Preface

The food market is currently changing from a producer-controlled to a consumer-directed market. A main driving force is consumer concern about agricultural production methods and food safety. More than before, the consumer demands transparency of the production and processing chain. Innovation of the production methods and the final products should therefore start with the demands of the consumer. To be able to address this in a scientifically sound way a chain approach is necessary. A general description of a food chain starts with primary production, i.e. breeding, seed-growing, plant cultivation and agronomy, to produce foods or raw materials for foods. Then, the harvested food is stored and distributed, in which step all kinds of changes may occur in the food or raw material. The next step is processing of the food and again all kinds of changes can take place. After processing come storage, distribution and retail, and finally storage and consumption at the consumer's end. In each step of this chain the food is subject to changes in quality, and the final quality when the food reaches the consumer is influenced by actions in every step of the chain. This introduces complexity but also opportunities to influence quality as expected by the consumer.

As described, a food chain can be quite complex and the use of models has become indispensable to handle this complexity. Modelling tools are becoming increasingly important to guide the decisions for production of high-quality and safe agricultural foods. With the aid of these models it becomes possible to control and predict quality attributes, so that product innovation can be done more efficiently. However, quality is an elusive concept, and there is always an aspect of subjectivity and uncertainty. This particularly applies to products in the agro-food chain because of biological variation and rather vague consumer wishes. In addition, the perception of food-safety risks by consumers may not coincide with real risks, for example those associated with genetically modified organisms, pesticide residues, toxins or human pathogens. A novel way in the agro-food chain would be to tackle subjective elements and uncertainty in modelling by using Bayesian statistics and Bayesian Belief Networks. Bayesian approaches use prior probabilities (partly accounting for subjectivity) to estimate posterior probabilities, resulting in higher accuracy than is possible with classical statistical techniques. Such approaches are already in use in other branches of science (especially in social sciences concerning decision analysis and risk analysis, and in medical applications with decision-support systems) but hardly at all in the agro-food chain. Yet, it seems that a Bayesian approach fits in quite well with the problems that have to be dealt with in the agro-food chain. It comes quite natural that the posterior probability of a preceding chain element can be used as prior probability for the next element. Also, the variability and uncertainty in data and decisions, inherent in a complex food chain, can be tackled using a Bayesian approach.

To address these issues, a 3-day workshop was organized in May 2003 in Wageningen, The Netherlands, with invited experts in the field of Bayesian approaches to explore the possibilities. The basic idea behind the workshop was that development of Bayesian models could contribute to a better structuring of the agro-food chain resulting in high-quality and safe food products. During the workshop the possibilities and limitations of Bayesian approaches in quality-modelling and risk analysis in the agro-food chain were discussed; the lectures presented are now laid down in this book.

The book is organized as follows. In Chapters 1 and 2 the subject is introduced to participants who are newcomers in this field, by presenting an overview of the state of the art. Chapters 3-5 discuss several aspects of relevant methodologies. Subsequently, research areas are discussed concerning the primary production, the first part in the food chain, where the Bayesian approach can be usefully applied (Chapters 6-8). Aspects of quality and safety after primary production are discussed in Chapters 9-10. Finally, Chapters 11-13 treat Bayesian approaches as applied over the whole food chain.

We would like to thank all participants for their contributions and lively discussions, providing a stimulating atmosphere. We hope that this book will act as a stimulus to use a Bayesian approach in food-chain research. We would like to thank our colleague Prof. Paul van Beek, Management Studies Group, Wageningen University, for help in organizing the conference. We also would like to express our sincere thanks to Dr. Rob Bogers, director of Frontis – Wageningen International Nucleus for Strategic Expertise, who organized the workshop in an excellent way, but who was also very enthusiastic about the subject and actively participated in the preparation and discussions.

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