the associated health effects, for example in terms of their risk of contracting cancer. On the other, it may not be possible to relate these health effects directly to the consumption of a particular product.

In the case of credence characteristics, consumers have to rely on external sources of information to assess indirectly the performance of the product. Common sources of information used by consumers include product claims, labeling, brand and price. This raises concerns regarding the reliability of these information cues as measures of product performance. For example, to what extent are product claims substantiated and relate directly to the potential health effects for the individual consumer? Likewise, to what extent does a higher product price correlate with better performance? Clearly, trust plays an important role in this respect – consumers will only put credence on information they consider to be reliable and trustworthy.

Markets tend to operate most effectively where buyers and sellers are equally well informed about the characteristics of the products and associated costs and benefits. However, in many markers there are asymmetries between the quantity and quality of information available to the seller and to the buyer. This is particularly the case with products that are scientifically or technologically complex, such as many processed foods, where the consumer may find it extremely difficult to assess whether the product is safe to eat or not. In situations of asymmetric information, the seller can derive market power over the buyer, particularly where the buyer has few alternative sources of information on the performance of the product.

Whilst suppliers may have incentives to communicate the benefits associated with their products, there is less incentive to provide information on risks or defects. This is particular the case where the negative performance of the product cannot be observed directly post-consumption. Furthermore, where all products share similar risks or defects, there is little incentive for competing suppliers to divulge information on each other's products. For example, in the absence of a regulatory requirement to do so, there is little incentive for manufacturers of cigarettes to warn consumers of the negative health effects associated with their products. Likewise, manufacturers of soft drinks may have little incentive to provide information on the sugar content of their products and the potential impact on dental health. Thus, we might reasonably expect that markets for many food products will provide little or no information to consumers on risks.

Consumer decision-making:

Having established whether consumers are adequately informed about the costs and benefits of food products, the next concern is the manner in which this information is utilized and decisions are made regarding the purchase and consumption of such products. In turn, this will relate to the manner in which consumers perceive the potential health effects of the foods they choose to

consume, or not to consume. Consumer demand for a particular food product will be directly related to perceptions of the associated risk to health, for example due to food poisoning or cancer. Thus, everything else being equal, we might expect the demand for a particular food product to decline as the perceived risk increases. Research suggests, however, that consumers routinely under-estimate the risk of death due to relatively high probability events such as cancer and heart disease, whilst over-estimating the risks due to low probability events such as botulism (Figure 3). Thus, consumers will tend to over-demand, and in turn markets will tend to over-supply, foods that are relatively more risky, whilst undersupplying products that are relatively more safe. More widely, the response by consumers to particular foods will also reflect their wider perceptions of the determinants of human health and the impact of their own actions. Consumers who perceive that they have some control over their health are more likely to consume foods that are perceived to be 'risky'. Conversely, consumers who perceive that their health is largely out of their own control are unlikely to consume foods that they perceive to be risky.

Transaction costs:

For markets to operate effectively, the costs associated with transactions should be limited, and ideally zero. In the case of many food products there may be significant transaction costs, in particular associated with the search for information on alternative products and assessment of the associated risks to health. This is particularly the case with new products and/or products for which the risks are perceived to be difficult to predict and understand. Classic examples are new technologies such as irradiation and genetic modification that many consumers perceive to be 'unknown', and thus inherently 'risky'.

Market competition:

For markets to operate effectively, sufficient competition must exist between buyers and sellers, none of which should have enough power to extract market rents. Thus, in order to assess the competitiveness of markets for food products in the context of food safety, the characteristics of the supply-side and the conduct and performance of suppliers, both individually and collectively, must be explored. Further, given that markets in general operate imperfectly, a benchmark must be defined against which comparison can be made. In most industrialized countries, large corporations typically dominate markets for food products. However, whilst individually these corporations have the potential to yield significant market power, whether they do so in practice is an empirical question. In many developing country contexts, however, food markets remain fragmented and are typified by numerous small suppliers with little or no market power, except perhaps at the very local level.

4. Food Safety Regulations

A wide range of safety control systems is in place for the typical food product being offered for sale to consumers. Direct *ex ante* regulation in the form of standards, inspection, product testing, and other programmes attempts to ensure the safety of the product by specifying how it is produced and/or its final quality. Suppliers that are found not to meet the standard are penalized, for example through a system of fines. Further, product liability is *ex post* regulation that punishes suppliers of unsafe products through damage awards to those harmed by their actions.
Direct regulation and product liability may complement or substitute for each other (or even conflict) in establishing incentives for companies to engage in effective food safety controls. Figure 1 details the standards that can be applied by governments in order to control the behavior of buyers and/or sellers in order to achieve a certain level of food safety. These regulatory approaches differ in the extent to which they impede freedom of activity. Information-based measures require suppliers to disclose certain facts about their products, but do not otherwise impose behavioral controls. Examples include health warnings, ingredients labels, and instructions on appropriate product use. At the other extreme, individuals or firms may be prevented from lawfully supplying a product without first obtaining prior approval. To obtain such approval, it must be demonstrated that the products meet certain safety criteria. This approach is most widely used in the regulation of pharmaceutical products and novel foods, for example the products of genetic-modification.

Figure 1 – Forms of Food Safety Regulation

Low	Degree of intervention			High
Information Provision	Standards			Prior Approval
	Target	Performance	Specification	

The standards approach allows the activity to take place without any *ex ante* control, but suppliers who fail to meet the specified safety standards commit an offence. Standards can be sub-divided into three categories that themselves differ in the amount to which they impede freedom of activity. A target standard prescribes no specific standard for the supplier's product or processes, but imposes criminal liability for certain harmful consequences arising from the product.
Performance standards require certain conditions of safety to be satisfied, although the supplier is free to choose how to meet these requirements. Finally, specification standards either require the use of certain production techniques or inputs in a product, or conversely prohibit the use of certain production techniques or inputs in a product.
The government can also use direct economic incentives and disincentives in an attempt to influence the behavior of buyers and/or sellers, in the form of taxes and subsidies. Thus, for

example, tobacco is taxed at a high rate in many developed countries. In food markets, however, subsidies are less common, although preferential or zero rates of sales tax may be applied.

A further important element of public food safety controls that is frequently overlooked is liability laws. Under these laws, parties who are harmed by a supplier's product may sue for damages. Under strict liability, the manufacturer is liable for injuries caused by defective products even when quality controls were adequate and the manufacturer was not at fault. Here the supplier cannot argue, as it could if a negligence standard were applied, that it took reasonable care in producing the product and should therefore not be held liable for any damages that occurred. Compliance with government regulations generally does not provide any protection from this type of liability nor would compliance with private certification standards. It should be noted, however, that the standard applied is determined on a case-by-case basis. Further, many consumer product liability cases are settled between the parties before they reach the courts.

Alternatively, a negligence standard may be applied in cases arising from food safety breakdowns. For example, companies along the supply chain may sue each other for damages resulting from loss of business and reputation, whilst shareholders may sue errant companies for breach of duties or issuing misinformation. Here evidence of how the companies' actions compare to a reasonable standard of care is relevant. Where regulatory standards establish a baseline, violation of the standard is usually considered to be negligence *per se*, whilst compliance with the standard is the only evidence to be considered in defining a reasonable standard of care. Thus 'reasonable' standard of care may be defined, at least in part, by reference to regulatory and certification standards.

Alongside government regulation operates private systems of food safety control, for example self-regulation and various forms of certification by other parties. Self-regulation includes internal control systems that assure product safety, where the company sets, monitors, and self-certifies the control parameters. It can take place at the level of the individual firm or be instituted by trade organizations which cover the predominance of market supply. Certification involves the setting of product quality standards and their monitoring and certification by parties outside the firm, for example customers, industry trade associations, or national or international standards-setting bodies such as the International Organization for Standardization (ISO). Certification may be voluntarily sought by the company or required by those with whom it does business. Indeed, increasingly certification to private standards is becoming *de facto* mandatory as a predominant proportion of market buyers require them. Both self-regulation and certification can act in both an offensive and a defensive manner. In the first case, for example, as a mechanism to increase market share by delivering higher or more dependable quality, and in the second, for example, by protecting current market share from erosion. In both cases this is an incentive for the adoption of private controls by individual operators in the food supply chain.

5. Food Safety Control

Three basic objectives of a food safety control system are identified as follows:

• **Protection** of the human population from hazards in agricultural and food products that pose of threat to human health.

• **Improvement** of hygienic handling of agricultural products for human consumption.

• **Regulation of inputs** used in agricultural production, including animal feed, agrochemicals and biological materials.

In pursuit of these objectives, a national food safety control system must possess the capacity to undertake a series of functions as detailed in Figure 5. These include (IICA, 1999a; Reid, 2000):

• **Epidemiological surveillance:** Capacity to detect the presence (or demonstrate the absence) of biological, chemical or physical hazards that may pose a risk to human health. It includes systems of reporting where problems are encountered and active surveillance efforts aimed at detecting and/or monitoring a specific agent.

• **Management of epidemiological information:** Having established a system of epidemiological surveillance and more generally for the capture of epidemiological information, procedures are required to utilize this information in decision-making with respect to food safety controls in domestic production, whether for domestic consumption or export, and imports.

• **Monitoring of emerging issues:** Systems to ensure access and appropriate management of information on new and emerging hazards to food safety.

• **Quarantine procedures:** Capabilities to undertake emergency actions for the protection of food safety in the case of emerging hazards and/or outbreaks.

• **Risk assessment studies:** Studies, based upon rigorous risk assessment methods, to assess the level of risk to food safety associated with new, emerging or established hazards.

• **Verification and certification:** Technical and organizational capabilities to verify the status of food and agricultural products that are imported and exported with respect to established risks to food safety.

• **Diagnosis and analysis:** Capacity to analyze food safety hazards in agricultural inputs and agricultural and food products.

• **Identification and traceability:** The ability to establish and maintain the identity of agricultural products through the supply chain, in order to permit traceability in the event of a food safety emergency.

• **Hygienic practices:** The establishment and maintenance of systems for hygienic practices in the handling, transformation and packaging of agricultural and food products throughout the supply chain. A key element of such systems is Hazard Analysis Critical Control Point (HACCP).

• **Registration and control of feed, agrochemicals and other inputs:** Systems for the registration and control of the production, distribution and use of agricultural inputs that pose a risk to food safety.

Superimposed on these functions at the national level, there is a need for governments to interact at the international level, in particular with international standard-setting bodies relevant to food safety issues, most notably the Codex Alimentarius Commission, and the World Trade Organization (WTO). Further, the SPS Agreement imposes certain obligations on WTO Members with respect to the food safety measures they apply (see below). Perhaps of greatest interest there are the basic capacity issues that underlie the establishment of an effective and efficient system of food safety controls. By identifying these capacity issues, the constraints faced by developing countries and the associated technical assistance needs can be identified more easily.

Figure 2 – WTO vision of Food Safety

Food Safety		
Food legislation and Enforcement	Educated and Knowledgeable Public	Good Practices by Primary Producers/ Distributors
Advice for Industry/Trade	Discriminating and Selective Consumers	Quality Assurance and Control of Processed Food
Consumer Education	Safe Food Practices in the Home	Appropriate Processes and Technology
Information Gathering and Research	Community Participation	Trained Managers and Food Handlers
Provision of Health-Related Services	Active Consumer Group	Informative Labelling and Consumer Education
Government	Consumers	Industry/Trade
National Commitment to Food Safety		

Source: WHO (1996).

Alongside processes of economic development, the structure and *modus operandi* of markets for food products change. In turn, there are shifts in the need for specific food safety interventions and their appropriateness. These changes cause a shift in both the responsibility for, and ability to, undertake food safety controls from consumers to producers and processors. At low levels of economic development, consumers mitigate the potential risks associated with food through their

food choices and/or preparation methods. However, as formal food markets evolve, food processors and producers play an increasing role. Further, as their incomes increase, consumers begin to demand enhanced food safety controls through their market transactions and political processes.

Figure 3 – Food Safety activities in food production

Farm Production	Transport of Animals and Agricultural Products	Slaughtering Packing Houses and First Distribution	Transport of Products	Industrial Processes	Retailing Food Service
Hygiene of facilities	Cleaning	Hygiene of establishments	Cleaning vehicles	Hygiene of establishments	Hygiene of establishments
Hygiene of personnel	Disinfection	Hygiene of personnel	Cooling	Hygiene of personnel	Hygiene of personnel
Use of water		Ante- and post-mortem inspection and hygiene handling	Hygiene of personnel	Hygienic handling of products	Hygienic handling of products
Sewage contamination		Hygienic handling of products		Microbiological monitoring	Labelling
Control of use of pesticides		Monitoring of agro-chemical residues		Labelling	
Control of use of veterinary drugs		Monitoring of residues of veterinary drugs			
		Microbiological monitoring			
		Labelling			

Source: Walker (1999); Unnevehr and Hirschhorn (2001).

Across these specific measures a number of common trends are apparent as economies develop:

- There is a shift in emphasis from basic investments and simple interventions to more complex and comprehensive regulatory systems.
- Priorities for action change. For example, in low-income countries basic water and sanitation infrastructure is a priority. As food supply systems change and capacity is enhanced, it is possible to undertake targeted interventions to address specific hazards. In high-income countries, comprehensive more comprehensive systems of regulation can be implemented.
- There is a shift from reliance on international standards and/or implementation of standards developed in high-income countries to the promulgation of national standards that take account of local circumstances, consumer demand, socio-cultural; factors etc.

- The provision of information shifts from targeted interventions to general campaigns and product labeling.
- Regulatory systems develop in both scope and depth as enforcement capacity evolves and there is a shift in the importance of the informal and formal sectors.

This highlights the need for efforts to enhance food safety controls in developing countries in order to implement measures that are appropriate given prevailing levels of development and local circumstances and capacity. It also emphasizes the role of international institutions, in particular international standard-setting organizations as modes of knowledge and technology transfer to developing countries.

In developing countries, food safety is closely linked with basic sanitation, water supply, housing conditions, access to adequate nutrition, environmental conditions etc. For example, food may become contaminated because of the way in which it has been produced and/or processed, through contact with non-potable water or the environment, contact with animals or humans, or a combination of these. Thus, the enhancement of food safety is only one of numerous interventions required in order to promote public health, recognizing the need to adopt a more holistic framework as suggested by the ecosystem approach to health discussed above. Further, efforts aimed at enhancing food safety, for example through food handler training, may be ineffective if these other risk factors are not addressed simultaneously.

Figure 4 – effect of food safety on different developed countries and income levels

	Low Income	High Income
Role of food markets	Own production a major source of food supply. Markets may be a relatively minor source of food, particularly in rural areas.	Own production an insignificant source of food supply. Virtually all food obtained through market
Food Processing Sector	Informal sector consisting of small-scale operations that are not legally-registered predominates	Formal sector consisting of legally-registered enterprises predominates
Branding	Non-branded food products predominate	Branded food products predominate
Food preparation	Most food preparation undertaken within the households	Significant proportion of food preparation undertaken outside the household by food processors and/or the food service sector
Food Retailing	Small informal retailers predominate	Large retail chains predominate
New food products	Low rates of entry of new food products	High rates of entry of new food products
Geographical distribution	Local food distribution networks predominate	Wide food distribution networks encompassing both national and international sources of supply
Consumer demand	Income and prices are main factors influencing consumer demand	Perceived food safety and quality have major influence on consumer demand

6. Section 2: Food Safety and Trade

It is widely recognized that food safety capacity is of vital importance to agricultural and food exports from developing countries. Whereas much of the focus of food safety controls at the national level is on domestic security issues, including protection of consumers against food-borne hazards, such capacity is also necessary in order to comply with food safety requirements in export markets, particularly in industrialized countries. For example, importing countries frequently require guarantees that minimum standards of hygiene have been applied in the manufacture of a food product, or that fresh fruits and vegetables do not have excessive residues of pesticides. The exporting country must have the capacity both to comply with such requirements and to undertake the necessary controls in order to demonstrate that compliance has been achieved.

Further, a number of agricultural and food products, for example fresh fruit and vegetables and fish, can provide significant opportunities for developing countries to develop nontraditional exports in the face of secular declines in the terms of trade for established commodity exports. However, these products are also associated with a range of potential food-borne hazards and, as a result, must comply with often strict regulatory requirements in high-income markets. Indeed,

the future growth of these exports will be dependent on the ability to up-grade food safety capacity in both the public and (in particular) private sectors. At the same time, this will bring about changes in the structure and *modus operandi* of supply chains, creating opportunities for some and a loss of livelihood for others.

In recent years there has been heightened interest in the impact of food safety and other SPS measures on trade in agricultural and food products. Whilst not having the restriction of trade as their primary objective, there is evidence that food safety requirements can act as a significant barrier to trade, particularly for developing countries (Henson *et al*., 2000a). Such concerns reflect the global proliferation of food safety and other technical measures in recent times, particularly in industrialized countries. This is evident from the number of notifications of technical measures to GATT/WTO over the period 1981 to 1999. Furthermore, it is now more widely recognized that food safety and other technical measures can act, either explicitly or implicitly, as barriers to trade.

A number of studies provide a commentary on the impact of food safety and other technical measures on developing country exports, although with no attempt to quantify the impact in terms of cost of compliance or volume/value of exports (see for example UNCTAD/Commonwealth Secretariat, 1996; Johnson, 1997; FAO, 1998). These studies suggest that developing countries face considerable difficulties complying with food safety requirements in industrialized country markets. Some more in-depth studies that do attempt to quantify the impact of SPS measures are described below. Further, some specific cases are provided as illustration in Boxes 6 to 10. A recent review of 'Food Safety in Food Security and Food Trade by the International Food Policy Research Institute (IFPRI) provides further examples.

Cato and Lima dos Santos (1998) and Rahman (2001) assess the impact of EU hygiene standards on the Bangladeshi shrimp sector. Over the period August to December 1997, exports of frozen shrimps from Bangladesh to the EU were prohibited because of concerns about hygiene standards in processing facilities and the efficiency of controls undertaken by Bangladeshi government inspectors. It is estimated that the loss of export revenue as a result of this ban was $14.6 million. Furthermore, the costs of upgrading sanitary conditions in the frozen shrimp industry to satisfy the EU's hygiene requirements over the period 1997- 98 is estimated to have been $17.6 million; an average cost per plant of $239,630. However, subsequently exports to the EU have increased significantly suggesting, perhaps, a not inconsiderable return on this investment!

There is evidence that the SPS Agreement has had some positive impacts on the application of SPS measures by WTO Members and their governance internationally. For example, it has enhanced transparency, encouraged the use of risk assessment techniques in the development of national SPS measures and emphasized the importance of pest and disease-free areas, both within and across national boundaries (IATRC, 2000). However, in other areas, for example equivalency, there has been less success. Whilst the SPS Committee has established general guidelines on the

assessment of equivalency, there are few concrete examples of equivalency having been established between trading partners. Arguably, the equivalency provision is one of the most valuable elements of the SPS Agreement to developing countries.

Henson (2003). "The Economics of Food Safety in Developing Countries," ESA Working Paper No. 03-19

7. Secion 3: Utility theory and empirical specifications

Utility is an adimensional measure and its evaluation consists just in comparing two or more utilities among each other.
Utility expresses the level of satisfaction generated by the consumption of a given good. Intuitively, utility includes two sources of satisfaction. The first is linked with the quality attributes of a product and the second corresponds to the strength of consumer's preferences towards these attributes.

Example 1 – utility generated by a single attribute product (X) for a given consumer (i)

$$U_{Xi} = b*Q_i$$

U – Indicates the level of quality attained by the left hand side of the equation
b – Indicates the strength of the consumer's preference towards Q
Q – Indicates the only quality attribute of the product X

Utility could be function of multiple sources of satisfaction, which means that a given product comprehends a certain number of attributes, each of them contributing to the formation of a certain level of utility. Attributes could be independent one other or have conditional dependency (the presence of one attribute conditions the presence of another attribute).
Independent attributes generate separable utility functions in which each attribute contributes to utility in an independent (separate) way relatively to other attributes.

Example 2 – utility generated by an independent set of three attributes (separable utility function)

$$U_{Xi} = b_1 * Q_{1i} + b_2 * Q_{2i} + b_3 * Q_{3i}$$

Conditionally dependent attributes generate complications in the specification of the utility function such as multiplicative attributes and tree structures of the equation.

Attributes include quality determinants of the product such as sweetness, flavor, freshness, but also price. Quality attributes are expected to contribute positively to the formation of the utility, and each attribute contributes with a different weight (each b is different and has a positive sign in front).
Price, on the other hand, is a negative attribute. When the good is more expensive, consumer's utility is expected to be lower. The b for the price will be negative in this case.

Example 3 – utility function relative to the organic salad

$$U_{xi} = a + b_i*\text{Organic} + b_2*\text{Price}$$

Organic indicates a conventional product when takes the value of 0, an organic product when 1.
That, in numbers could be:

$$2 = 3 + 2*1(\text{organic}) - 3*\text{EURO 1}$$

This example shows that in case the price increases by EURO 1, going from EURO 1 to EURO 2, the utility of the consumer i will move from 2 to -1.

8. The Willingness to Pay for additional elements of quality

The example above allows for other interpretations. In fact, the negative ratio between the coefficient relative to the attribute "organic", and the coefficient "b_2", relative to price, indicates the marginal rate of substitution (MRS) between price and organic. In simple words, the negative outcome of this ratio indicates the Willingness To Pay (WTP) for an organic product as opposed to the conventional.
This example shows that the negative ratio is 0.66 EURO and represents the additional value consumers they would pay for having the organic version of the product.
Using the economic terminology, the WTP is a representation of the Compensating Variation (CV). This economic concept refers to the monetary value a consumer would be willing to pay for having a quality upgrade of the given product. Since the higher quality increases their level of utility, the CV corresponds to the monetary value that consumer "i" has to pay for returning back to her initial level of utility.

9. Heterogeneity in taste

As already pointed out, the coefficient relative to the price represents the strength of consumer's preference towards the considered product attribute. This coefficient, expression of the individual perception and taste, cannot just be a unique measure for every consumer since preferences are unequivocally heterogeneous.
Income, education and other consumers' characteristics, for example, could affect significantly the WTP.

10. The Contingent Valuation Method

Contingent valuation is a survey-based economic technique for the valuation of non-market resources, such as environmental preservation or the impact of contamination. While these resources do give people utility, certain aspects of them do not have a market price as they are not directly sold--for example, people receive benefit from a beautiful view of a mountain, but it would be tough to value using price-based models. Contingent valuation surveys are one technique which is used to measure these aspects. Contingent valuation is often referred to as a stated preference model, in contrast to a price-based revealed preference model. Both models are utility-based.
Typically the survey asks how much money people would be willing to pay (or willing to accept) to maintain the existence of (or be compensated for the loss of) the existence of a some environmental feature, such as biodiversity.

Contingent valuation surveys were first proposed in theory by S.V. Ciriacy-Wantrup (1947) as a method for eliciting market valuation of a non-market good. The first practical application of the technique was in 1963 when Davis used surveys to estimate the value hunters and tourists placed on a particular wilderness area. He compared the survey results to an estimation of value based on travel costs and found good correlation with his results.

The method rose to high prominence in the 1980s when government agencies were given the power to sue for damage to environmental resources which they were trustees over. Following Ohio v Department of the Interior, the types of damages which they were able

to recover included non-use or existence values. Existence values are unable to be assessed through market pricing mechanisms so contingent valuation surveys were suggested to assess them. During this time the EPA convened an important conference with an aim to recommend guidelines for survey design. The Exxon Valdez oil spill in Prince William Sound was the first case where contingent valuation surveys were used in a quantitative assessment of damages. Use of the technique has spread from there.

Many economists question the use of stated preference to determine willingness to pay for a good, preferring to rely on people's revealed preferences in binding market transactions. Early contingent valuation surveys were often open-ended questions of the form "how much compensation would you demand for the destruction of X area" or "how much you would pay to preserve X". Such surveys potentially suffer from a number of shortcomings; strategic behavior, protest answers, response bias and respondents ignoring income constraints. Early surveys used in environmental valuation seemed to indicate people were expressing a general preference for environmental spending in their answers, described as the embedding effect by detractors of the method.

In response to criticisms of contingent valuation surveys, a panel of high profile economists (chaired by Nobel Prize laureates Kenneth Arrow and Robert Solow) was convened under the auspices of the National Oceanic and Atmospheric Administration (NOAA) in 1993. The panel heard evidence from 22 expert economists and published its results in 1995. The recommendations of the NOAA panel were that contingent valuation surveys should be carefully designed and controlled due to the inherent difficulties in eliciting accurate economic values through survey methods.

The most important recommendations of the NOAA panel were that:

* Personal interviews be used to conduct the survey, as opposed to telephone or mall-stop methods.
* Surveys be designed in a yes or no referendum format put to the respondent as a vote on a specific tax to protect a specified resource.
* Respondents be given detailed information on the resource in question and on the protection measure they were voting on. This information should include threats to the

resource (best and worst-case scenarios), scientific evaluation of its ecological importance and possible outcomes of protection measures.

* Income effects be carefully explained to ensure respondents understood that they were to express their willingness to pay to protect the particular resource in question, not the environment generally.

* Subsidiary questions be asked to ensure respondents understood the question posed.

The guiding principle behind these recommendations was that the survey operator has a high burden of proof to satisfy before the results can be seen as meaningful. Surveys meeting these criteria are very expensive to operate and to ameliorate the expense of conducting surveys the panel recommended a set of reference surveys which future surveys could be compared to and calibrated against. The NOAA panel also felt, in general, that conservative estimates of value were to be preferred and one important consequence of this decision is that they recommended contingent valuation surveys measure willingness to pay to protect the good rather than willingness to accept compensation for the loss of the resource.

As a result, current contingent valuation methodology corrects for these shortcomings, and current empirical testing indicates that such bias and inconsistency has been successfully addressed.

As shown by Mundy and McLean (1998), contingent valuation is now widely accepted as a real estate appraisal technique, particularly in contaminated property or other situations where revealed preference models (i.e. -- transaction pricing) fail due to disequilibrium in the market. McLean, Mundy, and Kilpatrick (1999) demonstrate the acceptability of contingent valuation in real estate expert testimony, and the current standards for use of contingent valuation in litigation situations is described by Diamond (2000).

The technique has been widely used by government departments in the US when performing cost-benefit analysis of projects impacting, positively or negatively, on the environment. Examples include a valuation of water quality and recreational opportunities in the river downstream from Glen Canyon dam, biodiversity restoration in the Mono Lake and restoration of salmon spawning grounds in certain rivers. The technique has also been

used in Australia to value areas of the Kakadu National Park as well as trophy property in the United States, and is recognized as a valuable tool in the appraisal of Brownfield.

11. Section 4: The main European Food Safety Organizations:

European Committee on the Environment, Public Health and Food Safety

European Food Safety Authority

Safe Foods

Food Safety Promotion Board

European Committee on the Environment, Public Health and Food Safety

The Committee on the Environment, Public Health and Food Safety (ENVI) is responsible for environmental policy and environmental protection measures, public health, food safety issues, in particular the labelling and safety of foodstuffs; veterinary legislation concerning protection against risks to human health; public health checks on foodstuffs and food production systems.

The European Food Safety Authority (EFSA)

It is the agency of the European Union (EU) that provides independent scientific advice and communicates on existing and emerging risks associated with the food chain. EFSA was established, with Regulation 178/2002, specifically as an independent source of scientific advice and communication on risks associated with the food chain. The new European food safety system has, above all else, delivered one crucial reform: the separation of risk assessment and risk management. As the EU's risk assessor, EFSA supports the European Commission, European Parliament and Member States in taking effective, appropriate and timely risk management decisions by providing a scientific-based foundation for policies and legislation.

Safe Foods is a European project established in 2004 that deals with food safety. It deals with comparative safety evaluation of plant breeding approaches and production practices,early detection of emerging food and feed risks, quantitative risk assessment of combined exposure to food contaminants and natural toxins, consumer research of food risk management perceptions, and i challenges and solutions to systemic risk management.

The Food Safety Promotion Board

It deals with promotion of food safety, research into food safety, communication of food alerts, surveillance of foodborne disease, promotion of scientific co-operation and laboratory linkages, development of cost-effective facilities for specialised laboratory testing.

12. General Food Law Regulation (EC) no. 178/2002

It lays down general principles and requirements of food law and food safety procedures, and established the European Food Safety Authority.

The regulation provides a framework for food and feed law in the EC and imposes both on Member States and on food and feed business operators. It applies to all stages of production, processing and distribution of food and feed, but does not apply to primary production for private domestic use or to the domestic preparation, handling or storage of food for private domestic consumption. The principal aim of the regulation is to protect public health and consumers' interests in relation to food. Article 5 deals with General objectives, Article 6 Risk analysis, Article 8 Protection of consumers' interests, Article 14 Food safety requirements, Article 17 Responsibilities, Article 22 Mission of the Authority.

http://www.efsa.europa.eu/en

https://www.food.gov.uk/business-industry/guidancenotes/hygguid/generalfoodlaw