Constructing a tool for Seafood Quality Traceability

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Abstract: **Seafood quality traceability systems have become of increasing concern for suppliers in both developed and developing countries. At this moment (2020), seafood produced in Vietnam often do not satisfy the expectations of Western consumers with respect to the desired quality. Moreover, production chains do not always operate efficiently and effectively, due to lack of quality traceability systems. The scientific challenge with respect to the improvement of the quality traceability of seafood supply chains implies the structural incorporation of the important elements in the process of food production, which are based on current scientific research for quality-orientated product development, namely a coordinated supply chain traceability approach to the production to deal with the complexity of optimising seafood production systems; and incorporation of extrinsic food quality parameters into the production and supply chain.**

Key words: **seafood quality, supply chain, traceability.**

I. INTRODUCTION

Consumers realize how many steps and procedures are required to put seafood products on the supermarket shelf, nor do they know how it is produced, or from which towns and villages it originates, so called traceability. Although this is changing for some consumers who are becoming more aware of the type of food they eat, most other actors in the supply chain must meet global standards and monitor activities to be able to satisfy consumers' demands. Supply chains for seafood products such as shrimp have changed from supply-driven to demand-driven. That means consumers are the key agent in the chain. Hence, coordination, trust and governance of the chain are of vital important to satisfy consumer preferences. This paper focused on seafood quality management supply chain in Vietnam.

Quality control at the farm level focuses on the biological and human activities for producing fish with certain intrinsic and extrinsic attributes). Quality assurance at the chain focuses on the chain actors' responsibilities for dovetailing several activities within the supply chain in order to deliver the quality that consumers desired. Quality management includes quality control and quality assurance that covers both biological management of the produce as well as human management of activities**.** The shrimp supply chain consists of several different actors: (1) small-scale producers, (2) traders and (3) processing/export firms

The present study aims to disentangle the problem related to quality management and coordination through the Pangasius supply chain. Essentially, the problem addressed in this research is how to improve quality performance by means of different coordination and governance regimes amongst chain actors. From the viewpoint of development economics, imperfect markets represent a crucial step in our understanding of the economic problems of developing coutries (Ray, 1998). The presence of information asymmetries, unaligned incentives between chain actors, low contract enforcement tend to increase market failures. It is therefore highly relevant to examine the role that governance of the supply chain plays in structuring business relationships. Williamson (1975) defined transaction costs for three main governance structures of exchanges, distinguishing spot markets, and vertical integration and hybrid forms.

II. LITERATURE REVIEW

Seafood sectors of many developing countries are nowadays witnessing tendencies toward even closer vertical coordination (Vietnam included). This implies that supply chain relationships become more closely coordinated. This occurs mainly to guarantee that technological, regulatory, and financial procedures respond to more stringent consumer preferences regarding quality and particularly safety (Hobbs and Young, 2000).

The governance structure addresses the interface between production system management by the small-holder farmers and the quality performance in the chain.

Seafood production systems are characterized by the production of raw materials coming from fish farm, to processing followed by distribution and retail and finally consumer. Production systems have the creation of quality in common, but also the maintenance of quality throughout the entire food supply chain in order to provide consumers with high quality products. Agricultural commodities from developing countries do not always successfully penetrate high-value markets in developed countries. An important drawback is that many products do not comply with food safety requirements (e.g. Henson *et al*., 2000). Moreover, the products offered to the consumers do not satisfy the growing demand for agro-food commodities with specific and constant quality characteristics. Producers in developing countries are often not acquainted with the wishes and demands of the foreign consumers of the products, and therefore cannot gear their production methods towards the desired product quality. Moreover, food supply chains do not always operate efficiently and effectively, adding an additional hurdle to successful market penetration (Jongen, 2000).

Integrated chain control systems describe all aspects of the chain and link product quality and economic benefits enabling optimization of product quality.

A scientific challenge with respect to the improvement of the quality performance of Pangasius chains is how current research results and insights can be used to build a structured methodology to design viable export supply chains from Vietnam to more developed countries. This implies the structural incorporation of innovative elements in the process of food production, which are based on current scientific research for quality-orientated product development.

To efficiently and effectively incorporate consumers' wishes a *coordinated supply chain approach* is necessary, especially for vulnerable fresh food products (Jongen *et al*., 2000). The actors in the shrimp supply chains are seed producers, input suppliers, farmers, traders, exporters, importers, and retailers. The main processes are culturing, storing, processing, packing, transportation, and trading of the product.

Chain cooperation in the food supply chain has proven its benefits in many ways. For example, supply chain management has shown its use for many years in terms of money, time and labour (Van der Vorst, 2000). Also, for food quality management a chain-orientated approach has been advocated (Luning *et al*., 2002), since food products and the raw materials and ingredients used for their production are living materials that change constantly in time because of physiological, physical and microbiological influences. In this respect, quality assessment can be performed from different perspectives for which different definitions for "good quality" are used. For example, a fish quality assessed early in the chain must be white colour and appropriate size and weight, free from antibiotic residues, suitable for handling and transportation, whereas fish purchased in the supermarket should be ready for consumption. The quality definitions differ, though the underlying physiological mechanisms causing the quality changes are the same. Moreover, technology plays an important role in managing these quality changes in the food supply chain.

Seafood quality needs to take 'the voice of the consumer' into account as well as 'the voice of the product'. 'The voice of the consumer' requires an integrated approach to food science, technology, nutrition and consumer science. On the other hand, 'the voice of the product' is about how quality can be obtained via a food science and technology approach and demarcates what is possible with a certain product and what is not.

The consumers' appreciation of food is the result of the interaction between several things, namely the consumer himself (e.g., habits, culture, personality, mood and physiology), specific quality attributes of the food (clustered in sensory, health, production and convenience attributes), and the context or situation in which this interaction takes place (e.g., time, place, who with, how, what with).

Quality, as seen from the consumers' perspectives, is a multifaceted concept, based on quality expectations as perceived prior to consumption and quality experiences as perceived during and after consumption (Grunert, 2002). While quality experience is very much related to physical product properties, quality expectation is related to previous quality experience as well as information about the production methods, packaging and the appearance.

Since these characteristics are specific for the agri-food chain, an integrated approach of management and technology is required for the measurement of food quality systems.

In conclusion, quality is considered from a broad perspective by selecting a management and a production based description. However, these descriptions have to be made quantifiable in order to measure the effectiveness of food quality systems

III. CONSTRUCTING A SEAFOOD TRACEABILITY SYSTEM TOOL

Traceability system must be quantifiable in order to measure the effectiveness of the production system. Therefore, besides the quality description, a traceability concept has to selected in order to measure the total quality performance. The primary objective of food quality management is to meet or exceed customer and consumer requirements on food quality (Luning, Marcelis, & Jongen, 2002). However, there is no unambiguous concept for food quality in literature (Da Cruz et al., 2006; Luning et al., 2007; Peri, 2006), so it is necessary to clarify a quality concept for our functions model (Fig. 1). From a techno-managerial perspective, food quality should be perceived broader than just physical product quality. In this research, the following quality dimensions have been selected to evaluate the quality concepts:

- *Product quality* refers to intrinsic and extrinsic quality attributes of the food product. Intrinsic attributes are directly related to the physical product, like safety, health, sensory value, convenience, while extrinsic ones refer to other aspects like how it is produced (e.g. animal friendly) (Luning et al., 2002). A food product as such has no quality but consists of physical chemical properties. Quality attributes are the result of (various) product properties, which are noticeable by sensory observation or via communication, and in this way they contribute to quality perception and experience of consumers and customers (Steenkamp, 1990; Van Trijp & Steenkamp, 2005).

- *Costs* incurred during the primary process including input purchasing, production and sales. It is the basis for quality/price perception

- *Reliability* refers to the ability of the organization to continuously meet requirements on quality, such as food safety level and other agreements, so providing confidence to customers and consumers.

Traceability systems as Quality Analysis Critical Control Points (QACCP) are effective management tools to achieve and ensure production and supply of safe seafoods (Luning *et al*., 2002; Ropkins & Beck, 2003). However, Western consumers usually see seafood safety as an implicit quality attribute; for them food quality embraces much more than just food safety. Nowadays, consumers have clear demands about other quality characteristics of their food such as flavour, taste, texture, appearance, shelf life, nutritional value, health value, convenience, etc. Yet, relatively little attention has been paid to the development of methodologies or systems for assessing and assuring consumer-orientated quality characteristics, a discrepancy that is particularly apparent in international agro-food chains. Therefore, we address this shortcoming by introducing the concept of QACCP in food supply chains as the tool for seafood quality traceability system

The tool for seafood quality traceability system is schematically represented in figure 1. It starts with the identification of consumer demands. Table 1 gives an overview of available tools that assist in 'hearing' the voice of the consumer. Each of the tools described in Table 1 has its merits and drawbacks, and one should realize that it is as yet not possible to capture consumers' motives for food choice and preferences unambiguously (adapted by the author, 2020).

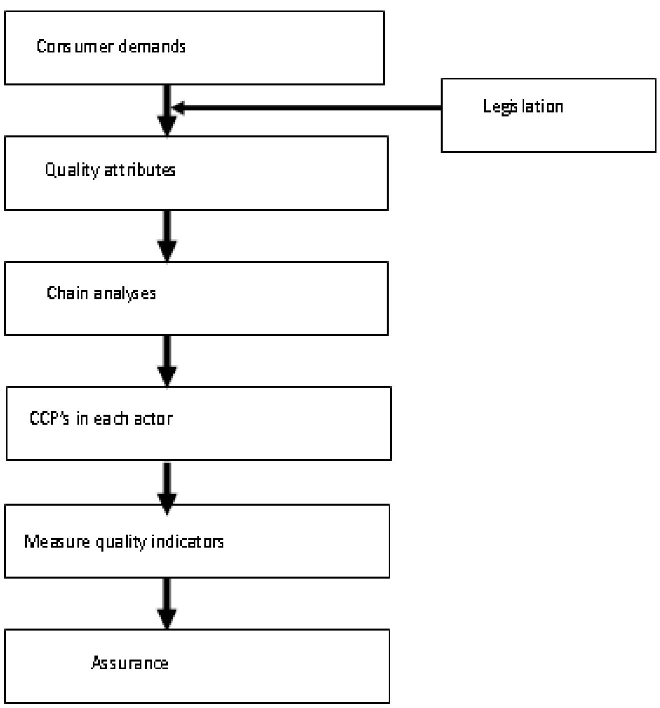

Figure 1. A tool for seafood quality traceability system

Next, the voice of the consumer has to be linked to the voice of the product. Here too, some tools exist that can be helpful (Table 2). However, their application requires a critical approach, since some of these tools were not developed for food product design, and are not yet widely accepted. In the tool for seafood quality traceability system is important to translate the consumer demands into controllable quality attributes as explained earlier, taking into account the legal requirements that aim to protect the health of the consumers.

Subsequently, the food supply chain needs to be characterized and the Critical Control Points (CCP's) affecting relevant quality attributes have to be established. This can be done by reviewing literature and consulting experts. After this, alternative strategies should be considered to obtain a better quality control. This could result in an alternative supply chain but also in a modification of a specific element in an existing link in the chain, such as an improved temperature control, or the introduction of modified atmosphere conditions. In this respect, predictive modelling of quality attributes is essential, because quantitative models quickly can calculate the effect of proposed modifications. It is impossible to do this by trial and error because of the time involved and the complexity and large number of variables.

The final step in the tool for seafood quality traceability system is the assurance of the critical quality control points in the seafood supply chain.

Table 1. Tools to listen to the voice of the consumer in food product development

Tool	**Description**	**References**
Focus group discussions	Discussing a topic in a group via a moderator	Casey and Krueger (1994); Köster (2003)
Questionnaires	Asking people questions via written questionnaires or via the internet	Dijksterhuis (1995); Risvika *et al*. (1997); Köster (2003)
Surveys	Analyzing consumption tables	Dijksterhuis (1995); Risvika *et al*. (1997); Köster (2003)
Conjoint analysis	Assesment of different product concepts by consumers, finding out what the role of different components is; multivariate analysis	Moskowitz *et al*. (2004)
Means-end theory, laddering technique	Tries to identify motivations behind choices via individual, in-depth interviews	Costa *et al*. (2004)
Collage techniques	Identifies feelings, emotions and experiences with foods	Costa *et al*. (2003)
Quality Guidance Model	Relating quality expectation and quality experience to quality cues and quality attributes via partial least squares	Steenkamp and Van Trijp (1996)
Kansei engineering	Extracting product descriptors and feelings about products from consumers without asking rational questions	Oliveira (2003), www.jske.org

Source: Adapted from author, 2020

Table 2. Tools to link the voice of the consumer to the voice of the product in seafood product development

Tool	**Description**	**Reference**
Quality Function Deployment (QFD)	Uses a matrix ('house of quality') that links consumer wishes to product properties	Benner *et al*. (2003)
TRIZ	Uses 40 inventive principles to overcome contradictions in design	Watzke and Saguy (2001); Mann and Winkless (2001)
Systematic Inventive Thinking	Uses 7 principles to come to innovation via an analysis of functions of components of the product	Goldenberg *et al*. (1999); Goldenberg and Mazursky (2002)
Chain Information Model (CIM)	Lists quality dependence diagrams for actors in a food chain	Benner *et al*. (2003)
Multi-criteria decision approach (MCDA)	Decision support system, defining the final objective, the relevant factors, and the options to reach the objective	Bevilacqua *et al*. (2004)
Bayesian Belief Networks (BBN)	Decision support system based on uncertain information using probability distributions	Corney (2000); van Boekel *et al*. (2004)
Design of experiments (DOE), Taguchi methods	Investigates detailed settings of design parameters, establishes interactions between ingredients	Arteaga *et al*. (1994); Roy (2001); Schönkopf *et al*. (1996)

Source: Adapted from author, 2020

IV. CONCLUSION

Application of the tool for seafood quality traceability system could be useful to facilitate the (re)design of products, or even whole supply chains, instruct chain actors on improved handling in order to produce consumer-orientated, high quality foods. Therefore, it is in international seafood supply chains could serve 3 objectives: i) identification and analysis of the most influential critical quality control points in the seafood supply chain, ii) assurance of the critical quality control points in the food supply chain, and iii) use the CCP's to design strategies for enhancement of end seafood product quality.

The tool for seafood quality traceability system philosophy needs to be incorporated throughout the entire food supply chain 'from fork to farm' and should include the understanding as well as the assurance of quality as perceived by consumers.

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