Quality and risk management in agri-food chains
Quality and risk management in agri-food chains

edited by:
Brigitte Petersen
Manfred Nüssel
Martin Hamer

Wageningen Academic Publishers
# Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of figures</td>
<td>11</td>
</tr>
<tr>
<td>List of tables</td>
<td>15</td>
</tr>
<tr>
<td>Preface</td>
<td>17</td>
</tr>
<tr>
<td>Chapter 1. Introduction</td>
<td>19</td>
</tr>
<tr>
<td>B. Petersen, M. Nüssel and M. Hamer</td>
<td></td>
</tr>
<tr>
<td>Chapter 2. Key terms and major developments</td>
<td>23</td>
</tr>
<tr>
<td>2.1 Definition of quality and its significance</td>
<td>24</td>
</tr>
<tr>
<td>V. Schütz, S. Lehnert and M. Nüssel</td>
<td></td>
</tr>
<tr>
<td>2.2 Quality management and quality assurance in supply chains to food retail</td>
<td>29</td>
</tr>
<tr>
<td>V. Schütz, S. Lehnert and M. Nüssel</td>
<td></td>
</tr>
<tr>
<td>2.3 Development of quality strategies in complex customer-supplier relationships</td>
<td>39</td>
</tr>
<tr>
<td>S. Lehnert, V. Schütz, and M. Nüssel</td>
<td></td>
</tr>
<tr>
<td>Chapter 3. Legal requirements – with special regard to European and German legislation</td>
<td>45</td>
</tr>
<tr>
<td>3.1 General framework conditions: Union law – national law</td>
<td>46</td>
</tr>
<tr>
<td>S. Leible, F. Ortgies and S. Schäfer</td>
<td></td>
</tr>
<tr>
<td>3.2 Principles of food law</td>
<td>48</td>
</tr>
<tr>
<td>S. Leible, F. Ortgies and S. Schäfer</td>
<td></td>
</tr>
<tr>
<td>3.3 Monitoring, risk assessment and prevention</td>
<td>50</td>
</tr>
<tr>
<td>S. Leible, F. Ortgies and S. Schäfer</td>
<td></td>
</tr>
</tbody>
</table>

*Quality and risk management in agri-food chains* 7
3.4 Labelling of products and designation of origin  
S. Leible, F. Ortgies and S. Schäfer

3.5 Prevention of fraud  
S. Leible, F. Ortgies and S. Schäfer

Chapter 4. Quality sciences as cross-sectional discipline  

4.1 Models in quality management  
B. Petersen and J. O’Hagan

4.2 Quality control cycles  
B. Petersen

4.3 Procedural models for the design of intercompany quality management systems  
V. Raab and B. Petersen

Chapter 5. Certification procedures and foundations  

5.1 International standards  
S. Bruckner, S. Lehnert and L. Theuvsen

5.2 Labels and certification systems  
L. Theuvsen, S. Bruckner and S. Lehnert

5.3 Further development of sector-specific accreditation and certification systems  
S. Lehnert, S. Bruckner and L. Theuvsen

5.4 Certification models in the agricultural sector  
S. Lehnert, S. Bruckner and L. Theuvsen

Chapter 6. Food chain management systems  

6.1 Information and communication systems in food chains  
J. Trienekens, A. Czekala, V. Schütz, N. Wognum and J. Denolf

6.2 Traceability and trust  
J. Trienekens, A. Czekala, V. Schütz, N. Wognum, J. Denolf and L. Theuvsen
6.3 Innovation management in agri-food networks & clusters
   M. Bruns, B. Hundt and M. Hamer

6.4 Cold chain management: new packaging concepts to reduce food waste
   J. Kreyenschmidt, U. Herbert, S. Rossaint and Y. Ilg

6.5 Supply chain environmental management
   K. Grekova, J. Trienekens, H. Bremmers, L. Heres and S.W.F. Omta

Chapter 7. Risk-oriented animal health and food safety management

7.1 Risk-based innovations in food safety management
   L. Heres, A. Hiller, G. Schulze Althoff and B. Urlings

7.2 Chain-oriented animal health management services
   J. O’Hagan, S. Düsseldorf, T. Klauke, A. Czekala and V. Schütz

7.3 On-farm biosecurity management
   T. Wilke, S. Schulze-Geisthövel and B. Petersen

Chapter 8. Experiences in intercompany quality management

8.1 Quality objectives and quality policy
   B. Petersen and V. Schütz

8.2 Organisational structures of intercompany quality management
   V. Schütz and B. Petersen

8.3 Supplier assessment and supplier promotion
   L. Theuvsen

8.4 Risk management and risk communication
   V. Raab and L. Theuvsen

Chapter 9. Recommendations on the advancement of quality management

9.1 Continuous improvement of communication in quality networks
   L. Theuvsen, V. Raab and S. Lehnert
9.2 Advancement of approaches in crisis management 257
S. Slütter, V. Raab and B. Petersen

9.3 Strengthening of the international dialog between industry and academia 266
V. Raab and B. Petersen

9.4 Advancement of quality management competences 272
S. Lehnert and S. Bruckner

Chapter 10. Epilogue 281
M. Hamer, B. Petersen, M. Nüssel

References 285

Keyword index 309
List of figures

2.1. Change of the position of customer and supplier
2.2. The Aachen quality management model
2.3. Schematic structure of the value chain
2.4. Development stages in quality control
2.5. Change of the quality assurance concepts in industry and the agricultural sector

3.1. Responsible federal and state-level ministries and administrative structure in health-related consumer protection
3.2. Process of risk analysis at national level

4.2. Process model of goods and information exchange between suppliers and customers
4.3. Model for the exchange of goods and information in value chains
4.4. The Netchain model
4.5. Three categories of alliances for the mutual organisation of risk-oriented inspection strategies (AMOR)
4.6. Effect of organising risk-oriented combined incoming and outgoing inspections in value chains
4.7. 3-level model
4.8. The concept of the quality broker as a variant of the 3-level model
4.9. Engage-exchange model
4.10. Combining risk analysis within the meaning of the EU Food Law with risk management from a corporate point of view
4.11. Plan-do-check-act cycle according to different standards
4.12. Schematic diagram of a socio-technical control cycle model with feedforward control
4.13. Control cycle of decision process
4.14. Levels of information increase by data processing
4.15. Stage concept for the conception and implementation of intercompany information and communication systems
4.16. Schematic diagram of the three-dimensional view for continuous improvement
4.17. Matrix structure of the assessment concept (multi-criteria decision aid – cold chain management) for evaluating and ranking of temperature monitoring possibilities
List of figures

4.18. GAP model
4.19. The seven steps of the AAD planning model

5.1. The PDCA (Plan-Do-Check-Act) cycle in international standards.
5.2. The concept of DIN EN ISO 50001
5.3. The seven core subjects of corporate social responsibility according to ISO 26000.
5.4. Overview of DS 49001
5.5. PDCA (Plan-Do-Check-Act) cycle of risk management
5.6. Risk management for organisations and systems
5.7. Systematics of the product labelling policy of the EU
5.8. Accreditation foundations
5.9. National, European and international accreditation infrastructure
5.10. Different types of audits
5.11. Four initial situations when establishing and certifying quality management systems
5.12. Certification models in the agricultural sector
5.13. Combinations of certification standards

6.1. Flow chart for planning and implementation of fields and constitutive criteria of services for animal health management
6.2. Operational structuring of participation in the Tiergesundheitsagentur eG (TiGA) Standard
6.3. Organisation and information flow in the Allianz Futtermittel Sicherheit
6.4. Relationship between the implementation of innovation activities and annual turnover in the food industry
6.5. ‘House of Innovation’
6.6. Scope of innovation regarding the number of organisations involved
6.7. Barriers in connection with R&D cooperation in the agri-food sector
6.8. Different packaging strategies to reduce food waste
6.9. Effect of modified atmosphere on shelf life extension of poultry meat
6.10. Different types of time-temperature indicator

7.1. Origin of residues and contaminants in food of animal origin
7.2. Characteristics of AMOR (Alliances for the Mutual Organisation of Risk oriented inspection strategies) inspection ‘livestock health status’
7.3. Inspection points in supply chains according to three purchase decisions
7.4. Procedural steps regarding the use of preventive quality management methods in processes of intercompany health management
7.5. Principle of risk reduction along the food chain and within one stage of the food chain through Biosecurity measures
7.6. Compliance with on-farm biosecurity measures
7.7. Role of Netchain coordinators within the concept of on-farm biosecurity Management
7.8. Enzootic risk matrix
List of figures

8.1. Embedding quality objectives and quality policy in the overall philosophy of companies and value chains
8.2. Reference levels of quality management
8.3. Coordinating services in intercompany quality and risk management for different stakeholders
8.4. Benchmark of five regional networks, evaluation criteria fulfilled in %
8.5. Assessment diagram for categorising network coordinators according to the degree of implementation of coordinating services and quality management methods
8.6. The procurement process
8.7. Motives for supplier assessment in the agri-food industry
8.8. Knowledge and use of qualitative assessment methods (in %)
8.9. Knowledge and use of quantitative assessment methods (in %)
8.10. Frequency of supplier assessment (in %)
8.11. Use of IT-based methods for supplier assessment (in %)
8.12. Example of a qualitative risk portfolio
8.13. Risk matrix by way of example of a dairy farm
8.14. Modularisation of Hazard Analysis and Critical Control Points (HACCP) and Failure Mode and Effects Analysis (FMEA) and creation of method modules for risk assessment
8.15. Steps of the Define-Measure-Analyse-Improve-Control (DMAIC) cycle and applicable tools
8.16. Distribution of slaughtering weight of slaughtering carcasses

9.1. Communication in quality networks
9.2. Relative importance of product characteristics
9.3. Levels of quality communication
9.4. Steps of planning, implementation, control and improvement of animal health standards
9.5. Levels of standard determination and implementation
9.6. Matrix to determine Alliances for the Mutual Organisations of Risk-oriented inspection strategies (AMOR) competences
9.7. Schematic illustration of the inspection model to use time-temperature indicators (TTIs) within the framework of continuous improvement of cold-chain management
9.8. Exemplary use of the intercompany inspection model for quality communication using time-temperature indicators (TTIs) as sensors
9.9. Responsibilities and chances of public-private partnerships
9.10. Public-private partnership (PPP) research and development platform Grenzüberschreitende Integrierte Qualitätssicherung (GIQS)
9.11. PDCA (Plan-Do-Check-Act) cycle as control cycle used in the minimisation concept
9.12. Software and hardware components to support planning safety and system innovations
9.13. Technical realisation of communication channels within a strategic alliance for animal disease prevention and management
9.14. Public-private partnership (PPP) platform for cross-country and cross-border exercises in crisis management
List of figures

9.15. PDCA (Plan-Do-Check-Act) cycle as control cycle of Public-private partnership (PPP) crisis exercises
9.16. Maturity development from competence building up to innovation in quality and risk management of global value chains
9.17. Research cooperations subject to degree of internationalisation and complexity of quality and risk management challenges
9.18. Ideal and typical composition of actors in networks
9.19. Competences of quality management (QM) teams in integrated systems
9.20. DGQ Qualification path in quality management (QM) in combination with EOQ QM Junior program at the University of Bonn
List of tables

2.1. More detailed explanations of the core and secondary areas of the value network
2.2. Overview matrix of methods, strategies and models in different areas of the quality management of individual companies and across several companies

4.1. Comparison of risk strategies in public and private organisations of the agri-food industry

5.1. Standards in the field of quality management and in related disciplines
5.2. Overview of relevant standards in the field of quality management
5.3. Selected certification systems in the German agri-food industry
5.4. Overview of different types of audits
5.5. Auditor qualification according to DIN EN ISO 19011
5.6. Reasons for the establishment of quality management (QM) systems

6.1. Important data storage and processing requirements for a trader of fruit and vegetables
6.2. Important data storage and processing requirements for various business processes in a food industry
6.3. Catalogue of management support service elements provided in inter-organisational innovation processes
6.4. A selection of quality indicators developed within the framework of the European Cluster Excellence Initiative
6.5. Factors that influence supply chain environmental management (SCEM) implementation
6.6. The contribution of supply chain environmental management (SCEM) to business performance

7.1. Examples of on-farm biosecurity measures for livestock farming

8.1. Criteria to categorise sustainability of production branches of agricultural enterprises
8.2. Contract criteria on the basis of the integration continuum
8.3. Criteria of different forms of intercompany systems in quality and health management
8.4. Overview of partial assessment approaches and model parameters with reference to intercompany quality communication in regional networks
8.5. Evaluation criteria
List of tables

8.6. Importance of various criteria for supplier assessment
8.7. Alternatives for action during risk control with examples for possible risk measures
8.8. Strategies in a company operating in the meat industry to limit risks during the production process

9.1. Aggregated standardised ‘calibrated utilities’ of the product characteristic
9.2. Elements of matrix dimensions
Effective quality and risk management is a topical issue that academia and industry is equally concerned with at the moment. These two management tasks belong together. Many companies in the agri-food industry but also public institutions have become painfully aware of the negative consequences of insufficient quality and risk management at the latest since the dioxin and EHEC crisis in 2011. It will be a challenge for the future to avoid negative impacts on all parts of the food chain starting with the environment as the main resource of food production and ending with the consumer.

Crises have quite often been triggered by avoidable management errors resulting from a not yet sufficiently developed quality and risk culture, on the one hand, and from a still existing attitude on the part of the managers of companies that quality and risk management are only annoying duties imposed either by legislation or by customers.

The objective of an economically oriented quality and risk management therefore must be to create transparency in the business and production processes and thus enable the management to recognise changes of risks and chances in good time and derive adequate options for action enabling quality and risk control. In addition to this, an integrated quality, environmental and risk management system forms the basis for fulfilling the increasing number of legal requirements, industry-specific standards and customer specifications as well as consumer demands.

Quality management (QM) is a very complex topic, however, which requires just as much knowledge about the statutory framework and numerous standards as well as knowledge about the fields of application for QM methods and an understanding of complex and intercompany production and value models. Qualitative aspects such as the importance of a coordinated quality policy at all stages of the value chain – from agricultural primary production and food processing to food retail – and the design of a common risk culture also play an important role in this regard. In addition to this, decision-theoretical foundations for structured handling of crisis situations are indispensable.

This book follows on the necessities and challenges mentioned by providing an up-to-date overview of queries, approaches and problem solutions in quality and risk management of
Preface

individual enterprises and across enterprises in the agri-food industry. This book addresses both, representatives from companies and from public and private organisations as well as teaching staff and students.

We would like to take this opportunity to express our gratitude to all co-authors for their vigorous and competent support and to Mike Jacobs from Wageningen Academic Publishers for his dedication and personal commitment as critical discussion partner and motivator. Our most sincere thanks goes to the doctoral candidates of the Universities of Bonn, Bayreuth, Göttingen and Wageningen who have dealt with various aspects of quality and crisis management in recent years within the framework of their doctorate since many results and important findings from their work have been incorporated into the texts and illustrations of this book.

Berlin – Bonn – Wageningen, January 2014
Brigitte Petersen, Manfred Nüssel, Martin Hamer