

# THESIS RESEARCH TOPICS

## MSc FOOD QUALITY MANAGEMENT 2025-2026

MFQ thesis coordinator: Dr. ir. Elsbeth Spelt

*These topics were made available in Spring 2025 for first-year students participating in the program Food Quality Management at Wageningen University who planned a thesis in the academic year 2025-2026. New topics will be issued in Spring 2026 for the academic year 2026-2027 and so on.*



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# I. Food safety and quality in food companies and supply chains

## Introduction

Ensuring food safety and quality is the daily business of food companies and supply chains worldwide. Multiple research projects are conducted to enhance the understanding of technological and managerial factors that influence the production of safe and high-quality food. Knowing these factors and their way(s) of influence is important for designing and implementing the necessary control and assurance systems. These systems should comply, on the one hand, with legislation, product specifications, public guidelines, and private standards, and, on the other hand, meet the consumers' expectations on food safety and food quality. Every year, we have new thesis topics combining these different stakeholders' interests, which require interdisciplinary research considering the technological and managerial disciplines. On the next pages, you can find these thesis topics contributing to a broad variety of interdisciplinary research projects in and outside Wageningen University.



**1. This topic has been withdrawn**

## 2. Identification of factors contributing to heat-stable proteolytic enzyme activity in UHT milk production and their impact on product quality

**Supervisors:** Kasper Hettinga (FQD) and Giorgiana Cătunescu (FQD)

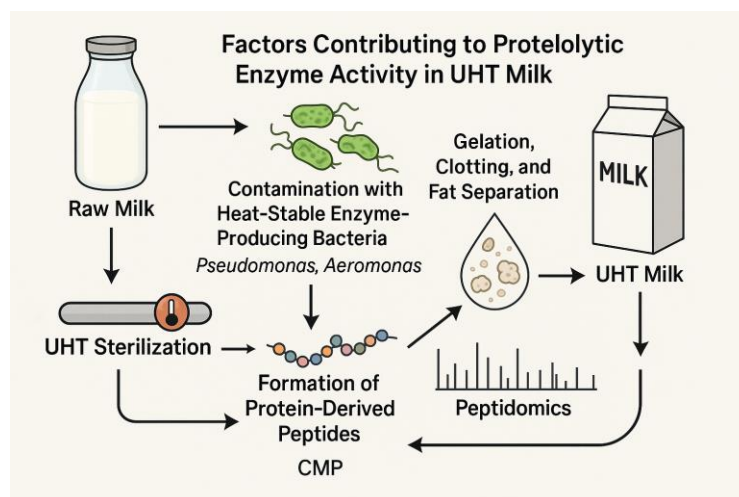
**Building on previous MFQ thesis research:** No

**MFQ specialisation:** Quality control and assurance

**Open to 1 student**

### Problem description

Ultra-high temperature (UHT) sterilization of milk generally inactivates bacteria. However, some bacteria contaminating the raw milk may produce extremely heat-stable enzymes that are not inactivated during the UHT treatment. *Pseudomonas* spp. and *Aeromonas* spp. are known to produce proteolytic enzymes that remain active after sterilization. These enzymes are of practical interest as they can degrade milk proteins, especially  $\kappa$ -casein, and lead to quality issues. This degradation process may result in gelation, clotting, and fat separation in UHT milk during its shelf life, similar to the chemical and structural changes of cheese-making, where the enzymatic degradation of  $\kappa$ -casein is part of the production process. The enzymatic activity can, however, be monitored using peptidomics, a technique that tracks the formation of peptides during the product's shelf life. Of particular interest is the presence of caseinomacropeptide (CMP), a degradation product of  $\kappa$ -casein, which may falsely indicate whey adulteration if not correctly interpreted.



Thus, there is a need to identify the techno-managerial (T-M) factors affecting both microbial contamination of raw milk with heat-stable proteolytic enzyme-producing bacteria, but also the formation of milk protein-derived peptides in UHT milk during its shelf life.

The aim of the project will be to 1) identify the T-M factors affecting the contamination of raw milk with heat-stable proteolytic enzyme-producing bacteria to better understand the sources and conditions leading to contamination, 2) determine the T-M factors affecting the formation of milk protein-derived peptides in UHT milk during its shelf life, to better understand the kinetics of enzyme activity and its impact on product stability; 3) perform a theoretical analysis of existing hypotheses from literature and industry sources to contextualize findings within current knowledge, and 4) propose recommendations for quality control strategies that can minimize the risk of UHT milk being falsely flagged for whey adulteration due to CMP presence.

### **3. Methods for measuring food safety culture in food businesses: An official authorities' perspective**

**Supervisors:** Yuanxiao (Evie) Ze (WFSR, WU-BEC) and Elsbeth Spelt (WU-FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisation:** Quality control and assurance

**Open to 1 student**

#### **Problem description**

Food safety culture is increasingly recognized as a critical factor in ensuring food safety within food businesses. It refers to the shared values, beliefs, attitudes, and behaviours related to food safety throughout an organization. A robust food safety culture supports compliance with regulatory requirements and helps prevent foodborne illnesses, thereby safeguarding public health.

This research focuses on exploring methods for measuring food safety culture, with the goal of developing a standardized framework to be used by official food safety authorities. It aims to identify reliable, valid, and practical tools that regulators can apply to assess food safety culture effectively to help structure risk-based food safety inspection plans. Current measurement approaches include quantitative surveys, qualitative interviews, observational assessments, and performance indicators capturing employee knowledge, attitudes, communication, leadership commitment, and adherence to food safety protocols (Griffith, Livesey, & Clayton, 2010; Cavallo, Cardone, & Angelillo, 2018).

The student will first conduct a systematic literature to critically review and compare existing food safety culture measurement methods, identifying key attributes, advantages, limitations, and relevance for official authorities.

Then, the student will design and distribute a questionnaire to experts from official food safety authorities. This survey will gather expert opinions on the attributes of measurement methods identified in the review, which will inform the development of a practical, evidence-based measurement framework for regulatory use.

By equipping inspectors and authorities with effective measurement tools, this research will support regulators optimising resource allocation and enforcement strategies, ultimately contributing to better public health outcomes.

#### **References**

- De Boeck, E., Jacxsens, L., & Uyttendaele, M. (2015). Food safety culture: The impact on food safety performance. *Trends in Food Science & Technology*, 45(2), 101–109. <https://doi.org/10.1016/j.tifs.2015.06.005>
- Griffith, C. J., Livesey, K. M., & Clayton, D. A. (2010). The assessment of food safety culture. *British Food Journal*, 112(4), 439–456. <https://doi.org/10.1108/00070701011034574>
- Cavallo, C., Cardone, F., & Angelillo, I. F. (2018). Food safety culture in food companies: A review. *Food Control*, 89, 336–345. <https://doi.org/10.1016/j.foodcont.2018.01.019>
- Yiannas, F. (2009). *Food Safety Culture: Creating a Behavior-Based Food Safety Management System*. Springer.
- Luning, P. A., Marcelis, W. J., & Jongen, W. M. (2011). *Food Quality Management: Technological and Managerial Principles and Practices*. Wageningen Academic Publishers.

#### **4. How to enable sustainable and resilient food product export from Africa to Europe?**

**Supervisors:** Ayalew Kassahun (WU-INF) and Elsbeth Spelt (WU-FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality control and assurance, quality and food logistics

**Open to 1-2 students**

##### **Problem description**

An EU Horizon research [call](#) funded two research proposals to support the AU-EU collaboration to advance fair, healthy, and eco-friendly food systems under the Green Deal and Farm-to-Fork strategy, with a focus on supporting sustainable agriculture, climate resilience, and ICT-based traceability to reduce non-tariff barriers in EU-African trade. One of the funded projects, [STREAMING](#), promotes innovation and entrepreneurship among women, researchers, and farmers by connecting academia and industry through networks, hubs, and training programs.

STREAMING aims to address challenges in the African food trade system by strengthening networks among food system actors. A key focus is the adoption of traceability systems to facilitate trade between Africa and Europe, which requires (1) preserving product quality during production, processing, and logistic operations, and (2) ensuring these quality attributes are traceable and transparent. The project specifically explores the use of global transparency standards.

This thesis research investigates food quality challenges in upcoming and promising food production chains in Africa targeting Europe as an export market, and examines how quality control and traceability systems can reduce trade barriers. Using a selected product case from the project, you will analyse both the food quality (technical) and managerial/policy (quality assurance) aspects through literature review, partner interviews in Africa and Europe, and supply chain modelling. You will particularly focus on the downstream (EU) part of the value chain.

##### **Tasks and objectives**

- Conduct a brief review of relevant scientific and grey literature to identify knowledge gaps.
- Select a case retail product (e.g., coffee, tea, teff, spices, cassava) and conduct interviews with project and case study partners in Africa and Europe to map its value chain.
- Analyse the value chain using food quality management models to recommend improvements in both technical and non-technical aspects of food quality management.

##### **References**

Kassahun, A., Verdouw, C. and Roomer, J., 2023. A framework for modelling and designing transparency systems: A case of a Vietnamese pork supply chain. *Heliyon*, 9(11).

Luning, P.A. and Marcelis, W.J., 2007. A conceptual model of food quality management functions based on a techno-managerial approach. *Trends in food science & technology*, 18(3), pp.159-166.

## 5. Developing and measuring management of food safety risks among traditional small-scale cereal processors in Sub-Saharan Africa

**Supervisors:** Julia Virol (WU-BEC) and Ine van der Fels-Klerx (WFSR, WU-BEC)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality control and assurance, quality management and entrepreneurship

**Open to 1 student**

### Problem description

In Sub-Saharan Africa, consumers source nearly all their food from informal markets. Informal food markets<sup>1</sup> are neither regulated nor protected by the state. They play a crucial role in food security, but they are also associated with consequent food safety risks. Overall, 135 million African people are affected by foodborne illnesses every year, leading to 180,000 deaths yearly. Therefore, the challenge of ensuring the provision of safe and nutritious food must be addressed.

This thesis explores how to assess traditional food producers' management of food safety risks. While food safety management systems can be evaluated for large processing firms, it is harder to define which measures ought to be in place for traditional processors. Indeed, they have limited knowledge of food safety risks, lack access to funds and infrastructure, and operate in a weak institutional environment where enforcement of regulation and controls are limited.

This research aims to create an indicator to measure the implementation of food safety practices by traditional Sub-Saharan producers. To do so, you will be able to review the literature to compare how measures of "food safety" have been constructed, conduct key informant interviews to identify their weaknesses and strengths, map the production process(es) used by traditional producers thanks to data collected in the UP-RISE project and suggest a new indicator to score producers on their food safety practices adapted to the context in which they operate.



*Traditional umqombothi beer - Picture taken during UP-RISE General Assembly, Johannesburg South Africa)*

For this thesis, you will work in particular on one of these two specific products: umqombothi, a traditional fermented beer produced in South Africa, or akpan, a traditional fermented dessert produced in Benin, both produced with either maize or sorghum.

This thesis is part of the European-funded UP-RISE food safety project, which uses a multidisciplinary approach to limit

mycotoxin contamination along traditional fermented food value chains in five African countries. Among different objectives, it aims to incentivise food safety among formal and informal agrifood entrepreneurs. For your work, you will be in contact with the relevant UP-RISE partners, including in-country partners. Travel is not foreseen.

### Resources

<https://uprisefoodsafety.org/>

Henson, S., Jaffee, S. and Wang, S. [New directions for tackling food safety risks in the informal sector of developing countries.](#) (2023). Nairobi, Kenya: ILRI.

<sup>1</sup> They are constituted of street vendors, sellers on wet markets, or processors working and selling from their home

## 6. Glycoalkaloids presence in dehydrated potato flakes

**Supervisors:** Elsbeth Spelt (FQD) and Jeroen Hendrickx (LambWeston)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality control and assurance, quality management and entrepreneurship

**Open to 1 student**

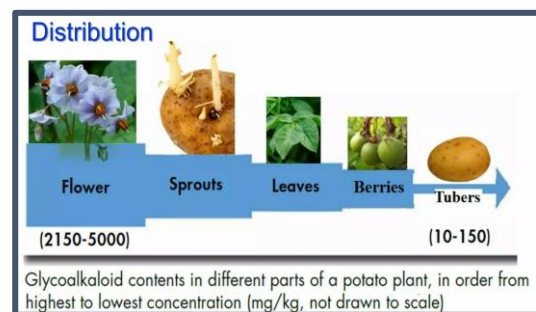
### Problem description

Lamb Weston is a world-leading brand in high-quality potato products and is sold in over 100 countries around the world. Lamb Weston BV trades under the name Lamb Weston EMEA and serves markets in Europe, the Middle East, and Africa (EMEA). Lamb Weston EMEA also supplies to our jurisdictions in APAC and LATAM. Supplying frozen potato products like Regular Fries (6x6 or 9x9 mm), Twisters®, Potato Dippers, and Connoisseur Fries as well as dehydrated potato flakes to customers in the Foodservice, Quick Service, Industry, and Retail segments.

Lamb Weston aims to reduce food waste to a minimum by processing side streams from the French fries production into value-adding products. One of the side-stream products is dehydrated potato flakes. Those flakes are sold as a B2B (intermediate) product that is processed into finished food products by our customers, such as pasta products (gnocchi) or potato snacks. Potato flakes can also be sold in consumer units abroad, where they can be mixed with boiled water into a nutritious meal component,

comparable to mashed potatoes, but with a significantly different sensorial profile. Glycoalkaloids naturally occur in potatoes in levels that vary between different potato varieties, between 20–80 ppm. The side streams we send to our potato flakes processing are slivers, nubbins, greens, and other B-grade potatoes. In general, these side streams have higher glycoalkaloid levels due to the nature of the products. When dehydrated, the processing factor is 6 or more, and the levels in the finished product (as sold by Lamb Weston) can be up to six times the value in the potato. The European Commission initiated a regulatory process to come to a Regulation setting glycoalkaloid limits for processed potato products. The Commission Recommendation 2022/561 calls for data and asks the European potato processing industry to monitor at a level of 100 ppm for all processed potato products.

The student will conduct a semi-structured literature review on the available scientific studies and other papers on glycoalkaloids to gain a deep understanding of the glycoalkaloids in general (how they work, what it does, which factors affect) and will apply this in-depth knowledge on potatoes and dehydrated potato products. This thesis research will include recommendations with regard to potato varieties, processing conditions, new/disruptive technologies, and additives that Lamb Weston can explore when investigating technological solutions to reduce or eliminate the presence of glycoalkaloids to levels that are generally considered safe in the European Union.



### Resources

[EFSA CONTAM Panel \(EFSA Panel on Contaminants in the Food Chain\), 2020. Scientific Opinion – Risk assessment of glycoalkaloids in feed and food, in particular in potatoes and potato-derived products. EFSA Journal 2020;18\(8\):6222, 190 pp](#)

[Commission Recommendation 2022/561 on monitoring the presence of glycoalkaloids in potatoes and potato-derived products](#)

## 7. PFAS distribution in potatoes processed into potato products

**Supervisors:** Elsbeth Spelt (FQD) and Jeroen Hendrickx (LambWeston)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality control and assurance, quality management and entrepreneurship

**Open to 1 student**

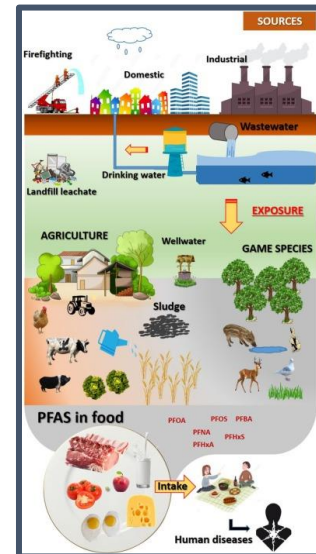
### Problem description

Lamb Weston is a world-leading brand in high-quality potato products and is sold in over 100 countries around the world. Lamb Weston BV trades under the name Lamb Weston EMEA and serves markets in Europe, the Middle East, and Africa (EMEA). Lamb Weston EMEA also supplies to our jurisdictions in APAC and LATAM. Supplying frozen potato products like Regular Fries (6x6 or 9x9 mm), Twisters®, Potato Dippers, and Connoisseur Fries as well as dehydrated potato flakes to customers in the Foodservice, Quick Service, Industry, and Retail segments. Lamb Weston BV has its headquarters in Breda in the south of the Netherlands at the crossing point of Amsterdam, Rotterdam, and Antwerp. The company operates seven factories: in the Netherlands (5), the United Kingdom (1), and Austria (1). The company employs approximately 1,600 individuals in the EMEA region and nearly 10,000 individuals globally.

‘The European Commission asked EFSA for a scientific evaluation on the risks to human health related to the presence of perfluoroalkyl substances (PFASs) in food. Based on several similar effects in animals, toxicokinetics, and observed concentrations in human blood, the CONTAM Panel decided to perform the assessment for the sum of four PFASs: PFOA, PFNA, PFHxS, and PFOS. Since accumulation over time is important, a tolerable weekly intake (TWI) of 4.4 ng/kg bw per week was established. This TWI also protects against other potential adverse effects observed in humans. Based on the estimated LB exposure, but also reported serum levels, the CONTAM Panel concluded that parts of the European population exceed this TWI, which is of concern.’ (EFSA)

‘Perfluorooctane sulphonate (PFOS) and perfluorooctanoic acid (PFOA) are chemical substances that do not naturally occur in the environment. These substances belong to the poly- and perfluoroalkyl group (PFAS) and are man-made. [...] RIVM has determined the risk limits for PFAS in soil for arable farming and livestock breeding, because there are, as yet, no national standards for PFAS in soil and dredging spoil. (RIVM)

The student will conduct a semi-structured literature review on the available scientific studies and other papers on PFAS to gain a deep understanding of PFAS in general (how it works, what it does, which factors affect) and apply this in-depth knowledge on potatoes and processed potato products (French fries). This thesis research will include recommendations for the distribution of PFAS via arable land into potatoes and how this evolves during the next stages of storage, processing, and packing into final product bags, concerning the documented human health risks of PFAS in processed potato products, more specifically frozen French fries.



### Resources

[Risk to human health related to the presence of perfluoroalkyl substances in food](#) (EFSA 2020)

[Per- and polyfluoroalkyl substances \(PFAS\)](#) (EFSA)

[PFAS](#) (RIVM)

## II. Food handlers' role and FS culture in food safety risks in catering and food manufacturing

### Introduction

For several decades, actors across the food supply chain, from primary production to catering and retail, have recognised the importance of maintaining robust food safety management systems to ensure safe food and meet legal requirements. In more recent years, there has been growing recognition of the vital role that people (such as farmers, food handlers, managers, and others) play in the effectiveness of these systems and in shaping an organisation's food safety culture. Today, the importance of food safety (FS) culture is acknowledged at multiple levels, including in the General Food Law, Codex Alimentarius guidelines, and the Global Food Safety Initiative (GFSI) Benchmarking Requirements. With FS culture now a part of the GFSI benchmarking criteria, all major private food safety standards (such as IFS, BRCGS, FSSC 22000, and SQF) have incorporated it into their schemes.



As a result, food enterprises are expected to actively engage with and cultivate a strong food safety culture. A strong and proactive FS culture is reflected in employees' consistent adherence to food safety and hygiene practices and a shared sense of responsibility for producing safe food across the entire organisation and supply chain. Among all employees, food handlers play a particularly critical role in the production, preparation, and serving of safe food. Understanding the technological, managerial, and personal factors that influence their behaviour is thus essential to developing strategies to enhance food safety culture and ensure safe food throughout the supply chain.



Another growing challenge highlighting the key role of food handlers is the industry-wide shift toward circular practices. Especially in the catering sector, circular approaches can help reduce food waste, but they may also introduce new food safety risks. Here, too, understanding food handlers' behaviour and the factors that drive their actions is crucial.

To support ongoing efforts in this field, we have outlined several research topics aimed at deepening the understanding of the role people play in preventing food safety issues from farm to factory to food service.

## **8. Factors influencing food handlers' compliance with hygiene requirements in food production**

**Supervisors:** Pieter Luning (FQD) and Laís Zanin (Univ. São Paulo)

**Building on previous MFQ thesis research:** Yes

**MFQ specialisation:** Quality control and assurance

**Open to 1 student**

### **Problem description**

Food safety (FS) culture is increasingly recognised as a key determinant of food safety performance. It plays a central role in shaping how individuals approach safety and hygiene in their daily routines. Nyarugwe et al. (2016) highlighted that a complex interplay of factors influences food handlers' hygiene behaviour. These include personal factors such as knowledge, awareness, attitudes, and social norms; technological factors, such as the layout of the facility and the design of processing equipment; organisational elements like leadership, tasks and responsibilities, and procedural clarity; and the effectiveness of food safety communication i.e., what is communicated, how it is shared when it is shared, and through which channels.

Previous ethnographic research has explored these dimensions in various contexts. Notably, case studies conducted in a Dutch company specialising in sprouted vegetables and a Greek dairy company producing soft cheese provided valuable insights into personal hygiene and cleaning and disinfection practices. These studies examined how factors across four broad domains (people, technology, organisation, and communication) influence hygiene behaviour and reflect the prevailing FS culture. Similar methodologies have been applied to understand food safety in informal food settings, such as street food vending environments in Ecuador and Lebanon, where resource constraints and informal organisational structures pose unique challenges.



The next phase will focus on new case studies in the food manufacturing or street food vending sectors to build on existing research and validate previous findings. The aim is to examine how different contexts influence hygiene behaviour and food safety culture. Using a mixed-method approach, including, for example, observations, interviews, document analysis, and site visits, data collection methods will be tailored to the sector-specific context. Thematic analysis will reveal patterns within cases and, if possible, enable comparisons with earlier studies to highlight shared and unique factors shaping FS culture and hygiene practices. The topic will be further defined at the start of the thesis and will be conducted in collaboration with the University of São Paulo.

### **Reference**

Nyarugwe, S. P., Linnemann, A., Hofstede, G. J., & Fogliano, V., & Luning, P.A. (2016). Review: Determinants for conducting food safety culture research. *Trends in Food Science and Technology*, 56, 77-87

## 9. Towards a science-based food safety culture assessment tool for practitioners and the development of interventions

**Supervisors:** Pieter Luning (FQD) and Laís Zanin (Univ. São Paulo)

**Building on previous MFQ thesis research:** Yes

**MFQ specialisations:** User-oriented food quality, quality control and assurance, quality management and entrepreneurship

**Open to 2 students**

### Problem description

The research's overarching aim is to advance the development of science-based food safety culture (FS culture) assessment tools that are both methodologically sound and practical, tailored to the specific needs of various sectors within the food industry. As FS culture gains recognition as a key driver of food safety performance, the need for robust, context-sensitive assessment methods has become increasingly pressing. However, despite a growing body of literature and industry initiatives, practitioners continue to face challenges in assessing FS culture in ways that are meaningful, actionable, and relevant to their operational realities.

FS culture refers to the shared values, beliefs, and behaviours that influence food safety practices across an organisation and is shaped by, amongst others, leadership, commitment, communication, people, and the organisational and technological environment. While research has outlined FS culture dimensions and proposed various assessment approaches, including mixed methods, there remains no consensus on which determinants to prioritise, which tools to use, or how to interpret results effectively.



This research seeks to address that gap through two potential directions. First, it can explore the current challenges practitioners face in designing, implementing, and interpreting FS culture assessments. This includes identifying which data collection tools are used (e.g., surveys, interviews, observations), how data are analysed, and what barriers or enablers exist in applying these tools across different sectors, particularly in underrepresented areas like food service and catering. A mixed-method approach combining literature review, case studies, and practitioner interviews could yield insights into sector-specific needs and best practices.

Second, the research could investigate effective interventions to foster FS culture. Assessment alone is insufficient without actionable strategies for improvement. By examining existing literature and gathering industry experiences, this research line aims to identify and evaluate interventions, such as leadership training, peer coaching, or digital tools, that foster a proactive and mature FS culture. Ultimately, this research aims to bridge the gap between theory and practice, offering evidence-based, user-friendly FS culture assessment and improvement tools adaptable across the diverse food sectors.

### Reference

Zanin, L.M., Luning, P.A., & Stedefeldt, E. (2021). The evolution of food safety culture assessment: a mixed-methods systematic review. *Trends in Food Science & Technology*, 118, 125-142.

<https://doi.org/10.1016/j.tifs.2021.08.013>

## 10. Risk-benefit analysis of circular practices in catering

**Supervisors:** Giorgiana Catunescu (FQD) and Pieternel Luning (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** User-oriented quality, quality control and assurance, quality management and entrepreneurship

**Open to 1 student**



### Problem description

The need for a transition towards a sustainable and circular economy has many implications for food production from farm to fork. Within this context, along the whole food supply chain, various initiatives are taken to reduce the burden of food waste, recycling packaging, valorisation of side streams, reuse of ingredients/foods, etc. In the catering sector, there is a need to move towards more sustainable and circular practices. Many studies have been conducted in catering that have provided insights into waste production and possible waste reduction strategies. However, circular practices in catering go beyond just food waste reduction (Greer et al, 2020). Heijink, (2019) described Greer et al, 2020, the following: The Ministry's vision of circular catering has been defined to encompass: procurement (choosing products that apply circular principles), production (increasing recyclable bio-based raw materials for disposables, with as little mono-packaging as possible), business operations (minimally burdensome preparation methods and distribution processes), assortment choice (more vegetable proteins, preferably produced locally), and the use of residual flows (e.g. coffee grounds, tomato stems, beet pulp). However, empirical work on the circular economy, particularly in catering, is still scarce (Kirchherr and van Santen, 2019).

Moreover, besides the expected benefits of circular practices, new food safety risks may arise that have not yet been studied. Chemical, microbiological, and nutritional hazards may be encountered and/or generated when applying circular practices (Bittner et al., 2024). Thus, a risk-benefit assessment is needed to evaluate potential circular practices in the catering sector, considering the benefits (such as sustainability, ethics, and consumer preference) and the risks.

A previous MSc thesis analysed circular catering practices through a systematic literature review and categorised the practices according to the waste hierarchy.

Furthermore, risks and benefits associated with these practices were identified. A follow-up study could investigate through a case study, which circular catering practices are applied in daily routine; which factors influence the consistent application of these practices, and how they reduce food waste and lower environmental impact (e.g. less water, energy, packaging, etc.). The thesis topic will be further refined at the start of the thesis.



### References

- Greer, E., von Wirth, T., & Loorbach, D. (2020). The diffusion of circular services: Transforming the Dutch catering sector. *Journal of Cleaner Production*, 267, 121906. <https://doi.org/10.1016/j.jclepro.2020.121906>.
- Kirchherr, J. W., and Ralf van Santen. "Research on the circular economy: A critique of the field." *Resources, conservation and recycling* 151 (2019).
- Membré, J. M., Farakos, S. S., & Nauta, M. (2021). Risk-benefit analysis in food safety and nutrition. *Current opinion in food science*, 39, 76-82.
- Bittner, N., Bakker, N., & Long, T. B. (2024). Circular economy and the hospitality industry: A comparison of the Netherlands and Indonesia. *Journal of Cleaner Production*, 141253.

## 11. Exploring the key techno-managerial drivers that lead to pig carcass contamination – a focus on food safety culture and hotspot mapping

**Supervisors:** IreOluwa Isaac-Bamgboye (PhD), Sara Erasmus (FQD), and Patricia Hoekstra (Marel)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** User-oriented quality, quality control and assurance, quality management and entrepreneurship

**Open to 1 student**

### Problem description

Pork is one of the most consumed meats worldwide. It is well-known for its rich flavour profile and versatility in the cooking process. Pork is a good source of iron, zinc, and thiamine, among other important vitamins and minerals, as well as protein. A major threat to the safety and quality during the processing of pork meat is microbial contamination of pig carcasses. It is essential to understand the dynamics and diversity of these contaminants from a techno-managerial viewpoint to be able to put control measures in place that effectively reduce the risks associated with foodborne illnesses.

The food safety culture of a company plays a role in product contamination. De Boeck (2018) described the food safety culture model as follows: “Food safety culture can be defined as the interplay of the food safety climate as perceived by employees and management at all levels of a company and the implemented FSMS, which will be influenced by company characteristics and the context of the company (techno-managerial route) resulting in a



certain level of food safety and hygiene of the final product”. The process to improve quality consists of several steps and is divided into two loops. The first loop is focused on incidental problems and having the process within the control limits. The second loop is focused on the structural problems based on the findings of the causes of deviations. Important steps within the improvement circle are determining structural problems by collecting information on the process, documentation of quality and consumer satisfaction, and employee performance. The next step is analysing the process and modifying the process (Luning & Marcelis, 2020). Behavioural patterns of products, processes, and people are analysed. The improvement activities can be influenced by technological conditions and administrative conditions. To obtain an overview of the food safety culture within the pork processing company, a thorough analysis must be performed while considering the interplay between the techno-managerial route and the human route.

This topic aims to analyse the crucial indicators of a food safety culture as well as the current food safety culture in the meat production environment for the improvement of pork quality. It will build on the work of a previous MFQ thesis that explored the key technological conditions, QA/QC activities, administrative conditions, and external environmental conditions that influence the microbiological contamination of pig carcasses in slaughterhouses. A follow-up study could broaden the theoretical framework to other key managerial activities, such as quality design, quality improvement, and quality policy. The thesis topic will be further refined at the start of the thesis.

### References

- De Boeck, E. (2018). *Food safety culture and climate, exploring the human factor in food safety management*. PhD Thesis, Ghent University. Faculty of Bioscience Engineering, Ghent, Belgium.
- Luning, P. A., & Marcelis, W. J. (2020). *Food quality management*. Wageningen Academic Publishers. <https://doi.org/10.3920/978-90-8686-899-5>.

## **12. Exploring root causes and stakeholder roles in postharvest Norovirus contamination using a techno-managerial approach and social network analysis – case study: Moroccan berry supply chains**

**Supervisors:** Giorgiana Catunescu (FQD), Pieternel Luning (FQD), and Amal Bouryad (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** User-oriented quality, quality control and assurance

**Open to 1-2 students**

### **Problem description**

Norovirus (NoV) has been identified as a leading cause of foodborne outbreaks globally and is increasingly linked to the consumption of fresh and frozen berries (Bozkurt et al., 2020). In Morocco, recent RASFF notifications implicating berry exports have drawn attention to the effectiveness of existing postharvest control measures. Despite the application of Good

Manufacturing Practices (GMP), Hazard Analysis and Critical Control Points (HACCP) systems, and hygiene training protocols (Bouwknegt et al., 2015), NoV



contamination continues to occur due to implementation gaps and context-

specific challenges. Furthermore, the complexity of the supply chain necessitates a better understanding of stakeholder roles and coordination mechanisms at the postharvest stage.

This thesis will apply a techno-managerial approach to investigate the root causes and shortcomings of NoV control measures at the postharvest stage of the Moroccan berry supply chain. It builds upon a prior study that explored technological, organisational and people-related factors at the preharvest and harvest stages. The study aims to gain insight into the most important factors affecting the likelihood of NoV contamination in fresh and packed berries for local and export markets, and which barriers hamper good safety and hygiene practices. Typical research methods could include literature and document analysis, in-depth interviews with supply chain actors, and/or focus group discussions to identify barriers that hamper adequate food safety and hygiene practices.

As the safety of berries is not only affected by the primary supply chain actors, there is a need to understand the network structures with its stakeholders, their goals and roles, their relations and their power position. For this purpose, the student could conduct a stakeholder analysis at the postharvest level using the Net-Map methodology (Schiffer & Hauck, 2010), to identify stakeholders, their goals and roles, their relations and their influence in the network. The findings inform who needs to be targeted to implement intervention strategies to improve food safety and hygiene practices, strengthening food safety and export sustainability in Morocco's berry sector.

### **References**

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### III. Digitalisation in food safety and quality management

#### Introduction

The food industry is challenged to consistently produce safe, high-quality food for a growing population; deal with climate change, the complex food supply chain, food loss and waste, comply with stricter official regulations, and respond to consumer demands for enhanced sustainability, authenticity and traceability. Under all these circumstances, the scope of traditional aspects of food safety and quality management (FSQM) is expanding toward sustainability, transparency, traceability, online/real-time access and evaluation aspects. The traditional FSQM methods (i.e., statistical process control, total quality management, and continuous improvement) are still relevant and useful, however, they are open to being complemented by digital technologies and data analytics.

With the spreading of the Fourth Industrial Revolution (Industry 4.0) towards other

concepts such as *Food Quality 4.0* (Djekić et al., 2023), *Food Safety 4.0* (Trollman et al., 2024) and *Food Traceability 4.0* (Hassoun et al., 2024)

have emerged. These concepts can be characterised by the use of novel and/or improving digital technologies (e.g., Artificial Intelligence (AI), cloud computing, blockchain, Internet of Things (IoT), smart sensors, autonomous robotics, big data and 3D food printing etc.) in FSQM, and enhanced interconnectivity. Besides that, the food industry and official authorities (FDA, WHO, EU Commission, etc.) have become more interested in digitalisation and

started moving towards Food Quality 4.0, Food Safety 4.0 and Food Traceability 4.0 concepts. However, despite the increasing interest in and potential benefits of Industry 4.0 technologies in food safety and quality management, there is a lack of awareness and information about how the implementation of these technologies can improve processes and what the technological and managerial challenges are in the digital transformation of traditional FSQM. This research theme aims to investigate the current state, along with the experienced and/or perceived challenges and barriers to the adoption and/or implementation of advanced technologies within the framework of Food Quality and Safety 4.0, considering both technological and managerial perspectives. The goal is to generate insights that support the improvement of quality and safety management in the food industry. To this end, the research will cover several core topics outlined in the following pages.



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### 13. Artificial intelligence and big data analytics in predictive food safety management

**Supervisors:** Selcen Semercioz-Oduncuoglu (FQD) and Pieternel Luning (FQD)

**Building on previous MFQ thesis research:** No

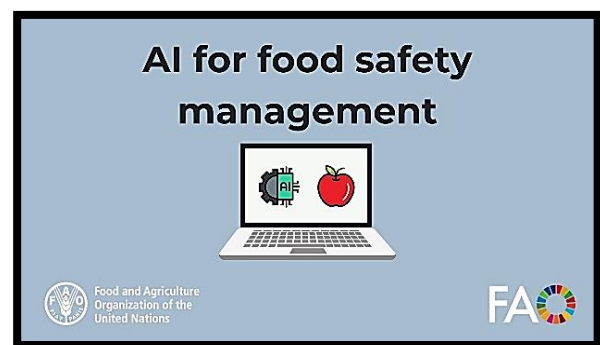
**MFQ specialisations:** Quality assurance and control, quality management and entrepreneurship

**Open to 1 student**

#### Problem description

The growing complexity of global food supply chains and increased demand for safer food have emphasised the need for predictive, data-driven safety management. In parallel, AI and Big Data analytics (BDA) in food safety management are currently one of the hot topics within both research and industry. The Food and Agriculture Organisation (FAO) hosted a global discussion on AI applications in areas such as bacterial phenotyping, food recall management, outbreak prediction, and antimicrobial resistance. As food systems generate massive volumes of such data, AI is gaining importance in food safety by enabling the extraction of predictive insights from digital data sources that were previously underutilised (Yu et al., 2024).

Data generated in operational FSMS includes, among others, product and process data from control of incoming materials/ingredients, final product inspections, data recorded at CCPs, and data from verification analyses (such as microbial and contaminant analyses).



In this context, this research topic aims to explore the types of predictive applications of AI and BDA that currently exist in food safety management, how they are being utilised, and the critical requirements for successful implementation of AI/BDA in food safety.

#### Reference

Yu, W., Ouyang, Z., Zhang, Y., Lu, Y., Wei, C., Tu, Y., & He, B. (2024). Research progress on the artificial intelligence applications in food safety and quality management. *Trends in Food Science & Technology*, 104855.

#### **14. Barriers to AI adoption and/or implementation in food quality and safety control: A multi-actor perspective**

**Supervisors:** Selcen Semercioz-Oduncuoglu (FQD) and Pieterneel Luning (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality control and assurance, quality management and entrepreneurship

**Open to 1 student**

##### **Problem description**

According to the Food Quality 4.0 and Food Safety 4.0 concepts, AI is recognised as a key innovative technology that offers promising opportunities to enhance the control and assurance of food quality and safety (Hassoun et al., 2023; Trollman et al., 2024). AI plays a crucial role in handling large volumes of data generated by sensors, devices, and systems in food networks. By training on food quality and safety data, AI can identify patterns and predict potential quality and safety incidents (Trollman et al., 2024). Although most of the AI applications in food quality and safety control are at the laboratory-tested level, it is the most commonly reported I4.0 technology that is offered for many control practices. Some of the applications involve the training of AI models with food images from the various types of cameras to classify product quality (Przybyl et al., 2023), detect adulteration (Setiadi et al., 2022), and



*Image source: google images*

predict safety and quality (Wang et al., 2022; ). Another frequently used tool with AI is the electronic nose (E-nose), where AI models are trained with volatile compound data from the E-nose combined with chemical, microbiological, instrumental, and sensory test results to assess quality and predict microbial levels (Pulluri and Kumar et al., 2022). Despite the remarkable interest in AI and AI-integrated technological designs, the barriers to their

adoption and implementation have been less discussed compared to their potential benefits.

Furthermore, organisational and people-related managerial barriers have been insufficiently addressed and discussed in the existing literature. Besides, while the technical feasibility of these technologies is often studied, the adoption and implementation barriers are rarely examined from the perspective of relevant actors. Within this frame, the proposed research aims to investigate experienced and/or perceived barriers in adoption and/or implementation of AI technologies in the food quality and safety systems through a literature review and interviews with multi-actors (i.e., Quality assurance or control managers or engineers, food production managers or engineers, food safety auditors, AI tech solution providers, regulatory agency representatives, certification body representatives etc.).

##### **References**

- Przybyl, K., Gawrysiak-Witulska, M., Bielska, P., Rusinek, R., Gancarz, M., Dobrzański Jr, B., & Siger, A. (2023). Application of machine learning to assess the quality of food products—case study: Coffee bean. *Applied Sciences*, 13(19), 10786.
- Setiadi, I. C., Hatta, A. M., Koentjoro, S., Stendafity, S., Azizah, N. N., & Wijaya, W. Y. (2022). Adulteration detection in minced beef using low-cost color imaging system coupled with deep neural network. *Frontiers in Sustainable Food Systems*, 6, 1073969.
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## 15. Enhancing food safety through the use of data-embedded barcodes in food packaging: A study of labelling, traceability, and compliance regulations

**Supervisors:** Selcen Semercioz-Oduncuoglu (FQD) and Deniz Turan-Kunter (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality control and assurance, quality and food logistics

**Open to 1 student**

### Problem description

Food labelling and traceability are legally mandatory in the EU for all food and feed businesses. Labelling is crucial for providing specific information related to food safety (e.g., ingredients, intended use, batch number, shelf-life and storage conditions) and can influence consumer preferences and even national diets<sup>[15]</sup>.

A well-designed food traceability system is essential to identify the source of contamination and quickly recall affected products, prevent the spread of illness, manage allergens, and prevent the distribution of fraudulent products. Traceability systems can also provide detailed information about a product's origin, components, and processing history, which can enhance consumer safety. Although all these benefits of labelling and traceability, compliance with regulations still lacks sufficient motivation, especially among small and medium entrepreneurs. Although money and time are common barriers, there are more complex root causes.

Embedding data in barcodes on food packaging can be considered one of the tools in the digitalisation of food quality and safety management and may be a remedy to all these current problems related to



labelling, traceability and compliance with food safety regulations. Data-embedded barcodes would help ensure compliance with the strict regulations that food manufacturers are subjected to by providing accurate and detailed information (e.g., ingredients, production methods, and distribution etc.) on food products compared to traditional labels and tracking and tracing the food products from the farm to their final destination more easily, more efficiently and more accurately. This research topic will

focus on the potential of data-embedded barcodes to enhance food safety and quality management by improving labelling, traceability, and compliance with regulations in the food industry.

The research would involve analysing the current regulatory framework related to food labelling, traceability, and compliance in the chosen country or region, and evaluating how the use of data-embedded barcodes can help address any gaps or weaknesses in the current regulations and managerial activities. The research would also examine the potential benefits and challenges of implementing such a system, including the costs and technical feasibility of incorporating data-embedded barcodes in food packaging. Finally, the thesis might propose recommendations for optimising the use of data-embedded barcodes in food packaging to enhance food safety management and consumer protection. For these goals, the knowledge/data collection is planned as a combination of literature research, industry surveys, case studies, and cost analysis. To support these findings, related expert interviews would also be consulted about the data-embedded system implementation in food packaging.

## 16. Understanding factors affecting digital transformation in the auditing of food safety management systems

**Supervisors:** Piernel Luning (FQD) and Selcen Semercioz-Oduncuoglu (FQD)

**Building on previous MFQ thesis research:** Yes

**MFQ specialisations:** Quality control and assurance, quality management and entrepreneurship

**Open to 1 student**

### Problem description

In recent years, sustainably producing safe, high-quality food has become more challenging due to dynamic and competitive conditions in food supply chains. Digital transformation in food quality management seems to be a powerful tool for improving quality outputs, enabling proactive management of possibilities and risk mitigation. By integrating digital technologies (e.g. data processing, automation, blockchain, AI, etc.) companies can modernise and ease their quality management processes. Multiple food companies are now investing in the digitalisation of their food quality and safety control and assurance processes.



For example, traditional in-person audit processes can be time-consuming, specifically when the company's food safety management system is still (partially) paper-based, thus open to errors, less efficient and cannot always be done on-site. Digital transformation offers opportunities to enhance audit transparency and accuracy by using and integrating digital tools (e.g. mobile applications, blockchain-based data collection systems, automated data

analysis, real-time reporting, etc.). Virtual or remote digital technologies could enable auditing through the food supply chain, from farm to fork. Recently, various private standard owners have published remote and/or blended audit manuals (SGS, 2023; BRCGS, 2022; SQF, 2020; FSSC22000, 2020) e.g., when sites cannot be accessed because of serious events. However, digital transformation needs critical consideration on data security, data collection, and data integrity and requires additional employee training.



The study aims to gain insight into the factors influencing the digital transformation of auditing food safety management systems from different perspectives, such as private standard owners, auditors, and food companies. The research will build further on a previous explorative thesis project. Research activities could include developing a survey to get more quantitative insights into the use of tools in auditing and associated benefits and barriers, conducting in-depth interviews with multiple stakeholders for comparative analysis, or other methods. The topic will be further discussed at the start of the research.

## **17. Artificial intelligence in managerial decision-making: Exploring strategic use in food processing firms**

**Supervisor:** Maria Annosi (BMO)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality control and assurance, quality management and entrepreneurship

**Open to 1 student**

### **Problem description**

The growing integration of Artificial Intelligence (AI) into business operations is reshaping how decisions are made, particularly in data-intensive industries such as food processing. As these firms face increasing pressure to optimise efficiency, ensure quality, and drive innovation, AI offers tools for predictive analytics, real-time monitoring, and resource optimisation. Yet, the managerial use of AI is far from straightforward. This thesis aims to explore how AI is adopted and strategically utilised in managerial decision-making processes within food processing firms. It will examine which areas benefit most from AI (e.g., supply chain management, quality control, innovation) and how its use reshapes managerial roles, organisational routines, and learning.

Through a qualitative multiple-case study approach, including semi-structured interviews with managers and key decision-makers, the study will identify enablers, barriers, and strategic implications of AI-driven decision-making. The research seeks to provide theoretical insights into the intersection of digital technologies and organisational decision-making and offer practical recommendations to firms aiming to adopt AI responsibly and effectively. Ultimately, the thesis contributes to understanding how traditional sectors can leverage AI not just for automation, but for enhanced strategic agility.

## IV: Sustainable food production and use of new technologies

### Introduction

In recent years, the agricultural and food industry has come to recognise the transformative potential of technology in making food production more sustainable. As the global population grows and environmental concerns intensify, the pressure to produce more with less—less waste, less energy, less environmental impact—has never been greater. Against this backdrop, innovative technological solutions are emerging as powerful tools to support companies, especially small and medium-sized enterprises (SMEs), which often face resource constraints yet play a critical role in the food supply chain.

From preventing food waste to extending shelf life, technology is opening new frontiers. Advanced processing methods, smart storage solutions, and intelligent packaging systems are now being developed to combat spoilage and keep food fresh for longer. These innovations are particularly crucial given the perishable nature of many food products, which are often lost before they reach consumers. Fruits and vegetables, in particular, offer high recoverability. Their by-products, often discarded, can become raw materials for new food products. This circular approach not only reduces waste but also creates economic value and fosters innovation across the industry. Yet despite the promise, adopting these technologies remains slower than expected, and many companies hesitate to embrace innovation. Why is this the case?



To utilise the benefits of innovation, it is essential to conduct thorough research to uncover the factors influencing successful adoption—what motivates companies to innovate, what obstacles stand in their way, and what support mechanisms are most effective. Only by understanding these dynamics can we bridge the gap between technological potential and real-world impact.

## 18. Understanding causes of post-harvest losses in mango supply chain systems - Technology adoption challenges

**Supervisors:** Pieterneel Luning (FQD), Selcen Semercioz-Oduncuoglu (FQD), and Jonda Rendayu Neisyafitri, PhD (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** All specialisations

**Open to 2 students**

### Problem description

Mango fruit is strategic for Indonesia, contributing to the economic situation of the fruit production sector. However, quality defects causing post-harvest losses (PHL) compromise the sustainability of the mango supply chain. The adoption of technology-based tools could support quality control and mitigate food loss, but the adoption is still low. Understanding the factors driving these adoptions and the involvement of stakeholders is crucial for developing a more sustainable mango supply chain.



The PhD research, overall, aims to gain a deeper understanding of the technological and people-related root causes of PHL and understand the organisational structures and business environments necessary to facilitate the adoption of these technologies. Various directions for research are possible within the research. One thesis project aims to investigate factors influencing the adoption of modern/new technologies to improve quality control and mitigate PHL. Literature will be analysed, and the reasons behind the reluctance of mango actors to adopt innovative technologies will be explored by conducting in-depth interviews with the mango actors and other stakeholders in the broader mango supply chain network.

Another thesis topic aims to conduct a network analysis using Net-Map to investigate the stakeholders involved in the mango supply chain network (at the micro\*, meso and macro level), their roles in mango quality, their relations and influence in the network. The idea is to identify critical stakeholders that can facilitate the adoption of new technologies to enhance current quality control and reduce mango PHL. *\*Micro stakeholders are the direct actors in the supply chain; meso stakeholders are supporting organisations/enterprises (such as farmer associations, fertiliser/equipment suppliers, financial institutions, NGOs, and research institutes); and macro stakeholders are those involved in legislation and enforcement (such as; Ministry of Agriculture and National Standardisation Agency).*

### References

Van der Linden, N., Meerpoel, C., Schebesta, H., & Luning, P. (2025). Development of a digital Net-Map tool to analyse multi-stakeholder networks in risk analysis of emerging food safety issues. *Food Control*, 169, 110975.

Pilamala, Rosales A., Linnemann, A.R., & Luning, P.A. (2023). A Net-Map analysis to understand the roles and influences of stakeholders in street food safety- A study in Ecuador. *Food Control*, 154, 109966, <https://doi.org/10.1016/j.foodcont.2023.109966>

## **19. Exploring the integration of novel technology to extend the shelf life and reduce food waste in the food industry**

**Supervisors:** Giustina Pellegrini (BMO) and Giorgiana Catunescu (FQD)

**Building on previous MFQ thesis research:** No

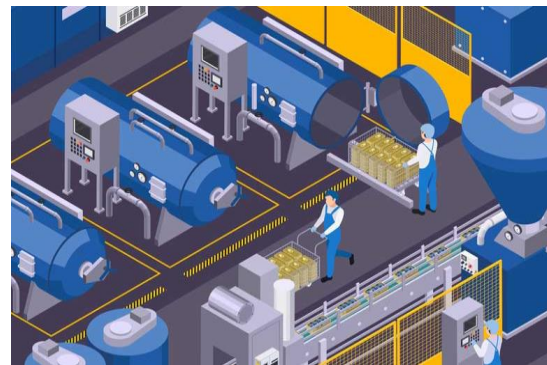
**MFQ specialisations:** Quality assurance and control, quality management and entrepreneurship

**Open to 2-3 students**

### **Problem description**

Food companies introduce novel processing technology to extend the shelf life of the product and reduce food waste, while maintaining or even enhancing product quality (e.g., higher nutritional value, improved taste). These are compelling reasons to implement processing technology. However, introducing new technology does not always guarantee the intended outcome.

The companies, especially agri-food SMEs, face two main challenges: (1) integrating the processing technology into existing processing activities and administrative procedures for operators (technology assimilation), and (2) aligning quality and shelf-life improvements with the preferences of the target consumer groups to maximise the opportunities presented by these technologies (business model innovation). Successfully addressing these challenges enables companies to gather the benefits of adopting new processing technologies. To optimise these processes and their interdependence, research into the factors influencing the successful introduction of processing technology is necessary.



Thus, the thesis aims to critically assess the factors encountered by agri-food business operators (FBOs) in general, and SMEs in particular, when integrating mild processing technologies both from a technological and a consumer-centred perspective. The research will include literature analysis, followed by expert interviews, and other relevant methods will be included. Based on the thesis results, recommendations will be developed for FBOs both for technology assimilation and the adoption of a new business model.

## 20. Sustainability of technological innovation in EU food systems

**Supervisors:** Giustina Pellegrini (BMO) and Giorgiana Catunescu (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality assurance and control, quality management and entrepreneurship

**Open to 1 student**

### Problem description

The EU food system is facing immense pressure to simultaneously improve its environmental, economic, and social sustainability across all aspects of the value chain. One of the main challenges is preserving the food quality, safety, and shelf life of perishable products like fruits and vegetables. Introducing technological innovations can be a crucial factor in addressing these sustainability challenges. However, companies, especially SMEs, often face difficulties in deciding whether to implement technological innovations due to uncertainties about their impact on sustainability.

This thesis aims to evaluate the sustainability impacts of innovative processing technologies systematically. The focus is primarily on the effects of these technologies on consumer-perceived quality, health, safety, and food waste reduction. By investigating the impact of these technologies on consumer-related aspects, the research aims to provide insights that can help develop strategies and interventions to promote sustainable production, improve consumer well-being, and reduce food waste by extending product shelf life. Food companies can use this information to make informed decisions on innovative processing technologies, contributing to the sustainability of the EU food system.



## 21. Sustainability integration: Transforming food quality management systems for resilience in dynamic business landscapes

**Supervisors:** Giustina Pellegrini (BMO) and Giorgiana Catunescu (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality assurance and control, quality management and entrepreneurship

**Open to 1 student**

### Problem description

The food industry is under increasing pressure to embrace sustainability due to environmental, social, and economic concerns. Companies are urged to integrate sustainability metrics into their quality management systems to meet these demands. This shift is driven by consumer awareness and stricter regulations, necessitating reevaluating business practices.



The thesis project aims to explore how sustainability metrics can seamlessly integrate into food quality management systems. This may involve revising existing quality management protocols, implementing new data collection and analysis procedures, and establishing performance indicators to monitor sustainability performance while maintaining the quality standard.

In addition, you could evaluate the impact of integrating sustainability metrics into food quality management systems on business resilience. This could focus on the main opportunities, obstacles, and strategies that food companies need to adopt to align their quality management practices with sustainability goals, fostering resilience in an evolving food business landscape and contributing to a more sustainable food industry. The methodology involves a blend of literature review, case study, and empirical research. It examines existing studies and real-world examples and conducts surveys or interviews. The thesis will build on the findings of the previous thesis student.

## 22. Quality monitoring and enhancement in the mango supply chain via smart packaging: A comparative study between Indonesia and the Netherlands

**Supervisors:** Deniz Turan-Kunter (FQD) and Iman Mas, PhD (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality assurance and control, quality management and entrepreneurship, quality and food logistics

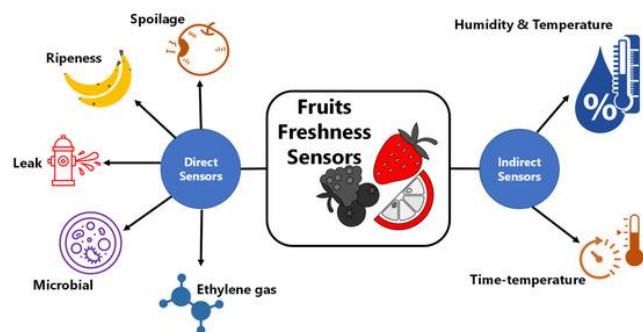
**Open to 1 student**

### Problem description

Mango is a tropical fruit, grown in over 91 countries, with top 5 producers in terms of yield being India, China, Indonesia, Pakistan and Mexico (Galán et al, 2025). However, the postharvest supply chain faces significant challenges in maintaining mango quality from harvest to consumer. Because of their high perishability, mangos require careful management to prevent postharvest losses, which can be up to 30% of the production as a result of improper handling, temperature fluctuations, and inefficient logistics (Martins Freitas et al, 2024). At the same time, advanced technologies such as IoT-based sensors and smart packaging are emerging as potential solutions to monitor and enhance the quality of perishable goods.

Overall, this PhD research seeks to understand the need as well as barriers and opportunities for adopting smart technologies in the mango supply chain, evaluate the cost-effectiveness of these innovations, and highlight the potential benefits for reducing food waste and enhancing sustainability. The findings will provide valuable insights into the need for IoT and smart packaging solutions and their practical application in improving mango quality monitoring and post-harvest management.

This MSc thesis explores the potential of IoT-based sensors and smart packaging to improve mango quality monitoring in the supply chain. It aims to identify key quality parameters that affect or are linked to its shelf life and investigate how these can be monitored in real-time using IoT sensors embedded in smart packaging systems. The study will also compare the need and adoption of these technologies in two contrasting regions via interviews with stakeholders in Indonesia, a developing market, and the Netherlands, a developed one.



### References

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- Martins Freitas, R., Silva Peixoto, L., Rodrigues de Oliveira, H., Resende, O., Rocha Plácido, G., Fonseca Souza, A., Moresco, K. S., & Romani, V. P. (2024). Biometric analysis of Palmer mangoes. *Comunicata Scientiae*, 15, e4255. <https://doi.org/10.14295/cs.v15.4255>
- Alam, A. U., Rathi, P., Beshai, H., Sarabha, G.K., and Deen, M.J. (2021), Fruit quality monitoring with smart packaging. *Sensors*, 21(4), 1509; <https://doi.org/10.3390/s21041509> (picture is from this paper)

## V: Sustainable food systems and novel protein production

### Introduction

The global food system faces significant challenges due to increasing population pressures, environmental degradation, and ethical concerns surrounding traditional food production methods. As the demand for sustainable food sources grows, there is a critical need to explore alternative protein sources, as well as ensure regional accessibility to affordable, healthy diets. This requires a comprehensive understanding of the complex value chains and regional factors that influence food production and consumption. Addressing these interconnected issues is essential for developing sustainable food systems that can meet future global nutritional needs while minimizing environmental impact.



### **23. Determining conditions to evaluate regional availability and accessibility of affordable and desirable foods for a sustainable, healthy diet**

**Supervisors:** Catriona Lakemond (FQD) and Giustina Pellegrini (BMO)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** Quality assurance and control, quality management and entrepreneurship

**Open to 1 student**

#### **Problem description**

Unhealthy diets are seen as a significant risk for death and disability-adjusted life years. To improve diets, the entire food system, from production up to disposal, needs to be considered. The food system itself is a leading cause of environmental degradation and depletion of natural resources. Hence, creating conditions for sustainable healthy diets doesn't only incorporate cooperation between supply chain partners but also involves consideration of the environment as well as social/cultural and economic aspects. In fact, food systems are embedded in a context amalgamated by historical, landscape, climatic, soil-related, religious, social, cultural and economic aspects. This depicts the uniqueness of sustainable healthy diets bound to geographic regions. For a region to be able to deal with the unique combination of regional, supply chain, environmental and resource-related characteristics, the conditions need to be shaped in such a manner that a regional availability and accessibility of affordable and desirable food for a sustainable, healthy diet are there. Hence, which kind of conditions determine and/or can be shaped to be able to have certain foods that together can present a sustainable healthy diet for the inhabitants?



## **VI: Consumer perceptions and product interactions**

## **24. Topics on “Consumer Studies”**

**Supervisors:** Bea Steenbekkers (FQD) and Pieter Groen (FQD)

**Building on previous MFQ thesis research:** No

**MFQ specialisation:** User-oriented food quality

**Open to 4 students who have preferably passed the course FQD33806, YSS31806 and/or YSS33306**

### **Problem description**

For this topic, you can choose a consumer food quality-related topic of your own choice. General guidelines for the topics are:

- Consumer perceptions and behaviour related to (innovative) food are involved
- The starting point should be the consumer-food product interaction, which might influence food quality
- The topic can be studied within different consumer segments and/or different contexts of use.

The final topic will be decided upon in consultation with the supervisor(s).

All topics have in common that they aim to get a deep understanding of consumer perceptions and behaviour, taking place in a certain daily-life context. Therefore, in most cases, qualitative research will be applied during your thesis. Some experience in doing qualitative research is thus required.

## VII: Food fraud – Elucidating food supply chain integrity

### Introduction

Food fraud is an emerging global issue that disturbs the normal market environment and a major concern not only for consumers (as end-users), but also for various supply chain actors as well as regulatory authorities. Food fraud is an ancient problem, with fraudsters becoming more sophisticated in their deceit in modern times. Food fraud activities result in considerable global monetary losses and erodes consumer confidence and trust in food products.

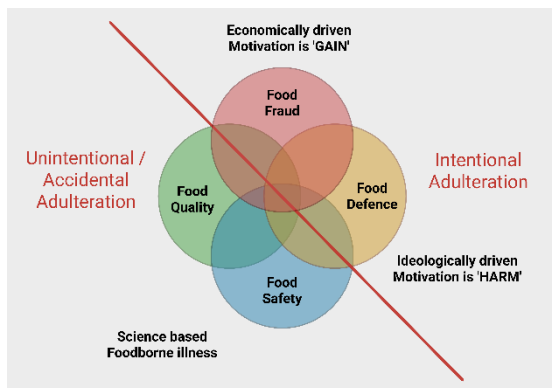


Image created with BioRender.com

Food fraud is defined by the Global Food Safety Initiative (GFSI) as “A collective term encompassing the deliberate and intentional substitution, addition, tampering or misrepresentation of food, food ingredients or food packaging, labeling, product information or false or misleading statements made about a product for economic gain that could impact consumer health.” (GFSI Benchmarking Requirements, 2017). The motivation behind food fraud is intentional and economically driven, where the crimes are defined as corporate or white-collar crimes. This implies that any plans and activities to

detect, mitigate, prevent, or even understand the risks associated with food fraud should consider an entire company’s activities, including some that may not be within the traditional food safety or even HACCP scope, applying methods closer to the criminal investigation. This means that when we study food fraud, we combine natural science with the social sciences to obtain a better understanding of food fraud.

Due to globalisation, food ingredients are sourced globally, while food supply chain networks have become more complex and adaptive in response to current worldwide incidents. There is also extra pressure to ensure that products from nature-positive agrifood production systems that enhance biodiversity and have lower environmental impacts do not fall victim to food fraud. The opportunities and motivations to commit fraud prevail, while the adequacy of controls is not always sufficient to deter fraud. Recently developed authentication techniques perform exceptionally well in detecting fraudulent, vulnerable food quality traits. However, rather than defending passively, an approach to actively prevent fraud crimes from happening in the early stage also needs to be investigated. This research topic on food fraud aims to investigate and provide research outcomes that can help to improve food supply chain integrity by elucidating risk factors (e.g., economic, societal, criminological, etc.) contributing to food fraud vulnerability and studying advances that can help in the fight against food fraud. The research will be conducted through the following topics described on the next pages.

## 25. Drivers and barriers of digital technologies implementation for fighting food fraud

**Supervisors:** Sara Erasmus (FQD)

**Building on previous MFQ thesis research:** Yes

**MFQ specialisations:** All specialisations

**Open to 1 student**

### Problem description

There are currently different types of digital technologies incorporated in the packaging of food products. These technologies, such as barcode, Quick Response (QR) code, and Radio Frequency Identification (RFID), play important roles in food delivery through the supply chain, transparency and integrity, marketing, and payment. For a review published by our team on QR codes, see the publication by Li et al. (2024). To be specific, a barcode, corresponding to a type of food product, is generally used to distinguish the food from others by entities in the supply chain; RFID enables identification of an object from a distance without requiring a line of sight and transmits measured environmental factors during food transportation, such as temperature and relative humidity; QR codes are attached on single food packaging and available to consumers, who can use their phone to scan for online information. GS1, a non-profit global organization, is working on further promoting the usage of technologies in the food sector.



Image by Li et al. (2024)

Digital technologies can contribute to food supervision.

Investigating the drivers and barriers to the implementation of identification technologies in the detection and prevention of food fraud is key to promoting their usage.

This topic will build on previous MFQ theses that have explored the use of digital technologies in the tuna, wine, and olive oil supply chains. It will further delve into the drivers/incentives and barriers to the usage of these identification technologies (other technologies can also be included) and propose mechanisms by which the implementation of these technologies can assist in the fight against food fraud.

### Reference

Li, P., Yang, J., Jiménez-Carvelo, A.M., & Erasmus, S.W. (2024). Applications of food packaging quick response codes in information transmission toward food supply chain integrity. *Trends in Food Science & Technology*, 146, 104384. <https://doi.org/10.1016/j.tifs.2024.104384>

## 26. Evaluating the cost/benefit aspects and barriers to implementation of food fraud research, prevention and detection practices, and innovations

**Supervisors:** Sara Erasmus (FQD) and Farah Aisyah Sukmawati (FQD)

**Building on previous MFQ thesis research:** Yes

**MFQ specialisations:** All specialisations

**Open to 1 student**



Image by <https://www.eff-cop.eu/>

### Problem description

Food fraud can be a threat to the global economy and public health (Moyer et al., 2017; Spink & Moyer, 2011), resulting in financial losses for the industry. Therefore, there have been substantial efforts to prevent and detect food fraud in the EU. Despite significant research and innovation (R&I) initiatives in the food fraud domain, there is still a disconnect between these R&I efforts and their implementation in practice to improve authenticity, traceability, and transparency in food systems (Lord et al., 2022). The European Food Fraud Community of Practice (EFF-CoP) is a new initiative funded by the EU, aimed at creating a sustainable ecosystem for food fraud prevention and detection research and innovation. The EFF-CoP project will mobilise its members, community of scientists, small- and large-sized businesses, regulatory agencies, laboratories, and other stakeholder groups to drive R&I, creating a future of greater traceability and integrity in our food supply chain. Several publications related to the cost-benefit aspects associated with the agri-food production (Bunduchi et al., 2011) and supply chain (Donnelly et al., 2013) exist. However, only a few studies have examined the cost-benefit aspects of the process to combat food fraud. You will work together with various stakeholder groups to evaluate the cost-benefit aspects and barriers to the implementation of food fraud research, prevention, and detection practices, and innovations. The inventory and map of the existing food fraud research, prevention, and detection practices, and innovations will be established before this research and will serve as the framework. Firstly, surveys and interview guides will be constructed. Next, surveys and semi-structured interviews with experts from the end-user/practitioner groups of EFF-CoP will be conducted to evaluate the cost-benefit aspects and potential barriers to implementing these practices and innovations.

### References

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- Donnelly, K.A.-M., Thakur, M., & Sakai, J. (2013). Following the mackerel – Cost and benefits of improved information exchange in food supply chains. *Food Control*, **33**(1), 25–31. <https://doi.org/10.1016/j.foodcont.2013.01.021>
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- Moyer, D.C., DeVries, J.W., & Spink, J. (2017). The economics of a food fraud incident – Case studies and examples including Melamine in Wheat Gluten. *Food Control*, **71**, 358–364. <https://doi.org/10.1016/j.foodcont.2016.07.015>
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## 27. Social networks and crime script analysis to combat food crimes

**Supervisors:** Sara Erasmus (FQD), Wim Huisman (Amsterdam Vrije Universiteit), and Annemieke Pustjens (WFSR)

**Building on previous MFQ thesis research:** Yes

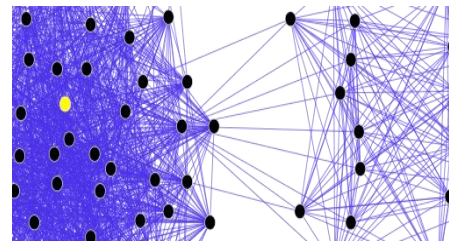
**MFQ specialisations:** Quality control and assurance, quality and food logistics

**Open to 1 student**

### Problem description

In the past years, the food fraud vulnerability assessment tool has been developed (van Ruth et al., 2017), and fraudulent company characteristics have been studied (van Ruth et al., 2021). Zhao et al. (2019) have conducted an empirical study on the supply chain adaptation to disruptions. Gomez et al (2021) studied how supply chain diversity fights against food shocks. Nonetheless, food fraud-oriented supply chain network mechanisms have not been extensively studied and can be considered a knowledge gap. To this end, crime script analysis can outline the consequential steps and actions that are undertaken to prepare for, engage in, and complete fraud crimes. Meanwhile, social network analysis as a developed tool can provide insights into social structures and supply chain actor interactions.

This topic will investigate the embedded mechanisms of fraud for a specific food product (to be decided) behind actors' social networks. The initial step is to build the food product's actors supply chain network. Afterwards, crime script analysis will be conducted to assess the opportunities and regulatory loopholes through previous food fraud cases. Social network analysis will then be implemented to identify the significant differences among their social networks and their critical nodes.



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Questionnaires oriented structural equation model and exponential random graph model will be utilized to provide insights into the relationships between social networks and food fraud crimes. The other approach for this topic would be to only focus on crime script analysis and conduct a study on online food fraud as presented by Holt and Lee (2022). This topic will build upon a previous FQD thesis that used crime script analysis for vegetable oils.

### References

- Gomez, M., Mejia, A., Ruddell, B.L., & Rushforth, R.R. (2021). Supply chain diversity buffers cities against food shocks. *Nature*, **595**(7866), 250-254.
- Holt, T.J., & Lee, J.R. (2022). A crime script analysis of counterfeit identity document procurement online. *Deviant Behavior*, **43**(3), 285–302. <https://doi.org/10.1080/01639625.2020.1825915>
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- van Ruth, S.M., & Nillesen, O. (2021). Which company characteristics make a food business at risk for food fraud? *Foods*, **10**(4), 842.
- Zhao, K., Zuo, Z., & Blackhurst, J.V. (2019). Modelling supply chain adaptation for disruptions: An empirically grounded complex adaptive systems approach. *Journal of Operations Management*, **65**(2), 190-212.

## 28. Tracing products from deforestation-free food systems – exploring the challenges that non-EU countries face

**Supervisors:** Sara Erasmus (FQD) and Farah Aisyah Sukmawati (FQD)

**Building on previous MFQ thesis research:** Yes

**MFQ specialisations:** All specialisations

**Open to 1-2 students**

### Problem description

The Regulation on Deforestation Free Products (EUDR) is an important turning point in the global fight against deforestation for several agrifood commodities, i.e., cattle, cocoa, soy, palm oil, and coffee. This is because the production of products from these commodities contributes to the expansion of agricultural land, which is a main driver of deforestation. The EUDR requires the global agrifood sector to be responsible for sustainable sourcing, providing proof that products do not originate from deforested land or have contributed to forest degradation. It has become a challenge for all supply chain actors to meet the legislative demands, especially in emerging countries where smallholders are vulnerable actors.

In the case of beef production, strengthening traceability is a strategic measure to dissociate ranching from illegal deforestation and contribute to global decarbonization efforts. Regarding imports and exports, Brazil has developed a cattle identification system, called SISBOV. Nevertheless, traceability still needs further development. Strategies to better monitor cattle traceability and test meat quality could leverage the livestock sector, which had suffered from different meat scandals i.e., “Carne Fraca” (“Weak Meat” investigation), impacting exportations to high standards markets like the EU. This



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topic will use qualitative data collection and interviews with industry professionals to identify challenges and create a supply chain map from farm to retailer, validated by area experts. Supply chain mapping and interviews will aim to identify areas of the Brazilian beef supply chain that lack the visibility required for management to guarantee sustainability, traceability, and product quality.

For palm oil production, it is vital to explore the traceability, authenticity, and sustainability gaps, and identify the potential benefits in the supply chain by addressing gaps in certification, regulations, and global and producing countries. This topic will explore these gaps by identifying and comparing the existing certifications and regulations in palm oil related to traceability and sustainability to EUDR requirements and technical guidelines; hence, the gaps between the current state and the expected outcome from EUDR, particularly in traceability and sustainability requirements, will be determined. Furthermore, gaps in global and producing countries are also necessary to include, providing a more comprehensive general and technical overview of traceability and sustainability. A similar study has been published by Cosimo et al. (2024) showing the gap analysis between voluntary standard schemes and EUDR.



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### Reference

Cosimo, L.H.E., Masiero, M., Mammadova, A., & Pettenella, D. (2024). Voluntary sustainability standards to cope with the new European Union regulation on deforestation-free products: A gap analysis. *Forest Policy and Economics*, **164**, 103235. <https://doi.org/10.1016/j.forpol.2024.103235>

## 29. Food fraud mitigation strategies in food-insecure and marginalized communities

**Supervisors:** Sara Erasmus (FQD)

**Building on previous MFQ thesis research:** Yes

**MFQ specialisations:** Quality control and assurance, user-oriented food quality, quality management and entrepreneurship

**Open to 1 student**

### Problem description

In low-income countries (LICs), food fraud is fuelled by factors such as inadequate surveillance systems, weak regulations, and policies. Investigating food fraud in LICs is crucial due to public health implication, lack of enforcement of food standards, the involvement of LICs in the chain, and the scarcity of food fraud research in LICs. Consequently, LICs contribute to the global burden of food fraud, where various foods are adulterated, counterfeited, or substituted for economic gains. Key food fraud main drivers are weak/poorly enforced regulations and policies coupled with corruption; poor/lack of effective surveillance systems; economic/financial constraints; demand exceeding supply (Gwenzi et al, 2023).



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This is also highly correlated with food insecurity because lack of food availability could increase food fraud risk. This food insecurity, fuelled by poverty, leads poor communities to purchase the lowest-priced food products to have more quantity gain. This creates an ideal opportunity for fraudsters to supply and sell fake and adulterated foods. Moreover, the bulk of the domestic food trade in LICs occurs via informal supply chains. This is characterized by low compliance with international standards, absence or non-enforcement of government regulations and limitations in technical expertise and infrastructure for food testing (Onyeaka et al, 2022). Although food fraud prevention frameworks

exist (Spink et al., 2019), their implementation remains limited in marginalized settings.

Understanding how food-insecure communities perceive and respond to food fraud risks is critical to addressing these vulnerabilities. Factors such as social norms, cultural practices, and economic constraints shape their awareness, understanding, and coping mechanisms. This topic builds on a previous thesis topic that investigated these perceptions and responses, filling a critical gap in knowledge and contributing to the development of targeted interventions to improve food safety and security in urban slums. You will expand on these new insights and aim to develop strategies and interventions for mitigating food fraud in food-insecure and marginalized communities. You can also decide to focus on one of the ten 'future research directions' as described by Gwenzi et al. (2023).

### References

- Gwenzi, W., Makuvara, Z., Marumure, J., Simbanegavi, T.T., Mukonza, S.S., & Chaukura, N. (2023). Chicanery in the food supply chain! Food fraud, mitigation, and research needs in low-income countries. *Trends in Food Science & Technology*, **136**, 194-223. <https://doi.org/10.1016/j.tifs.2023.03.027>
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- Spink, J., Chen, W., Zhang, G., & Speier-Pero, C. (2019). Introducing the food fraud prevention cycle (FFPC): A dynamic information management and strategic roadmap. *Food Control*, **105**, 233-241. <https://doi.org/10.1016/j.foodcont.2019.06.002>

### 30. Impact of sustainable food systems on the heritage food concept and product authenticity

**Supervisors:** Sara Erasmus (FQD), Omamuyovwi Dante Gbejewoh (Queens University, Kingston, Ontario, Canada), and Mohammad Almansouri (King Saud University, Riyadh, Saudi Arabia)

**Building on previous MFQ thesis research:** No

**MFQ specialisations:** All specialisations

**Open to 1 student**

#### Problem description

There is increasing pressure on the global food supply chain to become more sustainable. However, achieving sustainability is not an easy task, as sustainability is multifaceted, including dimensions of people/society, planet/environment, and profits/economics. A lot of focus is typically placed on the planet/environment dimension, especially relating to ethical concerns about conventional food production methods and providing alternative protein sources. With the pressure for food systems to become more sustainable, products and practices need to adapt accordingly, which could be detrimental to the authentic nature of a food product. Linking this specifically to the heritage food concept, that is defined according to the three dimensions of legacy ('anything that was transferred from the past to the present'), people ('group, society, and community'), and place ('country and geographical identity') (Almansouri et al., 2021), it is of interest to explore the effect of sustainability and alternative protein sources.

Heritage food also relates to food sovereignty, as they are interconnected concepts. Food sovereignty is grounded in six pillars: 1. the right to food and nutrition; 2. public policies that value and support small-scale food providers; 3. localised food systems; 4. local control over natural food-producing resources; 5. traditional knowledge; 6. agroecology. It emphasizes the right of communities to determine their own healthy and culturally appropriate food systems that produce food through ecologically sound and sustainable methods (Forum for Food Sovereignty, 2007). Integral is the idea of the need to foster environmental sustainability and social justice in food production and consumption (Almansouri et al., 2021). Agroecological food systems also align with this concept as it

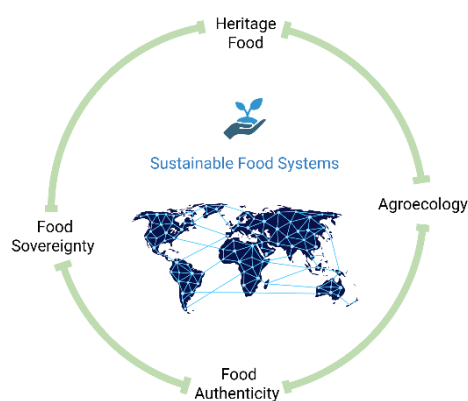


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create and manage diverse agricultural landscapes, sustain biodiversity, and maintain the cultural heritage.

Furthermore, the sustainable and ecologically sound practices associated with heritage food production align with the principles of agroecology.

This topic will explore, through a semi-structured literature review, the interconnectedness of the concepts of heritage food, food authenticity, food sovereignty, and agroecology, and how the transition to more sustainable food systems affect the heritage food concept (as defined by Almansouri et al., 2021) and the authenticity of these products. This can also be combined with semi-structured interviews with experts.

#### References

- Almansouri, M., Verkerk, R., Fogliano, V., & Luning, P.A. (2021). Exploration of heritage food concept. *Trends in Food Science & Technology*, **111**, 790-797. <https://doi.org/10.1016/j.tifs.2021.01.013>
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