AGRICULTURAL MANAGEMENT,
MARKETING AND FINANCE
WORKING DOCUMENT

22

Costs and benefits in food quality systems: concepts and a multi-criteria evaluation approach

AGRICULTURAL MANAGEMENT,
MARKETING AND FINANCE
WORKING DOCUMENT

22

Costs and benefits in food quality systems: concepts and a multi-criteria evaluation approach

by
Stephanie Krieger and Gerhard Schiefer
Chair for Business Management,
Organization and Information Management
University of Bonn
and
Carlos A. da Silva
Agribusiness Management,
Marketing and Finance Service,
Rural Infrastructure and Agro-Industries Division

Agricultural Management, Marketing and Finance Service (AGSF)
Rural Infrastructure and Agro-Industries Division
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2007

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to:
Chief
Electronic Publishing Policy and Support Branch
Communication Division
FAO
Viale delle Terme di Caracalla, 00153 Rome, Italy
or by e-mail to:
copyright@fao.org
© FAO 2007

Contents

Preface

The implementation of quality systems of various kinds has become a universal necessity in the agrifood sector. Indeed, in many countries the adoption of food quality and safety systems by enterprises is no longer a matter of choice, but a legal requirement. Based on the so-called 'grandparents' of quality control systems - the International Organization for Standardization's ISO 9000 for quality management and the Hazard Analysis and Critical Control Point (HACCP) approach for risk control - a number of different quality systems with regional, national or global appeal have been developed and introduced worldwide. These may focus on processing or retail enterprises, on farms, on the industry as a whole or on specific food chains. They all differ from traditional product-based food quality control, with their focus on processes, process organization, process control and process improvement. The process view builds on the assumptions that: (i) good process organization and process control allows for the guarantee of product quality, irrespective of individual product inspection and (ii) certain quality characteristics, for example, animal welfare considerations, cannot be identified through inspection of the final product, but depend instead on specific organizational process characteristics.

Today's quality systems incorporate a variety of different quality viewpoints, usually integrating ISO9000 and HACCP aspects. In this regard, 'quality' may refer to:

a) the quality of enterprise management (as exemplified in the term of 'total quality management');
b) the quality of process organization and control;
c) the quality of process management (as exemplified by the ISO 9000 standards on 'quality management');
d) the quality of products.

A given mix of requirements characterizes a particular quality system. Apart from HACCP, quality systems are usually established and managed by non-governmental bodies and implemented by enterprises in the agrifood sector with the goal of achieving improvements in process management and quality production. Quality systems are also implemented as enablers of market access. Indeed, in recent years, a major driver for the adoption of quality systems in enterprises has been the set of standards promoted by retail groups. Retailers, particularly those of the Western world, demand quality system implementation from their suppliers on a global scale, irrespective of country borders.

Enterprises wishing to become suppliers in the more demanding retail markets, either locally or globally, need to evaluate whether the costs of complying with the quality system requirements can be offset by the added benefits provided by the access to such markets. Yet, measuring benefits and costs within the context of quality system adoption decisions is by no means a simple task. Both conceptual and operational difficulties make the calculations complex and invariably cumbersome. Often, the decision choice involves the option of complying with more than one particular system, a fact that compounds the challenge of assessing costs and benefits in this context.

This working document has been developed as a reference source for professionals seeking guidance on conceptual and methodological frameworks for the consideration of costs and benefits in decision-making processes related to the adoption of quality systems. It discusses fundamental concepts, reviews an extensive range of bibliographical sources and provides some indications about alternative approaches to assess costs and benefits of alternative choices regarding quality system adoption. It also discusses a multiple-criteria decision approach for the evaluation of benefits and costs.

It is hoped that the text can represent a contribution to the technical literature in this general discipline. It is also hoped that it can stimulate further work in this area of interest, with a focus on the agrifood domain.

Acknowledgements

This document has been developed as part of the activities of the FAO programme on 'Enhancing Food Quality and Safety by Strengthening Handling, Processing and Marketing in the Food Chain' (PE 214A9) , that was later absorbed by the programme "Ensuring Product Quality and Safety in Agro-industries" (PE 2MA 04 MO 07). Suggestions and comments on the successive drafts were provided by Roberto Cuevas-Garcia, Eva Gálvez and Pilar Santacoloma, to whom appreciation by the authors is extended.

An additional thank you to Doyle Baker, Chief, Agricultural Management, Marketing and Finance Service, for his support and advice in the development of this study, to Martin Hilmi for the proofreading and for following the entire publication process and to Marianne Sinko for the layout and desktop publishing.

Acronyms

AFBM	All Farmer Base Module
AHP	Analytical Hierarchy Process
BRC	British Retailer Consortium
BSE	Bovine Spongiform Encephalopathy
CA	Codex Alimentarius
CBM	Crop Base Module
DQG	Danish Quality Guarantee
EPLL	European Product Liability Law
EUREPGAP*	Euro Retailer Produce Good Agricultural Practices
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration (United States)
FSIS	Food Safety Inspection Service
FVM	Fruit and Vegetable Module
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GFSI	Global Food Safety Initiative
HACCP	Hazard Analysis and Critical Control Point
IFS	International Food Standard
IKB	Integrated Chain Control System (The Netherlands)
IKM	Integrated Milk Chain (Belgium)
ISO	International Organization of Standardization
MRL	Maximum Residue Level
Q & S	Quality and Safety
SQF	Safe Quality Food
SPS	Sanitary and Phytosanitary Measures
TBT	Technical Barriers to Trade
WHO	World Health Organization
WTO	World Trade Organization

* Note, EurepGAP, as of September 2007, is referred to also as GLOBALG.A.P. (Global Partnership for Good Agricultural Practices). By January 2009, GLOBALG.A.P. will be used exclusively and will replace the EurepGAP term.

1. Introduction

Concerns with food safety and quality have persistently been present on the agenda of policy makers and managers concerned with food production and processing. . Though not novel, the interest in quality and safety issues has certainly been widened by recent changes in agrifood systems internationally. New developments in this regard include:

a) the ghe growing number of international trade agreements, in an increasingly globalized agrifood sector;
b) the industrialization of agriculture, which more and more separates consumers from food production processes, making consumers more dependent on information delivered with the food item purchased, in order to consider food safety and quality;
c) consumer requirements on food safety and quality, specially in more affluent markets, combined with the willingness and ability to react to safety and quality problems;
d) developments in product liability laws in major food markets.

These changes are associated with the proliferation of standards regarding the composition of foods and the limits in potentially hazardous residues, among other specifications. They also influence the design of so-called ‘quality systems’, which establish the organization and management of processes guaranteeing the quality and the safety of food products brought to markets.

From a historical perspective, until the later part of the last century, food product standards primarily focused on the safety issue. They built on the international agreements expressed in the ‘Codex Alimentarius’ (CA), an initiative jointly supported by the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), or were developed within the framework of the World Trade Organization’s (WTO) agreement on the application of ‘Sanitary and Phytosanitary Measures’ (SPS). As such, the agreements concentrated on limits of potentially hazardous residues and on the implementation of HACCP concepts for food safety control.

While countries could enforce such agreements in their own food policies, voluntary enterprise-oriented initiatives to communicate production and product reliability via the implementation of quality management systems were increasingly gaining attention., especially those linked to the ISO9000 quality management standards.,

With the Bovine Spongiform Encephalopathy (BSE), commonly known as mad-cow-disease, crisis in Europe and following a number of subsequent food safety scares, the general situation began to change. Numerous new ‘quality systems’ were began, building on a combination of requirements regarding the food product itself (product quality) and the organization and management of food production and transformation processes (process quality). While these developments took place primarily in Europe, with the advent of the Global Food Safety Initiative (GFSI) their reach was widened to a more global scale.

In the past few years, newer or stricter product liability laws enacted in the European Union (EU) and in other major markets of the developed world, have prompted large global retail chains (for example,. Wal-Mart, Carrefour, Metro, Tesco, etc.) to formulate their own supplier standards for product and process quality. With the global procurement activities of these chains and of their suppliers, such private standards have a global effect and ultimately establish the quality and safety benchmarks for many agrifood products.

Private standards reach as far upstream in the value chain as the agricultural production segment. Indeed, the European retail groups' EurepGAP (Euro Retailer Produce Good Agricultural Practices) standard for agricultural production has become a global initiative and a *de facto* benchmark within a short time since its implementation. The standards of the global retail chains (British Retailer Consortium (BRC), International Food Standards (IFS), etc.) consider, as a general framework, the requirements stated in the CA and SPS agreements. However, by definition they reach beyond the scope of the agreements and non-tariff trade barriers that are set independently of the WTO negotiations and CA developments. They do not constitute classical trade barriers between countries, but are instead seen as trade barriers between those enterprises that have been approved by retail chains as potential suppliers and those which have not been approved.

Such chain induced, non-tariff trade barriers, cannot be subject to any trade agreements as long as product liability laws make retailers fully liable for any harm their products might inflict on consumers. The switch from country-based trade barriers to value-chain based global trade barriers is only slowly being comprehended by policy makers. However, it puts the emerging quality and safety systems into a prominent position for consideration in discussions on the future development of the global agrifood system.

The European retail chains have assumed a leading role in the formulation of food safety and quality standards. Their international supplier base, especially in developing countries, needs to adapt and comply, if they wish to continue trading with major retailers. Furthermore, other retail groups outside Europe, including the international subsidiaries of European groups, are bound to eventually join and thus plausibly establish the private standards as the true international benchmark for food safety and quality. Under such a scenario, production groups in developing countries with trading interests with less developed economies are not in a position to establish standards for quality systems on their own. They must comply or else be excluded from trade. In this situation, it is important for enterprises to be able to:

a) follow the economic minimization principle, i.e. fulfil the necessary requirements of certain standards required by their trading partners with the lowest possible costs or, alternatively;

b) follow the economic maximization principle, i.e. to utilize a certain budget to adapt their production system to as many standards of potential trading partners as possible.

A decision on the principle to adopt requires the examination of the costs and benefits of each alternative. In the maximization principle, resources would not be used to adapt production processes to as many standards as possible, but only to those which are 'worthwhile', i.e. where benefits are greater than costs. A similar argument could be made, if an enterprise considers the minimization principle.

While this reasoning sounds simple, what needs to be kept in mind, is that alternative sets of standards might have overlapping requirements; a fact which can contribute to reducing their costs of implementation. The same holds true for the consideration of benefits. For example, if one standard requires the ability of tracking and tracing products to reduce risks and find the source of problems in case of failures, the implementation of an additional standard, with a similar requirement, would not add to benefits. As a consequence, enterprises would need to judge costs and benefits on the basis of their individual situation. Also, if groups of enterprises in a given country are in a similar decision situation, cost-benefit calculations can be considered for them as a group, in an aggregate fashion. Enterprise associations, public institutions or government agencies could utilize cost-benefit calculations to advise enterprises on the best sequence for a gradual implementation of standards, or to calculate the cost-benefit ratio for certain implementation paths.

This working document was developed to support enterprises, groups of enterprises and public authorities in their examination of costs and benefits in decision-making about the implementation of agrifood quality systems. The text also intends to provide guidance on the use of economic principles in the design of best practice implementation paths for quality and safety systems adoption. The document reviews alternative approaches and proposes a decision support methodology that specifically addresses situations where the quantification of costs and benefits is not straightforward.

Following this introduction, a discussion of cost-benefit issues concerning quality system implementation in the agrifood sector is presented. The subsequent section analyses legal requirements as a basis for 'quality' actions in enterprises and provides insights into the structure of quality and safety systems. The existing literature on the impact of methodologies and approaches for cost-benefit-estimations for agrifood quality and safety improvements is then reviewed. The text proceeds with a section dealing with the discussion of costs and benefits which could arise in quality and safety improvement processes at the level of the enterprise, value chain, market and public sector. Further, a methodological concept for the estimation of cost and benefits of quality and safety standards is presented and a case study illustrating the estimation of costs and benefits under the proposed approach is provided. Finally, the document concludes with recommendations for public policy to improve the actual and the future situation of quality and food safety.

2. The challenges of measuring cost and benefits of agrifood quality systems

The agrifood system can be viewed as a network composed of different subsystems in which multiple products are produced and marketed by different actors. Cooperation in such networks is characterized by vertical or horizontal interactions, competitive relations and cross-cutting interactions among different subsystems located in one or more countries. This complex organization represents a challenge for any identification/ isolation of effects of management activities, such as the improvement initiatives towards the quality and safety of agrifood products, the consequences of which reach beyond the limits of the individual enterprise.

In this framework, improvements in the quality and safety of food products build on decisions linked to requirements. These are defined by general legislation, by agreements within the scope of the CA that could be enforced within the WTO trade accords, and by quality standards devised by public or private groups that cannot be enforced by administrative rules, but through markets and its participants.

Enterprise decisions on the adoption of quality and safety standards might focus on the implementation of individual requirements or of comprehensive systems. Policy decisions by public or private agencies might on the other hand focus on the provision of support for sector developments in quality and safety improvements, beyond legal regulations. In both cases, decisions will have to deal with the feasibility of implementation and on an analysis of its consequences, involving those related to costs and benefits.

Meeting standards could become a major difficulty for enterprises, as the adoption of the associated requirements may require specific technical skills, facilities, and equipment. Problems could also arise during the implementation of different quality systems by an individual enterprise, as there might be conflicting requirements; while one system might call for intensive cleaning and disinfection, another might ask for minimization in the use of cleaning and disinfection agents.

In principle, enterprises have to search for the best solution regarding the adherence to particular sets of standards and improvements in food safety and quality with a view on costs and overall benefits.

The analysis of costs and benefits is a traditional approach for decision support in economics. However, the consideration of cost-benefit relationships linked to the implementation of quality improvements and quality management systems in the agrifood sector is less common. The few studies documented in the literature refer to costs and benefits of food safety as an integral part of quality management concerns (Grunert, 2005). Other studies deal with trade and especially with the agreements on 'SPS' measures and on Technical Barriers to Trade (TBT).

Furthermore, studies primarily focus on an analysis of individual quality systems, such as HACCP (Unnevehr & Jensen, 1999), and not on the identification of an 'optimal' decision alternative. They accentuate risk assessment or risk reduction, not quality improvement and focus primarily on the United States, where the implementation of the HACCP principles received more attention by the research community than elsewhere. Improvements in food safety were primarily discussed at the processing level (Jensen *et al.* 1998; Gould *et al.*, 2000), the retailers' level (Mortlock *et al.* 2000), and only in some few cases on the chain as a whole (Valeeva, 2005).

Measuring costs and benefits of quality and food safety improvements faces practical and conceptual difficulties. Some of the difficulties are associated with the need to isolate the impact of individual standards. The same problem exists concerning benefits of a quality system. Challenges of valuing benefits involve the need to quantify items such as improved market access, enhanced corporate image (trusted supplier), environmentally improved products, improved health and higher overall efficiency. Quality of food has also been seen as a factor for small food industry competitiveness (Cuevas, 2004). In Asia, it has been found that food quality in traditional markets depends on the degree of economic benefits expected along the chain (Shepherd, 2006), while in Latin America studies in several countries found that traditional chains lack the appropriate incentives to promote improvements in food quality and safety (Gálvez, 2006).

Costs and benefits of safety and quality improvements depend on the internal and the external conditions under which an enterprise operates. The calculation of costs and benefits will therefore have to focus on individual enterprises or on groups of enterprises with similar characteristics regarding the implementation and the consequences of improvements in food safety and quality.

3. Quality system principles

Legal requirements

Generally, legislation places extensive and stringent requirements on quality and safety of agrifood products. A whole range of laws, acts, regulations, norms and directives exist that are related to the production of food and agricultural products, minimization of environmental implications and prevention of unfair trade. Such regulations address a variety of different aspects; food hygiene, traceability, reduction of pesticides, animal feed hygiene, product-related requirements and control-systems, including requirements for trade. These regulations may act on different levels, world-wide (i.e. CA), continental, national or sectoral (i.e., guidelines for dairy products) (Luning *et al.*, 2002).

During the past few years, changes in food legislation in major consumer markets of the developed world, especially regarding product liability, had a major impact on the formulation of quality system standards for the agrifood sector. As an example, the European Product Liability Law (EPLL) requires the fulfilment of 'due diligence' of products, asking enterprises to take **all relevant steps** to assure the safety of their products (Krieger, 2004). These requirements were complemented (EU regulation 178/2002) by new requirements on traceability, monitoring (self-control) and reporting. Especially the requirements on traceability have a **global effect**, as they apply to the entire value chain, reaching from retail to agriculture and beyond. These requirements on the value chain have been further intensified through the EU regulation 852/2004, which formulates general requirements regarding food hygiene in enterprises in the whole food value chain, including agriculture, linked to consumer products sold in the EU market and produced anywhere in the world. The implementation of food safety control systems based on the HACCP principles is mandatory, except for agriculture.

Focus

Quality system standards may contain requirements related to:

a) the organization of production processes (for example, setting limits on the utilization of pesticides in farms);
b) the management of processes (for example, traceability requirements);
c) Product characteristics regarding quality (for example, hygiene), safety (for example. pesticide residue);
d) authenticity (for example, geographical origin) (Giovannucci & Reardon, 1999);
e) infrastructure (Krieger & Schiefer, 2007a).

While compliance with these requirements will allow enterprises to access markets with associated benefits, they will most likely imply the need for new investments and an increase in operating costs.

Existing quality system standards can in principle be used by legislative bodies as a model and then incorporated into mandatory requirements, as exemplified by the enforcement of the HACCP principles in many countries, including those of the EU. However, as the CA and the SPS agreements set limits to such activities, the implementation of quality systems is primarily a function of decisions by individual enterprises or groups of enterprises to improve individual performance or market access or, alternatively, is promoted by market demands.

Depending on the focus, the orientation of standards could be towards enterprises at a certain stage of the value chain (horizontal) or towards enterprises throughout the value chain (vertical).

Vertically-oriented quality system standards (for example, the Dutch Integrated Chain Control System (IKB) , Quality and Safety (Q&S), Certus) set requirements for compliance at several or all stages of the value chain. These vertically-oriented approaches aim to ensure chain wide quality guarantees. Beyond this feature, such systems have additional benefits that facilitate acceptance in the sector. They include the fact that enterprises at any stage are free to select trading partners, as long as these adhere to the standard without compromising the system's quality guarantee promise. This facilitates acceptance in a sector with dynamically evolving supplier-customer relationships. Moreover, enterprises do not have to exchange quality information as long as they are in line with the standard's requirements. This facilitates acceptance in a sector without a homogenous, well developed information infrastructure. It also facilitates the linkage between enterprises from developed and less developed economic environments.

Horizontally-oriented quality standards (for example. IFS, BRC, EurepGAP) set no overlapping requirements for subsequent stages of the value chain. EurepGAP standards for instance, are relevant for farmers only, while the BRC standard applies only to suppliers of retail groups.

INTERNAL STRUCTURE

In general, quality system standards are presented in manuals that include requirements and interpretations, plus checklists for self-control and audits. In some system standards, requirements are structured hierarchically, distinguishing between classifications as 'high and low priority' (IKM), 'critical, not critical and recommendations' (EurepGAP), 'basic and high level' (IFS), or as '*1, 2, and 3*' (Safe Quality Food (SQF) 1000 and SQF 2000).

The different hierarchical levels allow a degree of implementation flexibility in system certification by external auditors. As an example, for the IFS, the fulfilment of 75 percent of the requirements, including all so-called 'KO-Criteria', is sufficient to yield a basic level certification. The 'SQF 1000' and 'SQF 2000' standards on the other hand distinguish between three certification levels which build on the cumulative implementation of different sets of requirements. Level 1 involves fundamental food safety requirements, level 2 extends requirements towards an accredited 'HACCP Food Safety Plan', and level 3 incorporates special requirements for quality management. However, the hierarchy principle is not a general one; system standards like the Danish Quality Guarantee (DQG), for instance, ask for a complete fulfilment of all of its requirements (Krieger & Schiefer, 2007b).

Audit checklists give a precise specification on what an enterprise needs to prove for an appropriate implementation of a quality system. They are, therefore, a baseline source for the analysis of costs and benefits.

4. Approaches to the estimation of costs and benefits of quality systems

Categories of costs and benefits

Cost and benefits are two dimensions for the economic evaluation of quality systems. They provide the basis for any judgement on the 'attractiveness' of alternative quality systems and for decisions on the extent of their implementation, be it minimally or beyond existing legal requirements.

The analysis of costs and benefits that could be attributed to quality systems is complex. Major difficulties include the allocation and the quantification of cost and benefit items. Costs and benefits may not only include elements that could be directly attributed to the implementation and operation of quality systems (direct costs and benefits), but also elements where the relationship is not exclusive (indirect costs and benefits). Furthermore, costs and benefits could involve monetary elements, non-monetary elements that could be quantified and non-monetary elements that are difficult to quantify (qualitative elements). The difficulties are, first, to find quantifiable indicators for qualitative elements and, secondly, to integrate all elements into a unified, if possible monetary, measurement. Benefits, in particular, involve mostly non-monetary and qualitative elements. This is one of the reasons why common approaches for the estimation of costs and those for the estimation of benefits differ.

For the analysis of costs in food quality and safety improvements, cost elements could be categorized as real-source compliance costs, social welfare losses, and transitional social costs (see for example Unnevehr & Jensen, 2001).

Real-source compliance costs refer to costs incurred **by firms** which must change their production to meet new standards. Examples involve the purchase of new equipment, the operation and maintenance of new equipment and the use of additional quality inputs, such as skilled labour.

Social welfare losses include higher consumer prices for food products or additional legal and administrative expenditures, such as higher premiums for insurances against product recalls.

Transitional social costs refer to costs that might occur in a transition period as, for example, the costs associated with the closure of firms that could not meet new standards.

As to the analysis of benefits**,** they could be distinguished between those that accrue to enterprises or consumers on one side, and social benefits on the other side. Consumer benefits arise from improvements in the quality of products and services. When consumers buy products from producers that have implemented quality systems, social benefits may arise from a reduction of monitoring costs from the regulatory authority (Unnevehr & Roberts, 1996). Several benefit categories may involve monetary gains as, for example, the reduction in failure costs or in the number of product recalls. They might also imply in non-monetary benefits, such as reductions in the loss of working days or lives (see, for example, Belli *et al.*, 2001).

APPROACHES FOR THE ESTIMATION OF COSTS

To analyse costs of quality standards, three different approaches have been proposed in literature, namely the **engineering**, the **accounting** and the **econometric estimation**. approaches.

Engineering analysis approach

The engineering analysis approach bases the estimation of costs of improvements in food quality and safety on the analysis of cost data available from existing (secondary) sources, considering the **individual elements** required by the improvement process. For example, if compliance requires construction of new plants, investments in equipment, training, testing regimes, and re-work strategies, then the overall cost is calculated as an aggregate of existing cost data, that could be associated with these individual elements (see for example, Jensen & Unnevehr, 2000). The production and cost functions are used to represent the processes and to identify a desired level of safety or, alternatively, to comply with a particular regulation. Examples of applications of this approach include the 'Final Regulatory Impact Assessment' studies on the cost of compliance for mandatory adoption of HACCP in the seafood, meat, and poultry industries in the United States Food and Drug Administration (FDA), 1995; Food Safety and Inspection Service (FSIS), 1995, 1996).

Engineering cost analyses are usually considered as transparent (i.e., precise and easy to understand) and reliable, as they usually build on new or existing real cost data. However, they also have their limitations, especially in cases where data is not available or regulations do not specify particular actions that enterprises would have to take. As an example, the adoption of the HACCP approach builds on the implementation of regulations that specify overall process control, but leaves individual implementation decisions to the firm. However, in engineering cost estimation the specification of implementation decisions is a necessity. As a consequence, the quality or reliability of engineering cost estimations depends on the ability of the analyst to obtain appropriate data and predict enterprise actions.

Accounting approach

The accounting approach measures the cost of improvements in food quality and safety through **structured surveys** among companies. This direct involvement of those confronted with the costs and their experience in estimating them is a major advantage of the approach. However, the quality of the analysis hinges on the quality of the survey. The survey design must be based on a comprehensive knowledge of the range of activities that the firm may have used, in order to ensure that the right questions are asked and the right information obtained. Furthermore, analysts have frequently found that plant level managers are able to enumerate the **inputs and outcomes** of safety enhancement actions, but may have difficulties to estimate the **associated costs**. Under such circumstances, the analyst may use market data (costs of machinery, hourly labour costs, etc.) to estimate overall costs.

A shortcoming of the accounting approach is its focus on 'ex-post' evaluations which makes it less suitable for 'ex-ante' planning and decision support. Yet, it does illustrate the nature and extent of costs actually incurred by firms. A further challenge to survey-based estimates is that the approach is time consuming, often resulting in small sample sizes, a fact that may raise doubts about the relevance of results.

An application of the accounting approach is documented in Beyer and Krieger (2004) who estimated costs associated with the implementation of the HACCP principles and the ISO9000 quality management system in food processing enterprises. The study also showed that enterprises were increasingly focusing on the implementation of 'integrated quality systems', i.e., systems that incorporated all requirements relevant for a set of quality systems that are of interest. In such situations, it is difficult to find a convincing and undisputed way of allocating costs to individual quality systems. The problem resembles the problem of allocating fixed costs in enterprises to individual production lines.

Colatore and Caswell (2000) used the accounting approach to assess the costs of HACCP adoption by fish producers in Massachusetts. The study revealed the difficulty in cost estimations. HACCP was required by FDA for seafood since 1997, but the level of implementation in individual enterprises varied widely. The differences arose because companies adopted plans that went beyond the FDA requirements; some companies had or would have adopted HACCP without the government directive. HACCP adoption allowed some companies to drop alternative quality certification systems. The authors had to distinguish between the companies' overall costs of HACCP, the costs of HACCP adoption attributable to the government requirements and the marginal costs for reaching those requirements. The first two scenarios provide global estimates of the voluntary and mandatory costs of adopting HACCP as an approach to quality assurance in the industry, while the third one would be more appropriate for a regulatory impact analysis.

Romano *et al.* (2005) analysed the costs of HACCP system implementation in the dairy and meat processing industry. Their results indicated a correlation between the size of a firm and the costs, an observation that was supported through a study by Nganje *et al.* (1995) in the meat sector which showed differences of up to 60 percent.

Further studies on the estimations of costs attributed to quality systems were published by Zugarramurdi *et al.* (2000), Nganje & Mazzocco (2000), Nicholls & Venoutsos (2001) who focused on the quality system 'SQF 2000', and Mora & Menozzi (2002), who dealt with the costs of traceability.

Econometric estimation

The econometric estimation approach uses models of plant costs to estimate the costs of quality and safety improvements (Antle, 2000; Ollinger & Mueller, 2003). Large industry wide data sets with plant level variables are used to estimate effects and their interdependencies with variables like plant size and others.

A major strength of the econometric cost estimation approach is that it captures the experience of entire industries, using uniformly collected data at a detailed plant level. The use of statistical procedures allows for the control of other important variables, yielding reliable measures of marginal impacts. A drawback of the approach is that available data sets, such as those maintained by Census Bureaus, frequently do not include variables that directly capture efforts, costs, and outcomes related to improvements in quality and safety.

Among the studies dealing with the relationship between costs and the size of enterprises, Ollinger and Mueller (2003) analysis is particularly of interest. The authors analysed costs of sanitation and process controls of plants producing meat and poultry in the United States in the late 1990s, prior to the adoption of mandatory pathogen reduction and HACCP controls. They found that these controls increased overall production costs with little variation because of plant size. Econometric studies at the farm level include Velthuis *et al.* (2004), who identified cost advantages for medium sized farms.

Approaches for the estimation of benefits

Purely monetary benefits are more the exception than the rule. The same is true regarding the singularity of benefits. A main focus of discussions on the estimation of benefits is, therefore, the integration of monetary and non-monetary benefit characteristics into a single monetary or non-monetary (qualitative) measurement. In exceptional cases with singular and non-monetary benefit characteristics, the analysis usually maintains the singular characteristic and expresses benefits in qualitative terms.

Typical examples of an integrated view of multi-dimensional benefit characteristics are the approaches that capture benefits in terms of consumers' 'willingness-to-pay', reductions in the 'cost of illness' or considering the economic concept of 'utility'.

The **willingness-to-pay** approach indicates consumers' willingness to pay for improvements in the safety and quality of food products. Studies are usually based on consumer surveys utilizing conjoint analysis or a similar approach (Enneking, 2004; Grunert *et al.* 2004), contingent valuation (Latvala & Kola, 2000; Gil *et al.* 2000; Maruyama & Kikuchi, 2004) experimental auctions (Lusk *et al.*, 2004; Rozan *et al.*, 2004).

In cases where transaction data can be accessed, the hedonic pricing method (Steiner, 2002) for the estimation of economic values that directly affect market prices and the mixed multinomial logit approach (Bonnet & Simioni, 2001) have been popular methods.

Examples of the application of the **willingness-to-pay** approach are the studies by Enneking (2004) or Latvala and Kola (2000), which showed that consumers were willing to pay a high premium for information about and guarantees on agrifood products safety and quality.

The **cost-of-illness** method derives benefits from reductions in costs related to food-borne diseases and deaths. As the real costs of diseases with their direct and indirect costs might be difficult to estimate, studies usually concentrate on a single indicator, such as the number of work days lost, as a basis for cost calculations. While some studies do not continue their analysis beyond the quantification of the indicator, a two-step cost-of-illness approach would transfer the initial indicator into a cost value. For this second step, a human capital approach has been proposed by Landefeld & Seskin (1982).

The **utility approach** integrates monetary and non-monetary benefit characteristics into a single (usually linear) utility function. It follows a three-step approach. In the first step, each benefit characteristic is evaluated regarding its possible (expected) achievement as compared to its potential, using a unified scale (ranging, for example, from 0 to 1). The second step attributes judgements (weights) to the different characteristics (between 0 and 1, for instance) which characterize their relevance for the decision-maker. The third step calculates the utility as follows, assuming linear relationships:

Total utility $U = \alpha_1 b_1 + \alpha_2 b_2 + \ldots + \alpha_n b_n$
with b_i (i=1,..,n) $\rightarrow$ (evaluation of benefit characteristic i)
α_i (i=1,..,n) $\rightarrow$ (judgement of relevance of characteristic i)

The utility approach is transparent and very flexible in its consideration of different benefit characteristics. The evaluations could be derived from surveys or empirical studies using, among others, approaches like the 'willingness-to-pay' approach regarding possible market effects.

APPROACHES FOR COST/BENEFIT COMPARISONS

As we earlier indicated, in the analysis of costs and benefits, **cost categories** are usually measured in monetary values. In this situation, methods for the comparison of costs and benefits could be distinguished according to the consideration of benefits in terms of monetary values (cost-benefit analysis), a single indicator (cost-effectiveness analysis) or an integrated utility criteria (cost-utility analysis).

However, for situations where cost categories are difficult to measure in monetary terms, alternative proposals for cost/benefit comparisons have been suggested as, for example, risk-risk analysis or health-health analysis.

Cost-benefit analysis requires monetary values for both costs and benefits. The results might be presented as a benefit-cost ratio or as net benefit with costs deducted from benefits. Whatever the calculation, it allows a clear ranking of alternatives for decision support.

Cost-effectiveness analysis sets monetary costs in relation to physical benefits. It is being used in quality system analysis in a variety of ways. One alternative formulates a relationship (ratio) between system costs (usually system administration costs) and a measure of health benefits like the reduction in selected cases of health problems, as, for instance, the cases of cancer that might be related to unsafe food. A second alternative reduces system costs by cost savings because of reductions in costs-of-illness. Garber *et al.* (1996) proposed a third alternative where system costs include an individuals' time lost to morbidity. With this variant, analysts tabulate annual programme-induced health changes over an individual's lifetime.

Cost-utility analysis considers different benefit characteristics simultaneously and supports multi-criteria decision situations (Becker, 1993). Gabler (1997) has integrated the multi-step utility calculation approach discussed above into an operational systematic matrix model.

The consideration of multi-criteria benefits in a utility approach has been discussed in the previous section. However, a linkage between costs and utilities in a cost-utility analysis for decision support might involve major complexities. The analysis is only straightforward if the decision alternatives involve similar costs and if the utilities build on a similar composition of benefits; at least a similar distribution between monetary and non-monetary elements should exist.

In any other case, one needs to clarify the scale relationship between costs and utilities or, in other words, the monetary equivalent of utilities. Furthermore, in the determination of the scale relationship between costs and utilities, a decision-maker might have different views depending on the distribution of monetary and non-monetary benefits in selected decision alternatives. As a consequence, in comparisons between decision alternatives with different compositions of monetary and non-monetary benefits, decision-makers might want to use different scale relationships. One could go even further and argue that utilities from non-monetary benefits are only considered if monetary benefits exceed monetary costs. This view reflects the long-term view of enterprises who depend on a positive monetary balance of their activities.

Risk-risk analysis compares risks that are reduced with risks that are increased in connection with food safety and quality issues. The comparison is based on an enumeration of risks and their identification in monetary or physical terms

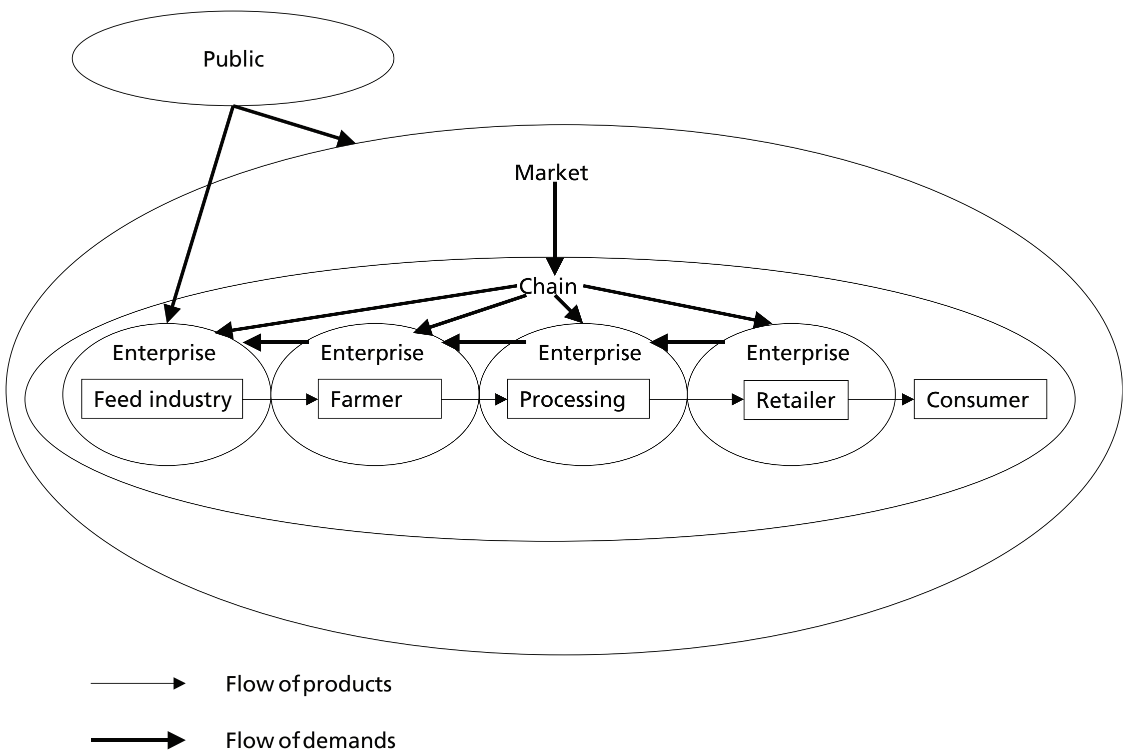
Health-health analysis evaluates policies by comparing a count of deaths prevented with a count of deaths induced by transferring income from individuals to the government for financing government health and food safety programmes. This approach builds on the observation that increases in individuals' income are partly used to reduce individual risks and that the financing of government programmes reduces, in principle, people's income. As a consequence, government programmes in food safety and quality might reduce risks for the sector, but at the expense of an increase in individuals' risks (Kuchler & Golan, 1999).

5. Costs and benefits of food quality systems under the perspectives of different stakeholders

INTRODUCTION

In the identification of sources of costs and benefits related to food quality systems, one needs to initially define the scope and focus of analysis. In the following discussion we differentiate the analysis according to the perspectives of different stakeholders. It is considered that individual enterprises, groups of enterprises, government and consumers will consider food quality and safety issues under perceptions that are not necessarily unique. Their views will of course be linked to quality system activities and as such they may in part coincide, but it is here understood that the identification, evaluation and quantification of costs and benefits will be influenced by the particular perspective. As such, this section discusses some of the interests and viewpoints of major stakeholders including enterprises, chains of vertically cooperating enterprises, sector interests (represented by institutions of any kind, including government), and public interests (consumers and the public as a whole). Figure 1 presents a schematic representation of this discussion framework.

Figure 1: Interactions between the enterprise, chain, market and public perspectives



Enterprises are the core units in the implementation of quality systems. If they participate in agreements along the vertical value chain regarding quality issues, they become part of a '**chain**', where vertical cooperation can involve a wide range of alternatives. As an example, a quality system could be devised and imposed by an enterprise that holds market power in a given value chain. Conversely, it could be a result of a joint, negotiated enterprise initiative. The enterprise and chain view could be reconciled, but as earlier mentioned are not necessarily the same.

The **sector view** is represented by the institutions that set market rules, supporting or limiting initiatives by market participants. Usually, this view is dominated by legislative and administrative interests. The role of these groups in relation to agrifood quality and safety activities may differ between countries, but the main viewpoints are essentially the same.

The **public view** represents, in principle, the stances of consumers. It involves individuals and institutions affected by the activities of the enterprises.

The enterprise perspective

Reardon *et al.* (2001) hypothesise that the compliance of an enterprise with food quality and safety requirements is correlated with its size. Large enterprises tend to engage in the development of quality standards (regulations) in their own interest, i.e., adopting and even intensifying public regulations as part of their own individual quality activities. Examples are the quality standards developed by retailers as a strategy for tighter chain control. In international trade, the typical, small or medium-sized enterprise is a '**standard-taker**' that will likely expect assistance from the public sector in the adjustment process to comply.

This argument is supported by Seddon *et al.* (1993), who indicate that large firms introduce the ISO9000 quality system standard primarily for **internal reasons**, while small ones are adopting such standards mainly because of **external factors**. The motivation for small firms to adopt quality assurance systems is mainly associated with their desire to acquire new customers and maintain their existing customer base, rather than decreasing costs of production.

This difference is crucial, as it substantiates the greater need by small and medium-sized enterprises for external assistance in regard to improvements in agrifood safety and quality. Apart from public engagement, such assistance may entail cooperation at the sector level or with importing and exporting agents. However, under this scenario small-scale enterprises are at risk of ending up in a situation of being 'locked' into the commercial relationship with the buyer who requires the implementation of a certain standard (see also Farina & Reardon, 2000). This would add to (non-monetary) costs at enterprise level.

A key issue in quality assurance concerns the control of the production cycle during the manufacturing of agrifood products. According to Luning *et al.* (2002), the following components are part of this control cycle and consequently contribute to its cost: a measurement or inspection unit, the comparison of actual results with a target value (i.e. norm, standard, goal or specification) within tolerances, the assessment of the direction of corrective action (i.e. regulation) and the actual corrective actions.

Regarding benefits, Mazzocco (1996) and Bredahl and Zaibet (1995) showed that most of the firms that adopt quality systems have seen not only declines in the cost of transactions, but also have experienced improvements related to their production processes and final product. Among these benefits are increases in productivity, better management, improvements in consumer relations, elimination of deficiencies in production processes, better adaptation of new personnel, and the conservation of current customers. Bredahl & Zaibet (1995) showed in their study that for enterprises the total cost of implementing quality systems was less than the benefits acquired directly or indirectly. Consequently, they argued that the adoption of a quality system could be an important strategy for enterprise development.

However, it is interesting to note that there might be a high variance between enterprises regarding costs and benefits of quality systems. In a study by Deroanne *et al.* (2002) the highest cost enterprise differed from the lowest cost one by a factor of 15.There are explanations for higher costs which at least partly show links to probably higher absolute or relative benefits, including:

- a ‘quality philosophy’ may be present in the company and there is a specific focus on quality in general and food safety in particular,
- the enterprise is acting in a sector characterized by higher food safety risks, which requires higher efforts for food safety and quality control,
- food safety efforts in small enterprises are relatively more expensive than in larger ones, which can benefit from scale effects (Gellynck *et al.*, 2004).

The chain perspective

The agrifood industry is strongly dependent on horizontal and vertical cooperation, a characteristic which exerts also influence on the organization of quality systems. The concept of the value chain, introduced by Porter (1985), recognises that the individual activities within the sequence of activities in the overall production process determine costs and quality of the end product.

In this scenario, quality system standards that support transactions in enterprises as well as between enterprises in the chain are instrumental for achieving efficiency gains. Holleran *et al.* (1999) note that especially large firms may have strong internal incentives to adopt quality assurance schemes as a means to increase the efficiency of their operations. Also, quality has been seen as a factor for competitiveness (Cuevas, 2004). It is well known, that one of the problems in the delivery of ‘quality and safety guarantees’ is the information asymmetry between sellers and buyers. Sellers know the quality and safety attributes of their products much better than buyers do, and it is hardly possible for buyers to fully assess these attributes during the transactions. As a consequence, buyers may end up with lower quality food than expected. The fact that market participants may be confronted unknowingly with an asymmetric information scenario, increases the transaction costs; because of increases in costs for information search, negotiation costs, and monitoring and enforcement costs (Hobbs, 1996). This generates private incentives to decrease such costs (Holleran *et al.* 1999) through, for example, the adoption of quality assurance systems.

Other cost and benefit aspects within the chain view include; traceability, transparency, product liability, product safety and the organization of controls, aspects that are embedded in almost all quality systems.

A core issue in the organization of vertically-oriented food quality systems is indeed traceability. In principle, an interaction between similar and between different quality management systems over the stages of the agrifood supply chain would facilitate traceability.

Initially, most chain-oriented quality systems (as IKB or Q&S. for instance) were initiated by the production stages of the value chain and required some level of chain cooperation. This led to a differentiation between enterprises that are 'in' and those that are 'out' of a given quality system: such distinction creates a discriminating effect against enterprises that have difficulties to adhere. However, this production-led approach met and meets resistance from the retail stage, as it reduces its purchasing flexibility (Krieger & Schiefer, 2005). As an alternative, retail groups have formulated their own quality system standards (for example, IFS and BRC) and require compliance from their suppliers, who, in turn, are inclined to communicate the requirements further down the chain.

A well developed traceability capability could reduce the product liability exposure of enterprises. As we have earlier discussed, increasingly sellers are becoming legally liable for the safety of their products. Agrifood quality systems in the supply chain can provide a supportive basis for product liability cases and thus reduce product liability risks. The certification systems allow the reduction of controls at the end of the value chain and transfers costs of control down the value chain. Retailers incentives to require quality system investments by suppliers and, in consequence, further upstream the value chain, set small and medium sized enterprises at a disadvantage, as compared to larger enterprises. This makes them in principle more dependent on public support to fulfil their obligations regarding improvements in agrifood safety and quality.

The sector (market) perspective

Quality signals

The credibility of quality guarantee signals between enterprises is increasingly important in market activities and, as such, to exporters and importers. This has direct consequences for developing countries with an interest in food exports and is thus a potential benefit of quality systems adoption.

Governments or other sector-wide organizations with professional interest in sector development have responsibilities for promoting the credibility of quality signals in countries with weak or poorly developed control institutions and infrastructure. This may include the provision of testing facilities, the establishment of government accreditation programmes or agencies, or the adoption/implementation of (international) product standards. Economies of scale, via quality coordination between individual producers, also provide arguments for government-led initiatives regarding quality systems (Achterbosch & van Tongeren, 2002). Yet, many countries in the developing world that could benefit from scale economies in quality systems promotion lack access to accurate and concise information on quality requirements for trade, such as maximum residue levels (MRLs) and good agricultural practices (GAP) (DeJager & Smelt, 2001; SADC, 2000).

A common view, supported by studies such as Caswell & Mojduszka (1996), is that food safety standards are an important part of any quality guarantee scheme, and as a consequence, an appropriate set of elements for safety assurance (as, for example, the HACCP principles) and signals on their existence, become important components for any quality system promoted at the sector level. Caswell& Mojduszka (1996) emphasized the importance of a market-clearing price to satisfy the demand and supply of food safety. Marette *et al.* (1999) and Mazzocchi *et al.* (2004) have shown that food quality and safety information to consumers may result in considerable welfare effects. Other studies also indicate that quality labels improve consumers' perception of quality (Verbeke & Viaene, 1999, Hermann *et al.*, 2002, Roosen *et al.*, 2003, and Hobbs *et al.*, 2005).

Compliance

Compliance with quality systems is likely to cause increases in enterprise costs, the magnitude of which being positively correlated with the extent of divergence between general food safety standards in exporting and importing countries (Henson & Loader, 1999). For developing countries that export agrifood products, there is concern that compliance costs tend to be high and thus negatively affect competitiveness. Especially for the poorest market participants, standards may indeed constitute barriers to entry (Giovannucci & Reardon, 1999). Nonetheless, it should be noted that the added costs may be offset by gains in efficiency and realization of economies of scale as processes are adjusted along the supply chains. Furthermore, in developing countries the costs of quality system compliance can be contained by making use of available domestic resources, such that their export position need not necessarily degrade, as the result of regulations or other compliance requirements (Caswell, 1998). In fact, those countries that act early regarding compliance, may achieve so called 'first-mover' advantages with respect to earlier sunk costs, reputation or greater flexibility in adapting owed to a longer time span available for the change process (World Bank, 2005).

Quality perception

Superior quality perception has proven to be an effective product differentiation strategy to create customer loyalty, lower price elasticity and present barriers to competition (Porter, 1980). Superior quality positively affects market share, selling price, and profitability (Buzzell & Gale, 1987).

It is a known economic principle (Engel´s law) that with increasing income the percentage of consumers´ disposable income spent on food decreases. However, this does not hold true for consumer demands for quality. Results of a 1993 survey of Dutch households revealed that the relative share of pork in total consumption of meat after introduction of a quality standard label (IKB) increased by about 15 percent. It is important to note that consumers' quality perceptions were not restricted to the characteristics actually captured / expressed by the product's label, but extended to beliefs about quality attributes that may subsequently be verified through personal consumption (Trijp van & Steenkamp, 2005). The challenge is the communication of quality in a way that addresses consumers perceptions. Salaün & Flores (2001) claim that much of today's information about food quality and safety is not entirely relevant to customers, as it does not address particular needs or expectations. Improvements in that regard are needed and might be promoted along with the promotion of quality systems.

Indirect market effects

The development of a 'quality sector' can have positive effects on the labour market (new jobs in certification organizations etc.), the industry and on the gross domestic product (GDP) in general. It has become commonly acknowledged that consumers, together with retailers as their primary direct trading partner in the agrifood chain, are the major driving forces in these developments. Future success depends more than ever on a better understanding of the motives, perceptions, attitudes and behaviour of consumers (Frewer *et al.*, 2004).

THE PUBLIC PERSPECTIVE

Legislation and trust in controls and quality assurances are key for consumer confidence on the safety and quality of agrifood products. A model case is represented by the quality systems developments in the EU, especially after the BSE crises. Public officers on one side and producers and retailers on the other tried to regain public confidence through legislative initiatives and the design and promotion of quality systems of various kinds.

Administrative requirements have to remain within the limits defined by the CA and the SPS agreements. They focus on food standards, codes of practice, labelling, quality and safety assurance and on product liability. In addition, public organizations assume responsibilities in food control, food production controls, and the enforcement of requirements.

The development of quality systems and the additional controls by private organizations,have caused, today, a higher control intensity in many countries than ever before. This supports developments towards higher food safety, fewer quality related crises and a better image for consumer protection. However, increased internal enterprise controls might support administrative tendencies to reduce public controls.

Legal requirements ask for the **labelling** of products, especially those targeting consumer markets. But labelling by itself might not result in appropriate benefits to consumers, since more information does not necessarily mean better informed consumers (Dranove *et al.,* 2003 & de Garidel-Thoron, 2005). Information seems to be effective only if it addresses specific needs of target groups who are, in addition, able to process and understand it (Verbeke, 2005).

DIFFERENT PERSPECTIVES VERSUS DIFFERENT APPROACHES FOR THE ANALYSIS OF COSTS AND BENEFITS

The suitability of the methodological approaches for the estimation of costs and benefits of quality systems may vary with respect to the different levels of analysis we have been discussing in the present section (Table 1). As a general principle, the higher the aggregation, the lower the range of methodological options.

Table 1 . Approaches for the estimation of costs, benefits and cost-benefit relationships in different application scenarios

Level	Cost/Benefit analysis methods
Enterprise	Engineering analysis method, accounting method, econometric estimation approach, cost utility analysis, cost-benefit analysis
Chain	Accounting method, econometric estimation approach, cost utility analysis
Market	Willingness-to-pay approach, cost estimation approach
Public	Cost-of-illness, cost-utility approach, cost estimation approach

By the same token, the level of analysis differentiates the types of costs and benefits of relevance for analysis. Table 2 indicates typical benefit categories (identified through literature reviews and expert surveys) and their potential relevance under the different analytical perspectives. Process quality and the improvement of processes are, for example, not only beneficial for an individual enterprise, but for the chain level of aggregation as well. One could even go further and indicate, as an indirect benefit, expected improvements in public image (which is not depicted in the table) as a function of quality systems adoption. Whatever the source of benefits, indirect benefits with more or less intensity might be observed under all of the analytical levels hereby considered.

Table 2. Sources of benefits and their relevance under different analytical perspectives

Source of benefits	Levels of Analysis			
	Enterprise	Chain	Market	Public
Process quality	+	+		
Product quality	+		+	+
Traceability	+	+		+
Market entry	+		+	
Cross Compliance	+			+
Trust	+		+	
Transaction efficiency	+	+	+	
Animal welfare	+		+	
Environmental protection	+			+
Occupational health	+			
Food safety assurance	+	+	+	+
Crisis prevention			+	+
Consumer protection			+	+
Labor market effects			+	+

6. Towards a workable methodological approach

The approaches for the analysis of costs and benefits reviewed in this document are all based on specifications of sources of costs and benefits and on their respective quantification. These are challenging tasks, as not all of the cost and benefit items related to these sources are easily measurable.

The requirements set by the standards prescribed by a given quality system put different burdens on different agrifood subsectors. Traceability, for instance, can be rather easily implemented with relatively low costs for products that remain unchanged between the stages of production and consumption, such as is the case of eggs or of some fruits and vegetables. The opposite would be true for subsectors where higher levels of processing are required, such as flours or animal feeds. Furthermore, some agrifood chain operations might be easier to adapt to the requirements of a new quality system than others. The need to introduce new equipment or to train personnel, for instance, might be associated with the decision to adopt a particular quality system in some operations, but not in others. Consequently, the analysis of costs and benefits requires adaptation to the specific characteristics of particular subsectors and agrifood chain activities. Because of such differences, the introduction of new quality systems might bring about costs that will fit into different general categories; some might be linked to the introduction of the quality system itself (‘system induced’ costs) while some will be linked to the operational processes and process controls associated with it (‘process dependent’ costs). Typical cost categories linked to the implementation of quality systems are listed in Table 3.

Table 3. Examples of system induced and process dependent cost categories

Cost Categories	System induced	Process dependent
Labelling	Initial implementation costs	Earrings for animals, shields, product labelling
Self-control		Regular self-controls
Employee security		Training courses, security plan
Training and qualification of employees		Training courses
Certification and control	Initial certification costs	Control costs; self-control costs
Traceability	Traceability system planning and set-up costs	Documentation costs; costs of certified material; operational costs of the traceability system
Laboratory tests	Laboratory equipment	Tests, monitoring of pathogens
Documentation/administration	Documentation management set-up	Process documentation
Animal welfare		Animal process controls
Cultivation		Pesticides, fertilizer and other input costs
Environmental protection	Waste treatment set-up	Waste treatment costs
Veterinary and veterinary medicine		Veterinary drugs, veterinarian services
New infrastructures	New buildings	
Transport	Equipment	Maintenance, driver certification, transport planning
Hygienic measures	Laboratory equipment	Disinfections agents, water, energy, laboratory costs
Technical (processing and handling) equipment	New machines, plant equipment and utilities	Maintenance, certification, energy, water

Benefits might also cover a wide range of elements. An illustration of common benefit categories identified and prioritized through expert surveys is listed in Table 4.

In view of: a) the variety of cost and benefit categories; b) the challenges to quantify them and c:) the potential for subjectivity in the evaluations, the development of a workable approach towards cost-benefit evaluations of agrifood quality systems can benefit from the principles of **multi-criteria decision-making.** These were the principles taken into account in the cost-utility approach earlier discussed in this document. In this section, we will utilize them in a hypothetical case study that illustrates what we consider to be a potentially suitable approach for supporting decisions regarding agrifood quality system implementations.

Table 4. Potential benefits of agrifood quality and safety improvements

Benefit categories	Benefit item
Process quality	- reduction of rework - reduction of recalls - higher employee motivation
Product quality and safety	- higher food safety - higher consumer satisfaction - reduction of biological, chemical and microbiological hazards
Traceability system	- facilitated crisis management - recall advantages - better trade conditions
Controls	- improved process control (internal audits) - external control
Market entry	- enlargement of customer base
Cross compliance	- financial rewards
Trust	- lower transaction costs - reduced need for controls
Transactions	- improved information - lower costs - better control
Animal welfare	- healthier animals
Environmental protection	- reduction of environmental damages - improved public image
Occupational health	- reduction of accidents - better coordination of occupational health

It should be noted that for the utilization of the multi-criteria decision approach one needs first to define an initial set of conditions - the so-called **'calculation base'**. Enterprises or chains with already high quality standards, for instance, are less likely to be affected by the requirements of a new quality system. They are also less likely to reach higher levels of benefits. Conversely, enterprises or chains that are lagging behind in quality system adoptions may incur in higher adoption costs, but may stand to benefit the most from the additional costs. As such, the decision analysis calls for a consideration of **marginal costs and benefits.** Moreover, the generalization of results from enterprise to enterprise or chain to chain will not always be viable, as the initial sets of conditions are not necessarily heterogeneous. Only when 'typical' or sufficiently homogeneous conditions exist could a general analysis be advisable.

In sum, the consideration of marginal costs and benefits requires a very clear identification of the quality situation one starts from. A typical example is a situation where enterprises already have implemented certain quality systems and intend to implement an additional one. For a more general discussion one can use, as a base reference, either a scenario where legal requirements have been fulfilled or a quality scenario which is 'typical' for a certain sector or subsector under consideration.

For the quantification of costs, and to some extent for benefits as well, checklists of quality system standards - especially the **audit checklists** available for the different standards - are the best basis for the identification of relevant categories of costs and benefits. Under such an approach, the calculation of costs would be best linked to the engineering approach earlier discussed.

However, for a preliminary analysis or in a situation where one wants to rapidly evaluate costs for enterprises in a sector, the identification of cost items could be difficult. The same may hold true for analyses in countries where a good statistical base is not available. For such situations, we propose a stepwise approach which builds, in principle, on the utility concept but moves gradually from a first rough estimation of indicators for the magnitude of costs and benefits to an increasingly better indication of the real values of costs and benefits.

Assuming that the cost items could be classified in accordance to their magnitude, one could follow a procedure where **cost categories** are defined, for example, as high, medium and low. To illustrate, the need for wearing headgear would fall into a low cost category, whereas the need for investing in a cold-storage depot would fall into the high cost category. This differentiation in cost levels could be based on expert evaluations, with flexibility to consider any number of categories considered appropriate for the particular situation at hand. Each of the cost levels would then be linked to a certain **average cost figure.** Expert evaluations would result in the assignment of average values that could be successively refined, as illustrated in Figure 2.

Figure 2: Stepwise improvement of cost calculations for quality requirements

From quality system checklists	Judgements level 1	Judgements level 2	
requirement	Indicator of costs	cost value of range	cost value
requirement	Indicator of costs	cost value of range	cost value
requirement	Indicator of costs	cost value of range	cost value
requirement	Indicator of costs	cost value of range	cost value

In principle, the use of an average cost value could be replaced by a probability distribution function of costs or their measures of distribution, like the expected value combined with the variance or the standard deviation. This would allow the determination of probabilities for ranges of total costs. The difficulty with this approach is probably less the identification of probability distributions for individual cost categories, but the correlations between them. For a further discussion of these issues see Bechmann (1978).

The identification of benefits could follow the approach discussed for cost-benefit analysis in preceding chapters. However, as pointed out, the utilization of cost-benefit calculations for comparisons of alternatives in decision situations requires the identification of an appropriate relationship between costs and benefits. With the cost argument involved, monetary relationships are the most appropriate if not the only suitable reference.

Assuming that this approach will be followed, the 'judgement' factors α_i in the benefit utility function $U = \alpha_1 b_1 + \alpha_2 b_2 + \ldots + \alpha_n b_n$ discussed in the fourth section of this document would have to be selected. They would represent indicators of the ranges of monetary levels, as defined above (for example. low, medium, high, etc.) and would be linked to potential benefits.

AN ILLUSTRATIVE CASE STUDY

The calculation will be demonstrated through a case study that has been developed in an expert discussion workshop with a focus on agricultural production. It assumes a decision scenario where a Latin American citrus grower is confronted with requests from potential trading partners (importers) in France, Germany, and Italy for EurepGAP certification and from the United Kingdom for ISO 9000 certification. This leaves the decision-maker with four alternatives:

a) Implementation of ISO 9000.
b) Implementation of EurepGAP.
c) Simultaneous implementation of ISO 9000 and EurepGAP.
d) No implementation of quality systems.

The decision will be based on an analysis of these alternatives, considering benefits, costs, and the relationship between the two. It is assumed that costs and benefits cannot be quantified directly and that potential benefits cover a range of dimensions that are difficult to single out and measure. Under such a scenario, cost and benefit utility indicators are determined that, independently, could allow the identification of a prioritization of the attractiveness for the decision alternatives. In other words, the approach identifies their relative attractiveness regarding costs and regarding benefits. For the joint consideration of costs and benefits, the calculation establishes a monetary relationship between these two dimensions.

DETERMINATION OF BENEFITS

The potential benefits of the decision alternatives, as seen by the enterprise, are listed in Table 5. The list draws from a literature review and a discussion with experts. It also follows principles of the AHP (Analytical Hierarchy Process) priority identification analysis pioneered by Saaty (1980).

Table 5. Potential benefits of the decision alternatives

Potential benefits	Decision alternatives			
	ISO 9000	EurepGAP	ISO 9000 + EurepGAP	No additional quality system
Market access	Customer in the United Kingdom	Customers in Germany, France and Italy	Customers in United Kingdom, Germany, France and Italy	No additional benefit
Risk control from product liability	Better product liability	"Insurance" possibility	"Insurance" possibility	No additional benefit
Cross Compliance	No additional benefit	No additional benefit	No additional benefit	No additional benefit
Improved process quality	Better structural processes	Reduction of rework	Reduction of rework	No additional benefit
Improved product quality	Non obligatory improvement	Better product quality	Better product quality	No additional benefit
Traceability	Recall advantages	Recall advantages	Recall advantages	No additional benefit
Improvement of trust	Less trust	More trust	More trust	No additional benefit
Environment Protection	No specific environmental aspects	Environmental aspects	Environmental aspects	No additional benefit
Transaction support	Reduction of transaction costs	Reduction of transaction costs	Reduction of transaction costs	No additional benefit

The identified benefit categories have the following rationale:

- **Access to markets.** Increasingly, a quality system certification is a pre-condition for a successful market entry. The barriers are not caused by government regulations, but by pre-conditions set by buyers (wholesalers, retailers, etc.)

- **Product liability.** As we have already mentioned, product liability has become a critical issue for agrifood enterprises in the EU, especially for retailers. Legal requirements to practice 'due diligence' force enterprises to take all necessary steps for assuring the safety of their products.

- **Cross Compliance.** For the EU market, 'Cross Compliance' refers to farms' adherence to certain EU regulations (for example., in environmental control), some of which are directly interlinked with the implementation of quality systems. Such regulations tend to become standards for suppliers beyond the boundary of the EU.

- **Process quality.** Process quality refers to the organization and control of internal processes and transactions between firms. Process quality is a core requirement in most quality systems and a means for improvements in product quality and process efficiency.

- **Product quality and food safety**. Product quality concerns product attributes (taste, shelf-life, etc.) expected by customers. Food safety considers the appropriate control of processes to assure the safety of deliveries prior to any final or external product check.

- **Traceability.** The EU regulation 178/2002 contains general provisions for traceability, which cover all enterprises in the food and feed sector. Importers and, in consequence, their suppliers all over the world, are similarly affected. Next to the legal requirements quality systems ask for traceability in different ways (Poignee, 2003).

- **Trust.** Trust in food quality and safety is a key element in food markets for transactions between enterprises and the acceptance by consumers (Fritz & Fischer, 2007). It has been documented that trust could further reduce transaction costs (Hagan and Hathaway, 1995 or Ganesan, 1994) and be supported by quality standards and quality labels.

- **Environment.** There are specific management systems for environmental control. However, quality systems do increasingly include environmental aspects as well. Apart from the fulfilment of legal requirements, they constitute benefits for the environment and might support sustainability for the enterprise.

- **Transaction support.** Transactions between enterprises generate costs (Hobbs, 1996). They encompass all aspects of the contractual relationship including informational search costs, negotiation costs and the costs of monitoring and enforcement. The implementation of quality systems and the communication of its implementation reduce information asymmetry, support transactions and, in consequence, reduce costs.

The next steps in the evaluation of benefits involve three activities:

1. Assignment of judgements (weights) to benefit categories according to the interests of the enterprise (see the case data in Table 6, assuming a judgement scale of relative weights between 0 and 1).
2. Evaluation of the likelihood of achieving each benefit characteristic in comparison to its perceived potential (see, as an example, the case data in Table 7 for the benefit category 'market entry', assuming an implementation scale of 0 to 1.)
3. Calculation of an aggregated indicator for the global benefit utility (see Table 8).

Table 6 . Judgement of benefit relevance for decision-maker's objectives in the case study.

Benefit categories	Weight
Market access	0.30
Product liability	0.10
Cross compliance	0
Process quality	0.10
Product quality	0.20
Traceability	0.10
Trust	0.05
Environment	0.05
Transaction support	0.10

Table 7. Evaluation of the likelihood of achieving the benefit potential of the characteristic 'market entry'

Decision alternative	Benefit characteristic	Likelihood of achieving the benefit
ISO 9000	New customers in United Kingdom	0.35
EurepGAP	New customers in Germany, France, Italy	0.60
ISO 9000 + EurepGAP	New customers in United Kingdom, Germany, France, Italy	0.70
No quality system	No additional benefit	0

Table 8. Calculation of the benefit utility value for the implementation of EurepGAP

Criteria	Judgement (A)	Likelihood (B)	Global benefit index (A) x (B)
Market entry	0.30	0.60	0.18
Product liability	0.10	0.30	0.03
Cross compliance	0	0	0
Process quality	0.10	0.45	0.045
Product quality	0.20	0.60	0.12
Traceability	0.10	0.30	0.03
Trust	0.05	0.40	0.02
Environment	0.05	0.40	0.02
Transaction costs	0.10	0.40	0.04
Total			0.4850

Similar calculations on expected benefits for the remaining decision alternatives have led to the following priority for implementation:

{ISO9000 + EurepGAP} > {EurepGAP} > {ISO9000} > {none}

Determination of costs

The main basis for the calculation of costs for the implementation of the EurepGAP and ISO 9000 standards will be the cost model discussed in the fourth section of this document. However, the calculation needs to deal additionally with a number of specificities related to the quality system standards of the decision alternatives. Furthermore, we assume that although the real costs might be difficult to specify during the decision analysis, the magnitude of costs in various categories could be linked to ranges of cost levels. To facilitate the discussion, we limit the separation of cost levels to three (low, medium, and high).

To begin the discussion with the decision alternative '**implementation of the EurepGAP standard**' for an enterprise engaged in fruit production, one needs to distinguish between three modules to reach certification status, the 'All Farm Base Module'(AFBM), the ' Crops Base Module'(CBM) and the 'Fruit and Vegetable Module' (FVM). Requirements within these modules are categorized as 'major mandatory criteria', 'minor mandatory criteria' and 'recommendations'. In principle, 247 requirements are relevant for fruit growers. However, not all of them are requirements for certification. Some (about 10) are only relevant in certain situations as, for example, if the enterprise has a minimum number of employees; others (about 65) are only recommendations. This reduces the general requirements to 172. In the analysis of costs, one needs to deduct requirements the farm has already fulfilled (65) because of its engagement in GAP and the implementation of legislative requirements. Of the remaining requirements (107), one needs to distinguish between major and minor requirements. The first ones have to be fulfilled completely. The others need only 95 percent compliance, which further reduces the number of requirements for certification status, in our case study, to 105.

For the identification of costs one needs to link the case study requirements to affected cost categories and the associated cost ranges. In the present case study, typical cost categories included are:

a) **Low cost range**: labelling, self control, qualification of employees and costs for certification and control
b) **Medium cost range**: traceability, laboratory tests, documentation, animal welfare, environmental protection and costs for veterinary treatment
c) **High cost range**: structural investments, transportation, hygienic improvements to facilities and investments in technical equipment.

Considering the characteristics of the case under analysis, 69 requirements can be linked to the low cost range, 30 requirements to the medium range and 7 requirements to the high range. The total cost indicator I_c can be calculated by assigning weights (for example. 1, 4, and 6 in the present case) to the various cost groups. These weights should express the best judgements of the decision-maker with regard to the **relative monetary differences** between the groups. Hence, we would have:

$I_c = 1 \times 69 + 4 \times 30 + 6 \times 7 = 231$

A similar analysis would be necessary for the identification of requirements from system organization and customer requests for the adoption of a quality system that allows ISO 9000 certification. In the **ISO 9000 context**, the identified requirements are all of similar relevance. Their classification into cost categories and cost levels is 78, 40, and 3 for low, medium, and high level, respectively. Hence, for this decision alternative we would have:

$I_c = 1 \times 78 + 4 \times 40 + 6 \times 3 = 256$

The analysis of requirements for systems that follow both the EurepGAP and the ISO9000 standards takes into account the requisites for such a simultaneous implementation. As some of the requisites are common, the total number of requirements is less than the sum of the individual values. In the present example, the combined implementation results in 107 requirements belonging to the low cost category, in 55 for the medium cost category and in 8 for case of the high cost category. Therefore, the resulting measure for this decision alternative would be:

$I_c = 1 \text{ x } 107 + 4 \text{ x } 55 + 6 \text{ x } 8 = 375$

The costs for the non implementation alternative are estimated as zero, as obviously no additional investments are necessary under this hypothesis. The results of the calculations for the different decision alternatives are shown in Table 9.

Table 9. Cost indicators for system implementation decision alternatives

Quality system alternative	Cost indicator
ISO 9000	256
EurepGAP	231
ISO 9000 + EurepGAP	375
No implementation	0

This leads to the following prioritization for an implementation decision based on cost indicators:

{none} < {EurepGAP} < {ISO 9000} < {ISO 9000 + EurepGAP}

COST-BENEFIT RELATIONSHIPS

In comparing the results from singular views on benefits and costs, the case study confronts the decision-maker with the following conflicting results:

1. Benefit priority: {ISO 9000 + EurepGAP} > {EurepGAP} > {ISO 9000} > {none}
2. Cost priority: {none} < {EurepGAP} < {ISO 9000} < {ISO 9000 + EurepGAP}

The highest benefit utility {ISO 9000+EurepGAP} is linked with the highest costs. Although a seemingly attractive alternative would be the implementation of the 'EurepGAP' alternative, where rather high benefits are combined with rather low costs, this direct comparison would be misleading. This is because the calculation base for costs and benefits is not the same. To overcome this difficulty, one should consider a monetary relationship between costs and benefits.

In the cost calculations, the indicators were selected so as to represent different ranges of costs (low, medium, high). The same was not true for the consideration of benefits. A possible approach to overcome this lack of an uniform treatment is to replace the judgements of 'benefit relevance' by indicators that represent different ranges of monetary benefits (for example, low, medium, high). In case the ranges of benefits are of similar magnitude as the ranges of costs, we could use the same weights that were selected for the cost calculations, i.e., 1, 4, and 6 (Table 10).

Table 10. Judgement of the relative magnitude of ranges of monetar benefits

Benefit categories	Weight
Market Entry	6
Product liability	4
Cross Compliance	0
Process quality	4
Product quality	4
Traceability	6
Trust	1
Environment	1
Transaction support	1

The remaining benefit calculations remain the same as presented earlier. This approach allows the calculation of benefit-cost ratios or of benefit-cost differences that generate a prioritization of financial attractiveness for the decision alternatives. For a calculation of real costs and benefits, the indicators need to be replaced by the real average monetary values for the cost and benefit ranges they represent, a possibility that is not always feasible because of the measurement difficulties we have already pointed out.

FROM ENTERPRISE TO CHAIN

In agrifood systems, product quality is determined by the process activities that take place at all stages of the value chain. If enterprises act rather independently in their market activities, the enterprise based calculations of costs and benefits can be considered as adequate. However, if there are closer trading links between selected enterprises along the chain, a parallel calculation of costs and benefits for the chain as a whole would be necessary. The calculation follows the same approaches as discussed for individual enterprises. The difference would be in the focus and in the complexity of analysis, especially in the case of benefits. They might be dependent on the level of cooperation between enterprises, the quality of the information exchanges or the level of trust between different stages. There is potential for improved transparency, including the capability for tracking and tracing agrifood products, and for a reduction of inequality in access to information by chain participants, which could improve chain efficiency and consumer trust beyond individual enterprise initiatives.

In discussions on better integration of enterprises from developing countries, usually positioned in the upstream stages of the value chain, with enterprises at the retail end in higher income countries, a chain view would be appropriate. Actors in the upstream stages of the chain need to be aware of the costs and of the potential benefits enterprises in the end of the chain might incur by adopting a particular quality system. As an example, let us consider the case of consumers at the end of a meat chain that demand products derived from animals that have been raised in farms under conditions considered appropriate for animal welfare. If farms and retail are far apart, as for example in the case where animals are raised in a country and the meat issold in another, the realization of the potential chain benefits depends on consumers' trust in the chain as a whole. Because of the interrelationship between chain members, cost-benefit evaluations performed for individual components would not capture the synergistic effects of the joint adoption of quality systems.

A chain wide evaluation will not make individual enterprise cost-benefit calculations irrelevant though. These will, at least, allow to relate the chain cost-benefit situation to the enterprise cost-benefit situation. If at all feasible, such a calculation could also support transparency and negotiations on the distribution of costs and benefits along the value chain.

A chain wide valuation of costs and benefits may also be applied if a whole region or country intends to move towards higher levels of quality management, an approach that should appeal to developing countries in their quest to enter or expand export markets.

Conclusions

Food quality systems with a focus on products, processes and process management have been and are still being developed for the different stages of the agrifood industry, including feed production, primary production, food processing, storage, transport and retail. Initiators are usually retailers or private and public organizations.

Retailers in particular are increasingly requiring the adoption of quality systems by their suppliers, as evidenced by the recent proliferation of so-called private standards that apply to many agrifood products (BRC, IFS, EurepGAP). In principle, the adoption of such systems implies in costs for supplier enterprises and could be viewed as a trade barrier to enterprises or to entire countries that are not prepared or able to comply. The decision to comply depends thus on a consideration of these added costs vis-à-vis the potential benefits.

Yet, the consideration of cost and benefits is by no means a simple matter. Enterprises are increasingly faced with the necessity to consider multiple alternatives represented by the quality demands of different markets, different buyers within a given market and different legal environments. To remain in business, enterprises might have to either comply with many different quality systems or to restrict themselves to one or few market alternatives. Enterprises in developing countries are particularly affected by these developments in quality systems. The increasingly stricter requirements of quality systems established by enterprises from the end of the chain, especially from retail groups from the northern hemisphere, force them to adapt to quality demands determined by one or several quality systems.

A variety of approaches exist in the literature for the calculation of costs, benefits and cost-benefit comparisons. However, empirical studies on the costs and benefits of quality improvements and the implementation of quality systems are rare, as the determination and quantification of benefits in this domain is a rather complex task. The complexity stems from the fact that the evaluation involves a multitude of dimensions, which are difficult to integrate into single measures. Also, benefits exist that are indirect and thus difficult to isolate and quantify.

These difficulties notwithstanding, this document has proposed a methodological approach to guide decisions on the choices of quality systems. Based on a multiple criteria decision-making analysis framework, the approach draws from cost and benefit considerations to derive a ranking of decision alternatives.

In view of the increasing attractiveness of quality system implementations in agrifood systems, it is hoped that the information here reviewed and the approach proposed might be useful to individual decision-makers and / or agencies interested in promoting agrifood system development.

In closing, it should be mentioned that beyond cost and benefit considerations, some additional recommendations for sector initiatives to achieve improved agrifood quality and safety might be taken into account, including:

- Improvement in the cooperation between public and private initiatives in quality management and food safety control that could offset deficiencies and costs of control.
- Integration and coordination of private and public control systems through standardized checklists for quality and safety control.
- Intensification of capacity building activities.
- Promotion of an 'optimal' combination of systems that minimize efforts for reaching compliance with the most pressing requirements and reach a level of benefits that could realistically be expected within a predefined period.
- Specification of a clear system on sanctions and rewards linked to the fulfilment of quality and safety requirements.
- Improved communication between consumers, industry and policy makers on agrifood quality and safety initiatives

Annex 1.
Definitions of quality systems terms

Quality systems	Explanation
BRC	British Retailer Consortium (BRC) standard is a set of technical, non-organic food safety standards devised by the United Kingdom food retail trade for companies supplying retailer branded products.
Certus	Certus is a Belgian quality standard, which was developed for the pig industry.
DQG	Danish Quality Guarantee (DQG) is a vertically-oriented quality system, which was developed specifically for the pig industry in Denmark
EurepGAP	Eurep (Euro Retailer Produce Good Agricultural Practices) started as an initiative of retailers in 1997. It aimed at an agreement on standards and producers for the development of harmonized Good Agricultural Practices (GAP).
HACCP	The main point of Hazard Analyses and Critical Control Point (HACCP) is the identification of health hazards during production.
IFS	The International Food Standard (IFS) sets requirements for producers of retailer branded products.
IKB	Integrated chain control system (IKB) was published for the pig and egg supply chain in the Netherlands in the eighties.
IKM	Integrated Chain Milk (IKM) was created by a Belgian organization for milk producers.
ISO 9000	The International Organization for Standardization (ISO) is a consistent norm, which formulates the framework for quality management.
Q&S	Quality and Safety (Q&S) is a German quality system, which sets requirements for the meat and fruit and vegetables supply chain.
SQF 1000	Safe Quality Food (SQF) 1000 was designed specifically for primary producers and it was developed in 1999.
SQF 2000	Safe Quality Food (SQF) 2000 was published in 1995 specifically for the food industry

References

Achterbosch, T. & van Tongeren, F. 2002. *Food safety measures and developing countries: Literature overview.* (available at http://www.lei.dlo.nl/uk/content/research/FoodSafetyDCs.pdf)

Antle, J.M. 2000. No such thing as a free safe lunch: The cost of food safety regulation in the meat industry, *American Journal of Agricultural Economics*, 82, pp. 310-322

Becker G.S. 1993.The economic way of looking at behaviour, *Journal of Political Economy* 101. pp. 385-409

Bechmann, A. 1978. *Nutzwertanalyse, bewertungstheorie und planung*. Haupt Bern & Stuttgart

Belli, P., Anderson, J.R., Barnum, H.N., Dixon, J.A. & Tan, J.P. 2001. Economic evaluation of health projects *In* Economic analysis of investment operations: Analytical tools and practical applications, p.114 Washington D, C.World Bank..

Beyer, J. & Krieger, St. 2004. Kunden und mitarbeiter profitieren – Kosten-Nutzen-analyse von Qualitätsmanagementsystemen in der Ernährungswirtschaft. *In*: Fleischwirtschaft 6/84. pp. 59-60, Deutscher Fachverlag Frankfurt am Main.

Bonnet, C. & Simioni, M. 2001. Assessing consumer response to protected designation on origin labelling: a mixed multinomial logit approach. *European Review of Agricultural Economics* 28. pp.185-204

Bredahl, M. & Zaibet, L. 1991. ISO 9000 in the UK Food Sector. *The Complete European Food Digest*, 3 (2), pp.29-33

Buzzell, R.D. & Gale, B.T. 1987. *The PIMS principles: Linking strategy to performance*. New York, The Free Press,

Caswell, J. A. 1998. Valuing the benefits of costs of improved food safety and nutrition. *The Australian Journal of Agricultural and Resource Economics*, 42, pp. 409-424

Caswell, J.A. & Mojduszla, E.M. 1996. Using information labelling to influence the market for quality in food products. *American Journal of Agricultural Economics*, 78, pp. 1248-1253

Colatore, C. & Caswell, J.A. 2000. The cost of HACCP implementation in the seafood Industry: A case study of Breaded Fish. *In* L. Unnevehr, ed. *The economics of HACCP: Costs and benefits*, , pp. 45-68. St. Pazl, Eagan Press.

Cuevas-Garcia, R. *2004 Food engineering, quality and competitiveness in small food industry systems with emphasis on Latin America and the Caribbean* . Rome, FAO

De Garidel-Thoron, T. 2005. Welfare-improving asymmetric information in dynamic insurance markets. *Journal of Political – Economy* 113; pp.121-150

De Jager, A. & Smelt, A. 2001. *Review of the impacts of changes in EU pesticides legislation (directive 2000/42/EG) on fresh food exports from developing countries into the EU. Case study: the vegetable export sector in Zambia,* .Wageningen, DLO.

Deroanne, C., Sindic, M. & de Biourge, S. 2002. *Les coûts de la gestion de la qualité et de la sécurité alimentaire: Etude pilote réalisée pour la Fédération de l`Industrie Alimentaire FEVIA*. Faculté Universitaire des Sciences Agrocomiques de Gembloux.

Dranove, D., Kessler, D., McClellan, M. & Satterthwaite, M. 2003. Is more information better?. The effects of "report cards" on health care providers. *Journal of Political Economy* 111. pp. 555-588

Enneking, U. 2004. Willingness-to-pay for safety improvements in the German meat sector: the case of the Q&S level. *European Review of Agricultural Economics* Vol. 31 (2). pp.205-223

Farina, E. & Reardon, T. 2000. Agrifood changes and standards in the extended Mercosur: their role in the changing agrifood system. *American Journal of Agricultural Economics* 82(5), pp. 1170-1176

FDA. 1995. *Final Regulatory Impact Analysis (FRIA) of the Regulations to Establish Procedures for the Safe and Sanitary Processing and Importing of Fish and Fishery Products*. United States Food and Drug Administration.

Frewer, L.J., Hayes, D.J., Scholderer, J. & Verbeke, W. 2005. Food safety and consumer behaviour. *In:* Jongen, W.M.F & Meulenberg, M.T.G. *Innovation in agrifood Systems: Product Quality and Consumer Acceptance*. Wageningen, Wageningen Academic press

Fritz, M. & Fischer, Ch. 2007. The role of trust in European food chains – theory and empirical findings. *International Food and Agribusiness Management Review* 10 (2)

FSIS. 1995. Pathogen reduction; Hazard Analysis and Critical Control Points (HACCP) Systems; Proposed Rule, Federal Register 60 (23):6774-6889. United States Department of Agriculture, Food Safety and Inspection Service

FSIS. 1996. Pathogen reduction; Hazard analysis and Critical Control Points (HACCP) Systems; Final Rule, Supplement-final Regulatory Impact Assessment for Docket No. 93-016F, May 17. United States Department of Agriculture, Food Safety and Inspection Service

Galvez, E. 2006. *Calidad e inocuidad en las cadenas latinoamericanas de comercialización de alimentos*. Documento Ocasional 14, Rome,FAO.

Ganesan, S. 1994. Determinants of Lang-Term Orientation in buyer-seller relationships. *Journal of Marketing*. Vol. 58, pp. 1-19

Garber, A.M., Weinstein, M.C., Torrance, G.W. & Kamlet, M.S. 1996. *Theoretical foundations of cost-cffectiveness, cost-effectiveness in health and medicine. In*, M.R. Gould,L.B., Russell, J.E. Siegel, & M.C. Weinstein, (eds). New York:, Oxford University Press

Gellynck, X.; Verbeke, W. and Viaene, J. 2004. Quality management in the food supply chain: How does the food industry interact with consumers, retailers and public authorities?. *In* G. Schiefer, & U. Rickert, (eds): *Quality assurance, Risk management and Environmental control in agriculture and food supply networks*, Proceedings of the 82nd European Seminar of the European Association of Agricultural Economists (EAAE), S.443-452

Giovannucci & Reardon T. 1999. *Understanding grades and standards – and how to apply them. A guide to Developing Agricultural Markets and Agro-enterprises (* available at :http://lnweb18.worldbank.org/essd/essd.nsf/0/37343b58a4cf229c852568ae0012cbff/$FILE/ATT85XAU/grades_and_stds.pdf)

Gil, J.M.; Gracia, A. & Sanchez, M. 2000. Market segmentation and willingness to pay for organic products in Spain. *International Food and Agribusiness Management* Review 3. pp. 207-226

Gould, B.W.; Smukowski, M. & Bishop, J.R. 2000. HACCP and the dairy industry: an overview of international and U.S. experiences. *In*: L.J. Unnevehr (Ed.). *The Economics of HACCP. Costs and Benefits.*. pp. 365-384, St. Paul Eagan Press,.

Grunert, K.G., Bech-Larsen, T., Lähteenmäki, L., Ueland, O. & Aström, A. 2004. Attitudes towards the use of GMOs in food production and their impact on buying intention: the role of positive sensory experience. *Agribusiness* 20: pp. 95-107

Grunert, K.G. 2005. Food quality and safety: consumer perception and demand. *European review of Agricultural Economics* 32. pp. 369-391

Hagan, J.M. & Hathaway, B.A. 1995. *Reputation in interfirm relations: a research agenda*. Paper delivered at NE-165 meeting in Washington D.C. on Vertical Co-ordination in the Food System, June 1995

Henson, S. and Loader, R. 1999. Impact of sanitary and phytosanitary standards on developing countries and the role of the SPS Agreement. *Agribusiness* (3), pp.355-369

Hermann, R., Krischik-Bautz, Z. & Anders, S. 2002. Evaluating the success of generic promotion for beef: the case of Quality from Bavaria-Guaranteed origin. *Berichte über Landwirtschaft* 80. pp. 53-84

Hobbs, J.E., Bailey, D., Dickinson, D.I. & Haghiri, M. 2005. Traceability in the Canadian red meat sector: Do consumers care? *Canadian Journal of Agricultural Economics* 53. pp. 47-65

Hobbs, J. 1996. Transaction cost and slaughter cattle procurement: Processors selection of supply channels. *Agribusiness*, 12 (6), pp.509-523

Holleran, E., Bredahl, M.E. & Zaibet, L. 1999. Private incentives for adopting food safety and quality assurance. *Food Policy*, 24 , pp. 669-683

Jensen, H.H. & Unnevehr, L.J. 2000. HACCP in pork processing: costs and benefits: *In*: L.J. Unnevehr (Ed.). *The economics of HACCP: costs and benefits*. pp. 29-44. St. Paul, Eagan Press

Jensen, H.H., Unnevehr, L.J. & Gomez, M.I. 1998. Costs of improving food safety in the meat sector. *Journal of Agricultural and Applied Economics* 30. pp. 83-84

Krieger, St. & Schiefer, G. 2007a. The international quality systems environment. In: F. M., G. Schiefer, U. Rickert, (Eds), EAAE2007. *Innovation and system dynamics in food netoworks.*

Krieger, St. & Schiefer, G. 2007b. Conception of integrated models for quality management in production chains in the agrifood sector. *In*: Quality management and quality assurance in food chains proceeding of the EAAE Conference, 2.-4.Februrary, Göttingen, p. 303 - 313

Krieger, St. & Schiefer, G. 2004. Quality management schemes in Europe and beyond. *In*: *Quality assurance, risk management and environmental control in agriculture and food supply networks*, Proceedings of the 82nd European Seminar of the European Association of Agricultural Economists (EAAE), May 14-16, 2003, Bonn, Germany, p. 35-48.

Kuchler, F. & Golan, E.H. 1999. *Assigning values to life: Comparing methods for valuing health risks.* Agricultural Economic Report 784. Economic Research Service (ERS), United States Department of Agriculture, Washington DC,ERS.

Landefeld, J.S. & Seskin, E.P. 1982. The economic value of life: Linking theory to practice. *American Journal of public health* 6 pp. 555-566

Latvala, T. & Kola, J. 2000. *Consumers´ willingness to pay for information about food safety and quality: Case Beef.* Paper for the IAMA World food and agribusiness congress consumers, technology & environment: Creating opportunity and managing risk, Chicago. (available at http://www.ifama.org/conferences/2000Congress/default.htm)

Luning, M.A., Marcelis, W.J. & Jongen, W.M.F. 2002. *Food quality management: A techno-Managerial approach*. Wageningen ,Wageningen Pers.

Lusk, J.L., House, L.O., Valli, C., Jaeger, S.R., Moore, M. & Morrow, J.L. 2004. Effect of information about benefits of biotechnology on consumer acceptance of genetically modified food: evidence from experimental auctions in the United States, England, and France. *European Review of Agricultural Economics* 31. pp. 179-204

Marette, S., Crespi, J.M. & Schiavina, A. 1999. The role of common labelling in a context of asymmetric information. *European Review of Agricultural Economics* 26. pp.167-178

Maruyama, A. & Kikuchi, M. 2004. Risk-learning process in forming willingness-to-pay for egg safety. *Agribusiness* 20. pp.167-179

Mazzocco, M. 1996. HACCP as a Business management tool. *American Journal of Agricultural Economics* 78. pp.770-774

Mazzocchi, M., Stefani, G. & Henson, S.J. 2004. Consumer welfare and the loss induced by withholding information: the case of BSE in Italy. *Journal of Agricultural Economics* 55. pp. 41-58

Mora, C. & Menozzi, D. 2002. Traceability cost components for meat. *In*: J.H. Trienekens & S.W.F. Otma (Eds), *Paradoxes in food chains and networks*. Proceeding of the fifth international conference on chain and network management in agribusiness and the food industry. Wageningen ,Wageningen Academic Publishers. pp. 1066-1068

Mortlock, M.P., Peters, A.C. & Griffith, C.J. 2000. Applying HACCP to small retailers and caterers: a cost benefit approach. *In*: L.J. Unnevehr (Ed.) *The economics of HACCP: Cost and benefits*. pp.301-314, St. Paul ,Eagan Press.,

Nganje, W.E. & Mazzocco M.A. 2000. Economic efficiency analysis of HACCP in the U.S. red meat industry. *In:* L. Unnevehr (Ed.) *The economics of HACCP: Costs and benefits*, pp. 241 – 266, . St. Paul,: Eagan Press.

Nganje, E.W. , Mazzocco, M. & McKieth, F. 1995. *HACCP cost for small meat packers and processors in Illinois: A Simulation approach*. FAM, University of Illinois

Nicholls, D. & Venoutsos, D. 2001. *Seafood industry case studies on implementation of the SQF 2000 quality system*. WA Seafood quality management initiative, department of fisheries, WA and New West foods (WA) Pty Ltd

Ollinger, M. & Mueller, V. 2003. *Managing for safer food: The economics of sanitation and process controls in meat andpoultry plants*. Agricultural Economic Report 817. United States Department of Agriculture, Economic Research Service. (avalable at http://www.ers.usda.gov/publications/aer817/)

Poignee, O., Hannus, T. & Schiefer, G. 2003. Vertical integrated quality management in agribusiness: a case study. *In:* Z. Harnos, M. Herdon, & T.B. Wiwczaroski, (eds.) *Information technology for a better agri-food sector, environment and rural living*. pp. 581 - 588

Porter, M.E. 1985. *Competitive advantage: Creating and sustaining superior performance*. New York: The Free Press

Porter, M.E. 1980. *Competitive strategy*. New York, The Free Press.

Reardon, T., Farina, E., Codron, J.M., Busch, L. Bingen, J. & Harris, C. 2001. Global change in agrifood grades and standards: Agribusiness strategic responses in developing countries. *International Food and Agribusiness Management Review* 2 (3)

Romano, D., Cavicchi, A., Rocchi, B. & Stefani, G. 2005. Exploring costs and benefits of compliance with HACCP regulation in the European meat and dairy sectors. *Acta Agriculturae Scand Section C*. Volume 2. Number 1 Taylor & Francis Group. pp. 52-59

Roosen, J.; Lusk, J.L. & Fox, J.A. 2003. Consumer demand for and attitudes toward alternative beef labelling strategies in France, Germany and the UK. *Agribusiness* 19. pp. 79-90

Rozan, A., Stenger, A. & Willinger, M. 2004. Willingness-to-pay for food safety: an experimental investigation of quality certification on bidding behaviour. *European Review of Agricultural Economics* 31. pp.279-291

Saaty, T.L. 1980. *The analytic hierarchy process: planning, priority setting, resource allocation*, New York, McGraw-Hill,

SADC 2000. SADC SPS and food safety issues: an agenda for action Proceedings of the – windhoek workshop on SPS/food safety, held by the SADC Consultive .Forum on SPS/Food Safety. Harare: The Southern African Development Community (SADC)

Salaün, Y. & Flores, K. 2001. Information quality: Meeting the needs of the consumer. *International Journal of Information Management* 21; pp.21-37

Schiefer, G. 2007. Tracking, tracing and online quality management support for risk control and market access. *In*: C. Parker,S. Skerratt,C. Park, & J. Shields (eds). *Tracking, tracing and online quality management support for risk control and market access*. EFITA (2007) Conference - CD

Seddon, J., Davis, R., Loughran, M. & Murrell, R. 1993. *BS 5750 implementation and value added: a survey of registered companies*. Buckingham: Vanguard consulting limited

Shepeherd, A. 2006; *Quality and safety in the traditional horticultural marketing chains of Asia*. Agricultural Management, Marketing and Finance Occasional Paper 11, FAO, Rome.

Steiner, B.W. (004. Australian wines in the British wine market: a hedonic price analysis. *Agribusiness* 20. pp.287-308

Trijp, van J.C.M. & Steenkamp, J.E.B.M. 1998. Consumer-oriented new product development: principles and practice. *In*: W.M.F. Jongen & M.T.J. Meulenberg (eds.). *Innovation of food production systems. Product quality and consumer acceptance*. Wageningen Pers.

Unnevehr, L.J. & Jensen, H.H .2001. *Industry compliance costs: What would they look like in a risk-based integrated food system?* Working paper 01-WP278. Ames,IA: Center for Agricultural and Rural Development. Iowa State University

Unnevehr, L.J. & Jensen, H.H. 1999. The economic implications of using HACCP as a food safety regulatory standard. *Food Policy*, 24, pp. 625-635

Unnevehr, L.J. & Roberts, T. 1996. Improving cost-benefit analysis for HACCP and microbial food safety: an Economist´s overview. *In*: J.A. Caswell & R.W. Cotterill (eds), Proceedings of NE-165 Conference on strategy and policy in the food system: emerging Issues. Washington D.C.. Pp.225-229

Valeeva, N.I. 2005. Cost-effectiveness of improving food safety in the dairy production chain. Wageningen University, (PhD-Thesis).

Velthuis, A.G.J., Walle van der K. & Saatkamp, H.W. 2004. Quality control systems in German and Dutch pig production: the differences between QS and IKB. (available at httw.p://www.giqs.org/documentation/Fleisch/0407_Report_IKB_QS_final.php)

Verbeke, W. 2005. Agriculture and the food industry in the information age. *European Review of agricultural economics*. Vol. 32 (3). pp. 347- 368

Verbeke, W. & Viaene, J. 1999. Consumer attitude to beef quality labelling and associations with beef quality labels. *Journal of International Food and Agribusiness Marketing* 10 (3). pp. 45-65

World Bank 2005. *Food safety and agricultural health standards – Challenges and opportunities for developing country exports*. Poverty reduction and economic management trade unit, and agriculture and rural development department.

Zugarramurdi, A., Parin, M.A., Gadaleta, L. & Lupin, H.M. 2000. The economics of HACCP. *In*: L. Unnevehr (Ed.), *The economics of HACCP. Cost and benefits*. . pp.403-412 St. Paul, Eagan Press