Traceability and Certification in High-Quality Food Production : A Critical Perspective

박 성 쾌, 서 주 남

부경대학교

1. Introduction

Today traceability[1] and certification[2] (TC) in food quality-assurance systems are both of domestic and international issues which are widely discussed and which are the basis for major initiatives in food policy, interest groups and industries. In particular, global expansion of food trade tends to facilitate such debates on TC and to work out as technical trade barriers.

This paper highlightssome arguments on these issues, which are meant to initiate a discussion on the appropriateness of principal developments and on the needs for engagements of research either to support or to change their course of direction. It is the opinion of the authors that present discussions and initiatives have lost focus on the key visions and messages of food quality management as it developed during the last couple of decades. It largely disregards developments in research and experiences fromindustries, and builds on the knowledge status of many years ago. This view isbased on ongoing developments with food sector-oriented quality-assurance systems in various countries (Budde and Richard 2002).

Difficulties in discussions are partly due to differences in focus. The focus of quality-management research is primarily on firms and on firm-level management approaches. If a sector is involved in quality discussions, it usually builds on clearly separated supply chains and brands like, e.g., in the automobile industry. The view is closely linked to the firm-level approach and covered by traditional quality- management research.

The food sector is different from the manufacturing sector in many aspects, which makes it difficult to link traditional firm-oriented quality-management approaches with quality-assurance requirements of the sector. Its infrastructure is characterized by a large number of rather small production management unitson one end and internationally operating industries and retail chains for input delivery and food product sales on the other end. The dependency on natural environments sets limits to the control of production conditions and makes the delivery of a comprehensive food program or the use of food-product ingredients dependent on a diversity of production sources on a regional/global scale. Basic food products are similar in appearance irrespective of their source and quality, which reduces consumers' ability to make informed decisions. However, difficulties in the utilization of firm-oriented quality-management approaches for the solution of sector quality-assurance problems should not result in the negligence of quality-management research results, but challenge quality-management research to

1) Traceabilityrefers to the completeness of the information about every step in a process chain. The formal definition: traceability is ability to chronologically interrelate the uniquely identifiable entities in a way that matters. Traceability is the ability to verify the history, location, or application of an item by means of recorded identification (http://en.wikipedia.org/wiki/Traceability). In Korea, the traceability systemwas first introduced into beef industry as a pilot program in 2004 and three fishery products (i.e. laver, oyster and flat fish) in 2005. Now, it is being applied to many other agricultural and fishery products (see, for details of fishery traceability in Korea, "Ministry of Maritime Affairs and Fisheries, *Pilot Traceability Program for Fishery Products*, Feb. 2006").

2) Certification refers to the confirmation of certain characteristics of an object, person, or organization. This confirmation is often, but not always, provided by some form of external review, education, or assessment. One of the most common types of certification in modern society is professional certification, where a person is certified as being able to competently complete a job or task, usually by the passing of an examination. There are two general types of professional certification: some are valid for lifetime, once the exam is passed. Others have to be recertified again after a certain period of time. Also, certifications can differ within a profession by the level or specific area of expertise they refer to (http://en.wikipedia.org/wiki/Certification).

find appropriate ways for the transfer of its accumulated knowledge from a firm into a sector perspective.

The purpose of this paper is to analyze some of the problems in sector-oriented quality-assurance approaches and to identify options for the transfer of established quality-management concepts and experience into the sector. The discussion has to some extent to rely on logical arguments and expert conclusions from general observations of developments, as scientific empirical studies on these subjects are still rare.

2. Food Traceability and Certification systems: Purpose and Requirements

■ Traceability

A traceability system provides a set of data about the location of food and food ingredients along the production chain. Data relate to both the where and when issues. There are various relevant understandings. Tracing is the ability to trace food and food ingredients back along the production chain, i.e., from the end user to the producer and evento the supplies of the product. Tracing is aimed at finding the history of the product, for example to allocate the source of contamination. Tracking refers to the ability to track food and food ingredients forward along the production chain. Tracking can be used to find and recall products that might present a serious risk to consumers' health. Identity preservation is the set of measures taken to preserve and communicate the exact identity and source of food and food ingredients to the end user.

Traceability systems can be set up with different purposes: for instance, to increase transparency in the production chain. More transparency is likely to increase consumers' trust in food safety due to the increased amount of information about, among others, production processes, food-safety controls, fish living conditions and the use of medicines. Increasing transparency is also likely to enhance the actual level of food safety as a result of the improved information flows throughout the chain. Another purpose of implementing a traceability system can be to reduce the risk of liability claims: a proper traceability system is a valuable tool for participants in the production chain. Traceability systems can also be developed to improve recall efficiency. With an adequate system, the efficiencyof recalls can be improved, which reduces costs and enhance the image of the production chain. These benefits can also be attributed to traceability systems that enhance the control of fish and food diseases.

For traceability system to be adequate there are a number of requirements. First of all, all partners within the production the production chain should be identifiable – also small fishery management units. They are especially important if the traceability system is also used for the control of fish diseases (Disney et al. 2001). Secondly, there should be a unique fisher/sea farmer identification system (McKean 2001), usually changed into an identification system for batches of fish as soon as the processing level is reached. Thirdly, an adequate traceability system requires a credible and complete (in a sense of what has been agreed upon) information transfer along all participants of the production chain.

Three different types of traceability systems can be distinguished. These are outlined in Figure 1. In system **A**, each link in the production chain gets its relevant information about the former link from the former link. The advantage of this type of system is that the amount of information to be communicated remains small, which reduces transaction cost. The disadvantage is that this system is largely based on trust. Each

link has to trust the former link on the quantity and quality of the information passed. Furthermore, in case of an emergency, all links need a perfect administration in order to act fast.

In system **B** each link gets the relevant information about all formers' links from the former link. With these systems, the speed at which tracking and tracing can be handled is much higher than with systems of type **A**. Moreover, because each link in the chain receives all other information, the information can be controlled on completeness. Also the chain's transparency seems larger than with system **A**. A disadvantage is that the amount of information to be transferred increases per link.

In the third type, system **C**, each link of the production chain provides the relevant information to a separate organization, which combines the information of all links in the whole production chain. Such organization can solve the matter of trust. Also, tracking and tracing can in principle be carried out rapidly. Moreover, since the organization is dedicated to the system, the danger that the system is not well maintained because of lack of time or other resources can be minimized. On the other hand, total costs may be larger.

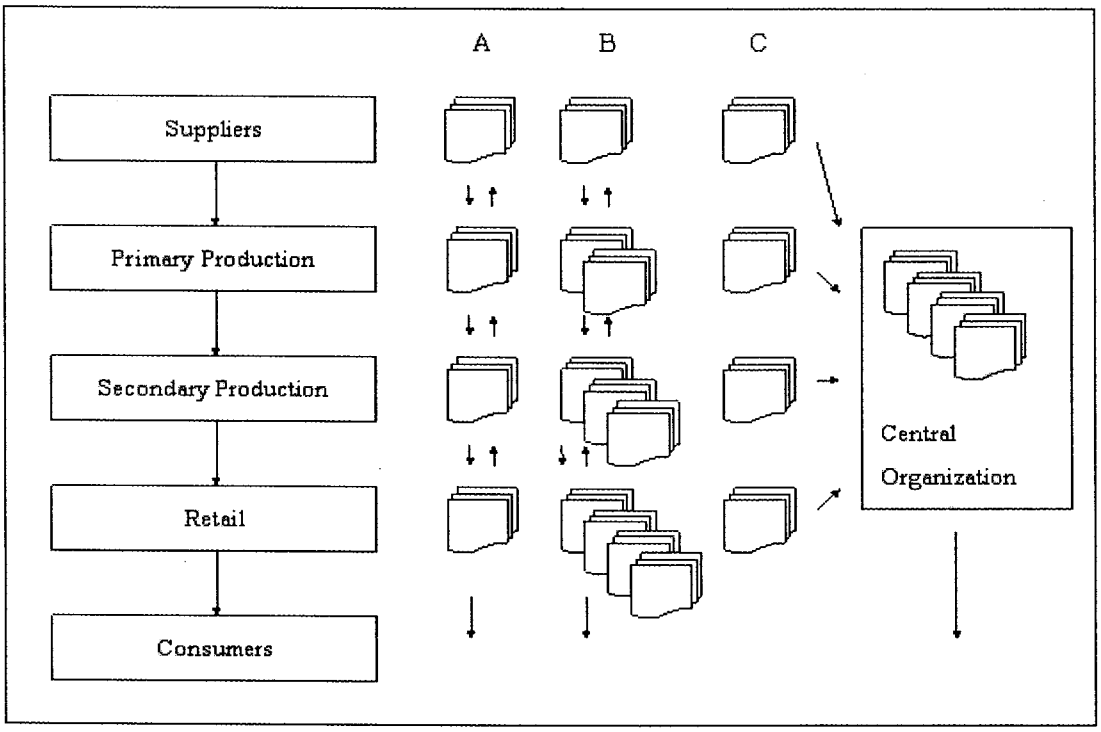

Figure 1. Traceability Systems in Production Chains.

■ Certification

In this paper certification is defined as follows: certification is (voluntary) assessment and approval by an (accredited) party on an (accredited) standard. As this definition shows, certification is very broadly used term. However, it certainly involves an assessment and an approval on some standard. The approval of good practice

distinguishes certification from the activities by national surveillance and control services, which do not go further than only evaluating if implemented systems fulfill the regulatory standards.

Certification is, in general, voluntary. However, there are also cases in which it is quasi-voluntary. For example, if it is a customers' requirement or if there are price disadvantages from not participating in a certification scheme (Payne et al. 1999, Bredahl et al. 2001). Also risk-financing organizations, such as banks and insurance companies may require some form of certification in their underwriting policy (Bullens, Van Asseldonk and Meusissen 2002, Skees, Bttos and Zeuli 2002). In relation to the certifying party and the standard used for certification, it can be stated that if an accredited party (Tanner 2000). All other type of standards can be certified by either accredited parties, (other) third parties, suchas product boards and interest groups, or customers (called second party). For stakeholders to regard certification as a valuable tool, they must trust the certification scheme as well as the certifying party. Also, there should be regular tests or audits (usually specified in the certification scheme) to verify whether the certified party still reaches the agreed performance level.

3. Enterprise vision and sector initiatives: the conflict

The term "quality management" describes a dynamic management perspective with an offensive and strategic vision. It evolved from half a century ofinitiatives initiated by Deming (1986) and continued by authors like Juran (1988), Crosby (1979), Ishikawa (1982), Taguchi (1986) and others (for a historical overview see Brocka et al.(1992)). Theircore messages focus on development paths towards.

- meeting customer expectations (described as quality),
- motivating people to engage in self-control and quality improvement, and
- improving process reliability and efficiency.

Current discussions and initiatives on tracking, traceability and quality certification throughout fisheries/agriculture and the sea- and agri-food sectorsare primarily defensive. Their focus is on external inspection and the establishment of sector-wide monitoring infrastructures, which are supposed to guarantee certain baseline quality characteristics and, in case of failures in delivery, to identify possible sources and causes for further

action. However, the establishment of monitoring and inspection systems free of risk is an illusion. Any failure to deliver quality in any part of such a system - which is supposed to deliver quality in food and perceived by consumers as risk-free or with a low risk -might discredit the whole sector monitoring infrastructure, while consumers will be unaware of any other accomplishments. Previous experiences with universal monitoring systems which had to be abandoned after food-quality failures support this view. A case in point is the German sector initiative 'controlled production,'which was abandoned after the BSE (bovine spongiform encephalopathy)[3] crises reached the country.

Professional evaluations of control systems usually focus on probabilities of failures derived from expert judgment or statistical experience and on probability-based definitions of food safety. However, customer evaluations are based on customers'subjective judgments of risk, which develop from different perspectives. It is sometimes argued that 'quality' and 'food safety' are commodities attached to products which could be handled like any other physical commodity. This argument builds on the assumption that one could link the commodities to undisputed objective values. While this may be feasible in certain environments, in many countries it is certainly not. The main tasks in the marketing of any quality management system are to

- reduce a gap between customers' risk perception and experts' risk judgment and
- reach a level of risk perception where distrust or unacceptable risk switches to trust or acceptable risk.

4. Consumer behavior/Attitude (Perception)/Communication

The evolution of food consumption reveals that distinct long-term changes have taken place. Animal protein and fat intake have risen along with increasing wealth in the Oriental and Western society. Over time, a gradual shift away from starch to red meat and fish was observed. Rice consumption level increase reached during the first half of the nineties. In Korea, over a period of 30 years (1976-2005) annual per capita consumption of livestock meat and fish/shellfish increased more than 277% points and 60% points, respectively, while during the same period rice consumption reduced by about 30% points. In the process of such structural change in Korean diet, consumers began to much perceive food safety issues.

3) Bovine spongiform encephalopathy (BSE), commonly known as mad-cow disease, is a fatal, neurodegenerative disease in cattle, that causes a spongy degeneration in the brain and spinal cord. BSE has a long incubation period, about 4 years, usually affecting adult cattle at a peak age onset of four to five years, all breeds being equally susceptible. In the United Kingdom, the country worst affected, 179,000 cattle were infected and 4.4 million killed as a precaution (http: // en.wikipedia.org / wiki/Bovine_spongiform_encephalopathy).

Annual Per Capita Consumption (kg)

	Meat	Fish/Shellfish	Rice
1976	9.66	24.03	121.00
2005	36.49	38.45	84.67
Change (% points)	277.74	60.00	△0.02

Source: Korea Rural Economic Institute, Food Balance Sheet, 1976-2005.

The importance of consumer perception to livestock products and seafood plays a significant role in food industries. Attribute profiles reveal that problems of food image pertain to safety and trustworthiness. For instance, fish and fish products are characterized as the most protein and the healthy but the safety-sensitive and the less trustworthy foods. Like the previous safety crises (hormoneabuses, antibiotic residues, BSE, contamination by wastes), safety-riskscare received considerable attention from the mass media, which brought the issue to the public's attention. Fishing industries were affected by the crisis, which was clearly reflected in their perceptual profiles.

The gap between scientific facts and their perception by consumers is largely shaped by communication.

5. The key issue: trust

The principal approaches for building trust are the experiences and beliefs of the consumers. Experience takes time to develop and can easily be shattered by singularevents of system failures, whatever their statistical probability, if they are perceived as severe by consumers. The feature of traceability does not improve or protect trust acquired through experience, i.e., the negative effects of system failures cannot be counterbalanced by the existence of a traceability feature.

Trust built on beliefs could develop faster on arguments convincing to the target group. And this type of trust remains more indifferent to singular system failures if the beliefs do not only refer to the system itself and its monitoring and control structurebut also to underlying supporting elements, which may not have failed, i.e., where the foundation of system trust remained unshattered. In this context a traceability feature

could have a positive effect if it demonstrated the stability of the supporting elements. This would allow a delineation of system failures from the supporting elements.

It is obvious that a combination of experience and beliefs would be the most stable basis for sustainable trust and the target to be approached. However, market pressures towards food-quality and food-safety guarantees force the sector to implement concepts which, in a first step, build on beliefs and lay the ground fur the subsequent development of experience. A starting point for beliefs could be the 'appropriate' communication of objective probabilities for system failures derived from expert judgment or statistical experience. It is sometimes argued that a low failure probability could be communicated as 'safe food' this might be the appropriate communication approach if consumers translate it back to 'low failure probability' However, if consumers translate it back to 'zero failure probability', any system failure will discredit the communication system. A communication system in the sensitive area of trust needs to build on a thorough analysis of consumers' perceptions of communication concepts. It is our opinion that in food-safety discussions, probabilities from expert judgment or statistical experience still receive too much attention as compared to consumers' perception of risk.

It is common understanding that principal supportive elements are (a) trust in the appropriateness of processes and (b) trust in people. The first element has been the essence of quality management from the very beginning. In this approach, trust builds onimpressions of customers that a certain qualify-assurance system is based on a progressive system approach where quality guarantees are combined with continuous and reliable quality assurance and improvement efforts. Such impressions can be developed for integrated food supply chains with clearly distinguishable brands or for clearlyidentifiable sub-sectors like the sub-sector for organic food.

Trust in the appropriateness of processes may receive additional support through reversebackward tracing. In this approach, backward tracing does not refer to failures but is used for the provision of supporting quality information like, e.g., the display of animals/fish livingconditions or the display of controls to consumers. This type of personal monitoring of guarantees by consumers may serve as a substitute for process guarantees provided by, for instance, certification.

The second principal supportive element, trust in people, builds on human relationships and longstanding established experience with the trustworthiness of people who provide personal guarantees on the effectiveness of controls or the reliability of

processes. Examples, which were well publicized during the BSE crises, are

- trust in the safety of organic food which did not build on traceability but on images of quality and reliability based on trust in the dedication of people, and
- common references to local butchers with their direct and longstanding supplier-customer relationship with consumers.

6. Certification as a Means for Trust

It is a common approach to use third parties to support promises of guarantees, Which build on control systems or appropriate process-organization and process-improvement systems through the procedure of auditing and certification. In food marketing, the value of such procedures depends on their ability to generate trust. Certification might support the development of experience or beliefs if critical customers understand a certification approach and is itself accepted as a trust worthy approach.

However, it is doubtful that certification in a general sector (network) control system can fulfill all the expectations. Network systems build on generally accepted quality levels which, as a consequence, tend to result in low-level guarantees. Supply chains in network systems evolve from actual market operations with changing partners and usually do not involve clearly visible 'trusted' supplier-customer relationships. In this scenario, quality-improvement initiatives face co-ordination problems and are of rather limited valve to participants and customers. Participants have difficulties to disconnect from the network in case of system failures anywhere in the network. Customers have to build their trust on a system, where guarantees primarily have to depend on the inspection system but less on widely accepted personal responsibilities or process organizations. This increases the risk of failures and reduces the value of guarantees for customers.

Certification in this application scenario lacks improvement potential and the personalization element which might shield it against the loss of trust in case of failures. Its main application value might be in the establishment of a new system along as no failures occur.

Sustainable and effective certification must allow clearly identifiable segmentation through, e.g., branding of products from clearly specified supply chains. Brandingbased

on clearly identifiable participants supports self-control, motivation and competitive quality improvement. Closed supply chains are the natural basis for high-quality branding, high value of certification, and high differentiation potential in case of system failures within the network as a whole.

However, while a general closed-chain approach might be appealing from a quality-assurance point of view, it is not a feasible solution for the agricultural/sea-food sector as a whole. The dependency of agricultural/fisheriesproduction on natural production environments leads to fluctuations in quantity and quality, and, in turn, to conflicts between the needs of markets for continuous delivery of a certain quality and the actual service possibility. This requires sector buffers and a sector organization, which is best modeled by a sector network with chains or enterprises as member units.

7. A Basic Framework for Sector Food-Quality Development

The various arguments can be grouped into a framework for sector-oriented quality-assurance systems in the food sector. It views the sector as a network of interconnected enterprises for the production and delivery of food products. The framework involves the following main features:

- Establishment of a hierarchical control and certification system which allows a clear, understandable and accepted identification of different levels of food quality and food safety.
- Visible delineation of co-operating sub-networks (or the introduction of stricter quality claims and far improved utilization of quality-supporting elements. This would facilitate a dissociation of sub-networks from the general network in the perception of customers in case of failures of the general control system.
- Utilization of quality-supporting and trust-generating elements by clearly identifiable sub-networks: (a) Personalization may be introduced through the organization of identifiable sub-networks consumers can identify themselves with (e.g., regions), the implementation of reverse backward tracing, or the activation and communication of dedication by people or groups involved. The latter requires, to be effective, a motivating incorporation of enterprises from all stages of the production and delivery process. (b) The activation and communication of processes with a

convincing built-in continuous quality-improvement feature.

The principal framework needs to be translated into sector activities. The identification of sub-networks through branding is not enough. The framework asks for a different understanding of branding as a comprehensive (total) approach for food quality assurance. It also changes our view on the development of market organizations towards a further electronic integration. It is best modeled by a network of interconnected but separable trade platforms which link participants of sub-networks (Lazzarine, Chaddad and Cook 2001, Hausen, Helbig and Schiefer 2001). Similar approaches need to be designed for other aspects of sector developments, which could together form a comprehensive quality-assurance model for the food sector.

8. Conclusion and policy implications

In the consumer psychology and behavior disciplines, it is widely recognized that there exists a distinct filter or gap between the external (objective) and the internal (subjective) world of consumers (Risvik 2001). This filter, also called a perception filter, accounts for the difference between scientific objectivity and human subjectivity. The great importance of human subjectivity or perception lies in the fact that exactly perception – and not necessarily scientific facts – determines consumers' reaction (e.g. preference and choice). Therefore, this perception should be of interest to health and nutrition policymakers, and is definitely of interest to the food industry.Consumer perception toward food safety needs to be measured in the regular basis.

Developments in food markets ask for sector quality-assurance systems. However, the focus of traditional quality-management research is on enterprises and not on sectors. The transfer of quality-management principles into sector environments and the analysis of customer perceptions and/or reactions on failures in food safety provide the basis for a sector quality-assurance model. While the principal elements of such a model seem to be clear, the translation into activities and organizational infrastructures still needs to be done.

References

Bredahl, M. E., Northen, J.R., Boecker, A., 2001. Consumer Demand Sparks the Growth of Quality Assurance Schemes in the European Food Sector. *In: Rgmi, A. ed. Changing Structure of Global Food Consumption and Trade*. Economic Research Service-USDA, Washington, DC, 90-102. Agricultural and Trade Report no. WRS-01-1.

Brocka, B. and brocka, M.S., 1992. Quality Management: Implementing the Best Ideas of the Masters, Irwin, Homewood.

Budde, F. J. and Richard, A., 2002. Qualitat and Sicherheit. Landwirtschaftliches Wochenblatt fur Westfalen und Lippe (Special issue).

Bullens, A.C.J., Van Asseldonk, M. A. P. M. and Meusissen, M. P. M., 2003. *Risk Management in Agriculture from A Mutual Insurance Perspective. 13th Conference on International Farm Management in Agriculture, 7-12 July 2002, Wageningen, The Netherlands.*

Crasby, P. B., Quality is Free : The Art of Making Quality Certain. McGraw-Hill, New York, NY.

Deming, W. E., 1986. Out of the Crises. Massachusetts Institute of Technology, Cambridge, MA.

Hausen, T., Helbig, R. and Scheifer, G., 2001. Networked Trade Platform. *In: Schiefer, G., Helgig, R. and Rickert, U. eds. E-Commerce and Electronic Markets in Agribusiness and Supply Chains. Proceedings of the 75th seminar of the EAAE,* February 14-16, 2001, Bonn, Germany. Universitat Bonn, ILB-Verlag, Bonn, 213-222.

Ishikawa, K., 1982. Guide to Quality Control. Asian Productivity Organization, Tokyo.

Juran, J. M., 1988. Juran on Planning for Quality. The Free Press, New York.

Lazzarine, S. G., Chaddad, F. R. and Cook, M. L., 2001. Integrating Supply Chain and Network Analysis: The Study of Net-Chains. *Journal of Chain and Network Science*,1(1), 7-22.

McKean, J.D., 2001. The Importance of Traceability for Public Health and Consumer Protection, Rvue Scientifigue et Technique, 20(2), 363-371.

Ministry of Maritime Affairs and Fisheries, Pilot Traceability Program of Fishery Products in Korea, Feb. 2006.

Payne, M., Bruhn, C.M., Reed, G.., et al., 1999. Our Industry Today: On-Farm Quality Assurance Programs: A Survey of Producer and Industry Leader Opinions. *Journal of Dairy Science*, 82(10), 2224-2230.

Skees, J. R., Botts, A. and Zeuli, K., 2002. The Potential for Recall Insurance to Improve Food Safety. *International Food and Agribusiness Management Review (Special Issue)*, 99-111.

Taguchi, G., 1986. *Introduction to Quality Engineering.* Asian Productivity Organization, Tokyo.

Tanner, B., 2000.Independent Assessment by Third-Party Certification Bodies. *Food Control*, 11(5), 415-417.

Visvik, E., 2001. The food and I: Sensory Perception as Revealed by Multivariate Methods. *In: Frewer, L., Risvik, E. and Shifferstein, H. eds. Food, People and Society: A European Perspective of Consumers' Food Choices.* Springer-Verlag, Heidelberg, 23-37,