

Strengthening the Business Case *for* Food Safety Management Systems

Report



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Foreword

Food safety is not only a regulatory imperative; it is a cornerstone of sustainable business growth, market access, and public trust. In an era marked by increasingly complex supply chains and heightened consumer expectations, food businesses face mounting pressure to demonstrate both compliance and value creation through robust food safety management systems. This report, "Strengthening the Business Case for Food Safety Management Systems", challenges the traditional narrative that views food safety management systems merely as a cost of doing business. Instead, it reframes FSMS as strategic investments essential for long-term competitiveness. By introducing the risk-adjusted return on investment (RAROI) framework, the study bridges the communication and skill gap between food safety/quality assurance and finance teams, offering a practical tools to quantify the economic benefits of food safety and justify investments in FSMS.

This report aligns closely with the World Bank Group's strategic commitment to advancing food safety, public health, and sustainable economic development. By emphasizing the role of Food Safety Management Systems as catalysts for operational excellence and market competitiveness, the study supports the World Bank's broader objectives of reducing poverty, enhancing food security, and fostering resilient supply chains in low- and middle-income countries. The introduction of the risk-adjusted return on investment (RAROI) framework and practical tools for measuring FSMS impact directly contribute to the World Bank's efforts to promote evidence-based decision-making, capacity building, and investment in food safety infrastructure. As part of the World Bank Group ongoing initiatives, this report provides actionable insights that empower food businesses and policymakers to drive meaningful improvements in food safety, economic growth, and global trade.

This report also reflects the International Finance Corporation's (IFC) strategic approach to investing in agribusiness as a driver of inclusive growth, innovation, and food security. IFC's investment strategy prioritizes the adoption of robust food safety management systems to enhance the competitiveness and sustainability of agribusinesses across emerging markets. By supporting the implementation of FSMSs, IFC aims to unlock access to premium markets, attract private sector investment, and strengthen supply chain resilience.

The report presented here is especially relevant for food businesses operating in dynamic and resource-constrained environments. It underscores the importance of integrating FSMS planning with strategic business objectives and continuous improvement, supported by clear performance indicators and transparent communication. As the food industry continues to evolve, the findings and frameworks in this report will serve as a valuable resource for those seeking to strengthen their food safety practices and unlock new opportunities for growth and competitiveness.

Anup Jagwani,
WBG Director, Farming and Agribusiness

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Abbreviations

| | |
|------------|--|
| FDA..... | Food and Drug Administration (United States) |
| FSMS..... | Food Safety Management System |
| FSSC..... | Food Safety System Certification |
| GFSI..... | Global Food Safety Initiative |
| HACCP..... | Hazard Analysis Critical Control Point |
| IFC..... | International Finance Corporation |
| KPI..... | Key Performance Indicator |
| RAROI..... | Risk-Adjusted Return On Investment |
| ROI..... | Return On Investment |
| SMEs..... | Small and Medium Enterprises |

Abstract

Food Safety Management Systems (FSMSs), including approaches based on hazard analysis critical control point (HACCP) and standards such as Food Safety System Certification (FSSC) 22000, have been widely adopted by food businesses to comply with regulatory requirements. However, their broader strategic and financial value remains underexplored. This study addresses the gap by evaluating the return on investment (ROI) of FSMSs and reframing them as value-generating systems rather than purely compliance mechanisms. Drawing primarily on peer-reviewed studies and case analyses, the review synthesizes the evidence on the financial and nonfinancial outcomes of FSMS implementation. Key benefits identified include cost avoidance through risk reduction, operational efficiency gains, and increased revenue through expanded market access. Meanwhile, barriers such as high implementation costs, limited internal capacity, and the absence of standardized ROI metrics constrain broader adoption. To respond to these constraints and support a more strategic

integration of FSMSs, the paper introduces the risk-adjusted return on investment (RAROI) framework for FSMSs, which encompasses implementation costs, operational improvements, market value creation, and risk reduction. The paper also proposes a set of performance indicators to help firms track and validate the impact of FSMSs. Case studies from the International Finance Corporation's (IFC) Food Safety Advisory Services and a literature case study illustrate how even modest food safety investments can yield substantial business returns. Ultimately, this study calls for a shift in perspective to position FSMSs as strategic business enablers essential to long-term competitiveness, risk management, and supply chain resilience.



1

Introduction

Estimates place the economic burden of food safety failures at more than US\$110 billion annually in low- and middle-income countries alone, driven by medical expenditures, productivity losses, and trade disruptions (Jaffee et al. 2019). A single contamination event at a food business can lead to a widespread recall, a supply chain breakdown, and long-term reputational damage. While food business operators often view regulatory compliance as the primary impetus for implementing food safety practices, there is growing recognition that Food Safety Management System (FSMS) certification, such as Food Safety System Certification (FSSC) 22000, hazard analysis critical control point (HACCP), and other certifications aligned with the Global Food Safety Initiative (GFSI), also deliver measurable business value by helping reduce risk, enhance efficiency, and expand market access.

An FSMS framework, such as schemes recognized through an HACCP, FSSC 22000, or GFSI process, provide structured, proactive mechanisms for identifying and mitigating food safety risks across operations. Though traditionally perceived as a tool among cost centers or to promote compliance, FSMSs are increasingly being acknowledged for their broad impact on operational performance, market access, brand value, risk reduction, and financial resilience (Radu et al. 2023).

Nonetheless, while much of the literature addresses the public health rationale and regulatory imperatives of food safety management, few studies explore the value created by FSMSs among food businesses, particularly in terms of financial returns. Studies often quantify the cost of illness or the regulatory burden of noncompliance, but rarely assess how an FSMS may drive long-term business performance. This gap in the literature reflects a broader disinclination to frame the FSMS as a strategic investment rather than a mandatory expense (Becot et al. 2021; Liu et al. 2021).

This study addresses the gap by aggregating recent empirical evidence on the returns on investment (ROIs) in an FSMS and offering a practical framework to businesses for the calculation and communication of the financial benefits of an FSMS. By repositioning an FSMS as an investment rather than an obligation, this study highlights the potential of an FSMS to drive sustainable value creation across diverse food industry environments.

The study synthesizes the current literature on FSMS-related ROI to evaluate financial and nonfinancial outcomes. It supports food business leaders and stakeholders in making informed, investment-oriented decisions about FSMSs. By introducing a practical ROI framework, it situates FSMSs as compliance mechanisms but also as strategic tools for improving operational performance, resilience, and long-term value creation.



2

Objectives *and* Scope

The literature review embodied in this study addresses the following research questions:

- What are the key motivations for adopting an FSMS?
- What nonfinancial and financial benefits result from FSMS implementation?
- What are the current barriers to FSMS implementation?
- What methodologies have been used to evaluate FSMS ROI, and what are the strengths and limitations of these methodologies?
- What are the gaps in the current research on FSMS ROI?
- How can businesses apply the ROI framework to communicate and validate FSMS ROI effectively?

The focus of the literature review includes peer-reviewed studies, case-based analyses, and publications on policy. Sources have been selected for their relevance to the financial, operational, and reputational implications of FSMS implementation within the food industry and spanning the global supply chain from primary production to retail. While most of the studies reviewed have been published within the last five years, the review has been expanded in areas in which the recent research is limited.



3

Methodology

Literature searches have been conducted across academic databases, including Google Scholar, PubMed, Scopus, and Web of Science.¹ Supplemental gray literature has been reviewed by reputable institutions, such as the Food and Agriculture Organization of the United Nations, the World Health Organization, and industry-focused organizations, including the GFSI.² The searches have also involved citation chaining and reference list mining to identify additional relevant studies.

Sources have been selected if they address the implementation of an FSMS, relevant certification schemes, or outcomes related to business performance. Additionally, the review has targeted studies involving stakeholders across the global food supply chain and has prioritized studies offering empirical, case-based, or economic data meaningful for the ROI. Exclusion criteria have included non-English language publications (because of resource constraints) and commentary lacking peer review.

Search terms have included food safety management system, FSMS, HACCP, ISO 22000, return on investment, key performance indicator (KPI), economic benefit, cost-effectiveness, market access, and business case.³ The research has relied on Boolean operators to refine searches by keyword proximity and publication year.

Thematic synthesis has been used to organize insights across five major domains: (1) motivations for FSMS adoption, (2) financial and nonfinancial outcomes, (3) barriers to FSMS adoption, (4) frameworks used to assess the ROI, and (5) food safety KPIs. Particular attention has been paid to studies offering empirical or case-based financial estimates to strengthen practical application. Gaps in ROI measurement approaches have also been noted.

¹ Refer to Google Scholar (portal), Google, Mountain View, CA, <https://scholar.google.com/>; PubMed (database), National Center for Biotechnology Information, US National Library of Medicine, Bethesda, MD, <https://www.ncbi.nlm.nih.gov/pubmed>; Scopus (dashboard), Elsevier, Amsterdam, <https://www.elsevier.com/products/scopus>; WoS (Web of Science) (platform), Clarivate, London and Philadelphia, <https://clarivate.com/academia-government/scientific-and-academic-research/research-discovery-and-referencing/web-of-science/>.

² For instance, refer to GFSI (Global Food Safety Initiative) (website), Consumer Goods Forum, Levallois-Perret, France, <https://mygfsi.com/>; INFOSAN (International Food Safety Authorities Network) (dashboard), Food and Agriculture Organization of the United Nations, Rome; World Health Organization, Geneva, <https://www.fao.org/food-safety/emergencies/infosan/en/>.

³ For ISO 22000, refer to ISO 22000:2018(en), Food Safety Management Systems: Requirements for Any Organization in the Food Chain, International Organization for Standardization, <https://www.iso.org/obp/ui/#iso:std:iso:22000:ed-2:vi:en>.



4

Literature Review

4.1 Food Safety Management Systems

FSMSs are critical in safeguarding public health, upholding food safety standards, and ensuring the reliability of food supply chains. An FSMS offers a structured, science-based framework for identifying, assessing, and controlling food safety hazards across the production and distribution process. If implemented effectively, FSMSs contribute to improved, more efficient operations and enhanced business performance (Arshad et al. 2023). They also support resilience by enabling companies to respond more effectively to emerging risks (Tibebu, Tamrat, and Bahiru 2024). As food systems become more complex, FSMSs function as a critical mechanism for aligning operational control with regulatory processes and consumer expectations.

Internationally recognized standards provide the foundation for FSMS implementation. These include systems such as HACCP, ISO 22000, and certification schemes benchmarked by the GFSI (Chen, Ping, and Liang 2023; Radu et al. 2023). Supporting these systems are prerequisite programs, such as good manufacturing practices and good agricultural practices, which provide baseline hygiene and production protocols (Lee et al. 2021). While good manufacturing and good agricultural practices focus on general food safety conditions, an FSMS framework offers a comprehensive

structure for managing risks and driving steady improvement (Radu et al. 2023). The worldwide acceptance of GFSI-benchmarked certification reflects an industry consensus on food safety and has positioned the FSMS as a strategic tool for enhancing food safety and market credibility (Granja 2022).

A food business must tailor the implementation of its FSMS to the various unique risk profiles and operational realities of the food sector. Customization is required to control hazards that vary widely across commodities and processing methods. For example, the microbial risks in fresh produce differ from the microbial risks in meat or dairy production (Jeffer et al. 2021). The geographic context, the available infrastructure, and the complexity of the supply chain shape FSMS requirements (Radu et al. 2023). Adaptive implementation strategies can improve compliance and operational outcomes, particularly in resource-constrained environments (Boulfoul and Brabez 2022; Duong, Nguyen, and Hoang 2023). Given the sector-specific complexities of FSMS implementation, access to technical assistance emerges as a critical enabler for success, particularly if internal expertise or infrastructure are limited.

4.2 Food Safety Advisory Services

External food safety consultants can fill gaps in internal capabilities by providing training, documentation support, and audit preparation. Engaging consultants may be especially beneficial if a business faces a complex certification process or lacks in-house expertise (Abebe et al. 2020). Often supported by public-private partnerships and industry-led development programs, access to consulting services has contributed to broader FSMS take-

up (Charalambous et al. 2015). Effective engagement with food safety consultants can promote alignment between leadership and operations, reinforcing the food safety culture and continuous improvement (Wilcock, Ball, and Fajumo 2011). Technical support can facilitate implementation, but the decision to adopt an FSMS is ultimately shaped by various business drivers, including the need for regulatory compliance, market access, and competitive positioning.

4.3 Motivations for Adopting FSMS

Compliance with food safety regulations remains a key motivation of FSMS implementation. Firms are increasingly recognizing that an FSMS is a tool to achieve market access, risk reduction, and competitive positioning. Understanding why food business operators seek FSMS certification is essential to gauging the expected ROI.

Compliance with national and international food safety regulations is a foundational driver of FSMS adoption. Regulatory bodies and trade agreements frequently now require systematic, auditable controls, especially in export-oriented sectors. Firms with an established FSMS can position themselves to meet the evolving demands and navigate regulatory inspections with confidence (Abebe et al. 2020). ISO 22000–certified companies, for example, have demonstrated lower rates of noncompliance and reduced exposure to penalties (Rihawi 2024). Proactive compliance also protects business continuity. Fitzsimmons, Kinchla, and Allingham (2024) observe that small and medium enterprises (SMEs) operating under the US Food Safety Modernization Act experienced smoother implementation and fewer regulatory disruptions if they had adopted structured food safety systems. While regulatory compliance is the basis of FSMS adoption, market access and customer expectations often serve as strategic incentives for FSMS certification.

FSMS certification has become a prerequisite for entry into high-value supply chains in many sectors. Large retailers, manufacturers, and institutional buyers often require certification to ensure traceability and reduce sourcing risks.

Certified food businesses are more likely to secure contracts with these buyers and participate in export markets (Arshad et al. 2023). As Tibebu, Tamrat, and Bahiru (2024) note, robust food safety systems satisfy market expectations and enhance alignment with trade and regulatory frameworks. The research of Ebata, Espinoza, and Ton (2025) highlights that certified firms can gain preferential treatment in procurement decisions, especially in sectors where food safety is tightly regulated and consumer trust is vital. Along with market incentives, risk management remains a core motivation for FSMS adoption, reflecting reactive responses to previous challenges and proactive efforts to safeguard operations.

An FSMS provides the structure to manage food safety risks proactively before they escalate into operational or reputational crises. Core system components, such as hazard analysis, traceability, and verification, reduce the likelihood and severity of contamination incidents. Firms with these controls are more resilient and more well equipped to respond to incidents (Kafetzopoulos, Psomas, and Kafetzopoulos 2013). FSSC 22000, in particular, emphasizes a risk-based approach that integrates food safety into broader operational planning. Failing to manage the risks can threaten international trade relationships and undermine buyer confidence, especially in highly regulated markets (Tibebu, Tamrat, and Bahiru 2024).

4.4 The Benefits of FSMS Implementation

An FSMS delivers tangible business benefits beyond regulatory compliance. These benefits include reduced financial risk, enhanced operational performance, improved market positioning, stronger customer relationships, and long-term cost savings. The following subsections summarize key outcomes documented in the literature that illustrate how an FSMS serves as a value-generating investment.

4.4.1 Financial Benefits

The capacity of an FSMS to reduce exposure to costly food safety failures is a key benefit. Through structured hazard analysis, preventive controls, and verification systems, an FSMS reduces the risk of contamination incidents, product recalls, and regulatory sanctions. Gomez and Marks (2020) find that Class I recalls in the low-moisture food sector led to median corporate losses of US\$243 million and estimate that a company that undertook preventive technologies would save more than US\$2 million annually in avoided costs.⁴ Similarly, Spalding et al. (2023) report that the 2018 romaine lettuce-associated *E. coli* outbreak resulted in economic losses exceeding US\$343 million in the United States, much of which could have been prevented with stronger traceability systems. Tibebe, Tamrat, and Bahiru (2024) emphasize that poor risk management leads to direct losses and can destabilize trade relationships. These findings highlight the value that an FSMS creates by safeguarding against the financial and operational disruption caused by food safety failures.

FSMS certification is increasingly required for access to high-value and export markets. Large retailers, institutional buyers, and export partners routinely mandate certification under schemes such as HACCP, ISO 22000, or other GFSI-aligned programs. Arshad et al. (2023) demonstrate

that smallholder dairy producers who adopt food safety standards gain access to new markets and secure stronger contract terms. Tibebe, Tamrat, and Bahiru (2024) observe that firms with an FSMS are more likely to comply with international trade regulations and less likely to experience shipment rejections. In a study of Turkish firms, Tunaer Vural and Akgüngör (2015) conclude that ISO 22000 certification led to a 37 percent increase in vegetable exports and a 53 percent increase in fruit exports and that this is direct financial evidence of the ability of FSMS adoption to enhance export performance in competitive agricultural markets. Such positive market outcomes show that an FSMS can help businesses access new markets and build a strong reputation that justifies higher prices.

Food businesses that implement an FSMS realize financially quantifiable operational gains, primarily through improved process consistency, reduced waste, and efficiency-enhancing standardization. FSMSs promote structured workflows, minimize rework, and reinforce quality assurance systems, which directly translates into cost savings. For example, El-Tanboly et al. (2021) document significant reductions in material waste and improved output stability at an Egyptian food manufacturer following HACCP implementation. Duong, Nguyen, and Hoang (2023) link formal FSMS elements, such as documented procedures, targeted staff training, and internal audits, to measurable improvements in productivity and cost control across food firms in China and Viet Nam. Similarly, Rihawi (2024) reports that ISO 22000 certification leads to enhanced production throughput and fewer noncompliance penalties and contributes to higher operational margins. Collectively, these findings highlight FSMSs as catalysts for measurable operational gains.

FSMSs enhance process reliability by reducing variability and enforcing consistent operational standards. Standardized protocols, critical control point monitoring, and routine audits lower the risk of deviation and ensure uniform product quality. Lee et al. (2023) find that HACCP systems help food firms improve cost management, increase product safety, and enhance conditions among workers. Fitzsimmons, Kinchla, and Allingham (2024) observe that

⁴ A Class I food recall is the most serious recall classification. It refers to the reasonable probability that consumption of or exposure to a product will lead to serious adverse health consequences or death. Examples include consumption of or exposure to food containing undeclared allergens, such as eggs or peanuts, that may cause life-threatening allergic reactions or food contaminated with dangerous pathogens, such as *Listeria* or *Salmonella*.

certified firms experience fewer customer complaints, more consistent performance indicators, and enhanced brand stability. Radu et al. (2023) emphasize that FSMSs foster crossfunctional alignment, clarify responsibilities, and reduce coordination inefficiencies. These studies affirm the FSMS as a strategic tool for food safety, quality assurance, and sustained, cost-effective operations.

In addition to the internal cost savings derived from improved operations, an FSMS can elevate a company's financial position by supporting market expansion and attracting external investment. By enabling compliance with international standards and buyer requirements, an FSMS helps firms access higher-value export markets and participate in global supply chains. Certification and improved traceability systems signal strong operational control and risk management, qualities that increase credibility with financial institutions, investors, and commercial partners. Across a portfolio of food businesses, improved food safety practices are associated with US\$478 million in new sales and US\$564 million in external investment (IFC 2020). While these financial outcomes are compelling, FSMS adoption also delivers several nonfinancial benefits that reinforce long-term business resilience and stakeholder trust.

4.4.2 Nonfinancial Benefits

A key nonfinancial benefit of an FSMS is its role in strengthening the organizational culture associated with accountability and continuous improvement. Systems such as HACCP and ISO 22000 tend to embed standard operating procedures, documentation protocols, and verification checks that shape staff routines and reinforce safety-focused behavior. Awuchi (2023) notes that a structured FSMS framework fosters discipline, teamwork, and professional development within food firms. Boulfoul and Brabez (2022) conclude that FSMS implementation among Algerian companies improved hygiene awareness and communication among workers. Spagnoli et al. (2024) observe that food safety culture maturity positively influences inspection outcomes and employee performance. These findings highlight that an FSMS may contribute appreciably to long-term organizational learning and behavior change.

An FSMS can also enhance the ability of companies to navigate a complex and evolving regulatory environment. By standardizing documentation, traceability, and reporting procedures, these systems improve audit readiness and reduce the risk of nonconformance. Nair et al. (2023) demonstrate that a small-scale Indian food manufacturer was able to achieve a 97 percent compliance score under the US Foreign Supplier Verification Program following FSMS certification. This outcome was linked to the resulting improved procedural controls and documentation. Fajarwaty and Jukes (2022) identify persistent compliance challenges among Indonesian SMEs and suggest that structured systems such as the FSMS could address gaps in regulatory awareness and inspection preparedness. Williamson, Pugh, and Akinbote (2024) find that firms with structured food safety approaches are better equipped to meet hygiene standards across diverse jurisdictions, particularly in settings with inconsistent enforcement. Farné (2020) emphasizes that FSMS-integrated traceability supports precise recall execution, a critical component of regulatory compliance. Together, these findings affirm that the FSMS is a strategic tool that helps firms achieve regulatory alignment, reduce inspection burdens, and strengthen legal resilience in global markets.

While FSMSs are primarily designed to ensure food safety, growing evidence shows they can support broader outcomes that are sustainable. Varyvoda et al. (2021) document that, across case studies in Ethiopia, Nepal, and Senegal, structured food safety practices aligned with FSMS principles enable small-scale food entrepreneurs to formalize operations, create jobs, and improve worker safety and public health. Similarly, Purwanto et al. (2020) find that companies combining FSMS with environmental and quality management systems achieve better business performance, including reduced noncompliance and higher customer satisfaction, while aligning more closely with sustainability goals. Together, these studies suggest that, while FSMSs are not frameworks for environmental, social, and governance principles, they may act as foundational tools for advancing responsible, resilient, and socially inclusive food systems, particularly if they are integrated within broader sustainability strategies.

4.5 Barriers to FSMS Implementation

Many food businesses face significant challenges in building and maintaining the technical capacity required for an effective FSMS. A lack of foundational expertise in hazard analysis, critical control point monitoring, and documentation procedures often hinders compliance with HACCP and food safety standards. These knowledge gaps can result in incomplete system implementation, which undermines regulatory compliance and operational performance. Studies have highlighted that limited internal expertise frequently forces companies to rely on external consultants, thus raising operational costs and reducing opportunities for internal skill development (Amer 2024; Fitzsimmons, Kinchla, and Allingham 2024). Duong, Nguyen, and Hoang (2023) report that firms in China and Viet Nam struggle with FSMS implementation because of insufficient technical infrastructure and fragmented coordination across departments. Alkhafaji and Herrera (2021) similarly note that firms delayed FSMS adoption in Iraq because of high consultancy costs and a lack of qualified personnel. These challenges reveal that technical capacity constraints represent persistent and systemic obstacles to implementing FSMS across the global supply chain.

Implementing an FSMS often requires a fundamental shift in organizational culture, from reactive informal practices to proactive standardized procedures. This transition may provoke resistance, particularly in family-owned or informal enterprises dominated by long-standing routines, and in which food safety is considered a regulatory obligation rather than a strategic priority (Granja 2022). Resistance to change frequently becomes manifest as employee reluctance, limited cross-functional communication, and superficial engagement with new systems (Radu et al. 2023). These challenges undermine training and reduce the long-term effectiveness of FSMS adoption. Research suggests that successful implementation depends on formal training, but also on fostering internal commitment. Spagnoli et al. (2024) observe that greater investment in food safety is only translated into improved outcomes if it is aligned with a strong internal food safety culture. These findings highlight that overcoming resistance requires visible leadership, sustained internal messaging, and a long-term commitment to embedding food safety among an organization's values

and day-to-day operations.

The perceived and actual costs of implementing an FSMS are a primary barrier to adoption, particularly among SMEs. Initial expenditures, such as staff training, infrastructure upgrades, equipment, product testing, and certification fees, can be prohibitive. Boulfoul and Brabez (2022) identify these factors as key deterrents to sustained FSMS engagement, especially in a resource-constrained environment. El-Tanboly et al. (2021) report that, in the Arab Republic of Egypt, HACCP implementation requires an initial investment of LE 65,200 per firm, equivalent to approximately US\$3,912 at 2021 exchange rates, including establishment of a laboratory, training, and documentation processes. The cost of regulatory compliance may also contribute significantly to the overall burden. Engle et al. (2023) find that regulatory costs account for 15 percent of total production costs among aquaculture firms, and this limits reinvestment in food safety improvements. For firms operating on narrow margins, these expenditures often compete with other core business needs, reinforcing the reluctance to initiate or expand the FSMS.

The recurring costs associated with FSMS maintenance also present substantial challenges. These include the cost of regular audits, third-party verification, recordkeeping, corrective actions, and consultant fees, the control of which may be perceived as challenging and always necessary. Fitzsimmons, Kinchla, and Allingham (2024) find that SMEs frequently cite these ongoing financial demands as a leading deterrent, even if they understand the potential benefits of preventive systems. Arshad et al. (2023) note that, while the long-term gains are evident in their case studies, firms lack the liquidity to sustain these expenditures. Nugroho et al. (2022) emphasize that certification-related implementation costs alone were sufficient to delay FSMS adoption among Indonesian producers, primarily because buyers did not provide technical or financial support. These findings indicate that, among many firms, cost-related hesitation is rooted in affordability, but also in uncertainty about duration, predictability, and the ROI.

Beyond actual budget limitations, many firms face challenges in estimating the financial requirements of FSMS implementation. Fitzsimmons, Kinchla, and Allingham (2024) find that 69 percent of participants believed that food safety upgrades were unaffordable or would require external assistance before training. This perception was attributed, in part, to a lack of internal cost estimation capacity. Inaccurate assumptions about cost magnitude or timing can lead to delayed adoption or underinvestment, even if the expected return is positive. Arshad et al. (2023) observe that, although long-term returns are evident in their sample, immediate budget constraints often delayed implementation. Without the tools to evaluate long-term benefits against short-term costs, firms may forgo changes that enhance performance and competitiveness.

Although these cost-related challenges are substantial, they are not insurmountable. If leaders frame FSMS

implementation as a staged investment with measurable returns, rather than a regulatory burden, firms will be more appropriately positioned to make informed decisions. Evidence suggests that FSMS adoption contributes to reduced product loss, improved efficiency, avoidance of regulatory and reputational risks, and access to high-value markets (Amer 2024; Duong, Nguyen, and Hoang 2023; Liu et al. 2021). These outcomes reflect operational gains and reduced exposure to costly disruptions, such as product recalls, noncompliance penalties, and supply chain delisting. Estimating these returns is critical to strengthening the business case for FSMS implementation. The following subsection examines established methods for quantifying the ROI in FSMSs and KPIs relevant to decision-makers across the food supply chain.

4.6 Return on Investment

This subsection provides a broad overview of the ROI. It traces the conceptual development and diverse applications. This is followed by a review of food safety-related financial metrics. The subsection then explores how the ROI can be applied to an FSMS and offers insight into how businesses can assess the financial and strategic value of food safety investments.

The ROI is widely used to measure the financial return generated by a strategic initiative relative to the cost. It helps businesses assess whether an investment creates net value. It is typically calculated as follows:

$$\text{ROI} = (\text{net gain} - \text{total cost}) / \text{total cost} \times 100\% \quad (4.1)$$

The ROI enables organizations to prioritize resources, compare investment alternatives, and measure performance over time. Initially applied in capital finance, the use of the ROI has expanded across sectors, from workforce training and infrastructure upgrades to digital marketing and sustainability initiatives (Patrocínio, Madaleno, and Nogueira 2024). The ROI measure is critical for food businesses if firms are navigating the pressure to invest while remaining cost efficient and in compliance.

A wide range of financial measures appear in the food safety literature. While most are not explicitly designed to assess the ROI, they help quantify the economic and societal impacts of food safety interventions. The methods

include cost-of-illness models, cost-benefit analyses, partial budgeting, and event studies. Their complexity, data needs, and capacity to capture value vary. Table 1 outlines common economic tools. It distinguishes between those that measure the burden of food safety failure (for example, illness, recalls) and those that estimate the value of preventive investments (for instance, cost-benefit analysis, the ROI). To contextualize the ROI within the broader landscape of food safety economics, it summarizes the financial evaluation methods used in the literature. These metrics highlight the range of tools available to quantify the costs of food safety failure and the benefits of preventive investments.

Table 1

Food Safety–Related Economic Measures

| Method | Type | Focus | Description | Pros | Cons | References |
|--|---------------|-------------------|--|--|---|---|
| Cost of illness | Public health | Burden of failure | Sums up medical, nonmedical, and indirect costs to quantify economic burden of foodborne illness | Provides a comprehensive measure of economic burden; widely used in public health | Does not directly capture benefits of preventive measures; requires conversion to investment terms | Hoffmann and Ahn (2021) |
| Disability-adjusted life years | Public health | Burden of failure | Estimates total healthy life years lost because of illness or premature death | Enables comparison across health impacts; a standard global health metric | Does not yield monetary values; requires assumptions for financial conversion | Focker and van der Fels-Klerx (2020); USDA (2001) |
| Quality-adjusted life years | Public health | Burden of failure | Accounts for the quality and quantity of life lost because of foodborne illness | Widely used in health care economics; compares benefits across interventions | Complex to monetize; quality-of-life values can be subjective | Focker and van der Fels-Klerx (2020); USDA (2001) |
| Cost-benefit analysis | Mixed | Prevention value | Compares all monetary costs associated with food safety interventions against quantified benefits to yield a net benefit or benefit-cost ratio | Widely understood; provides a single ratio to justify investments; can integrate various cost and benefit elements | Difficult to quantify intangible benefits (for instance, consumer trust, reputation); sensitive to assumptions and data quality; limited in comparisons across multiple investments | Bovay (2023); Golan et al. (2000) |
| Cumulative abnormal returns | Business | Burden of failure | Assesses recall impact on firm performance using market-based financial comparisons | Utilizes real-time market data; effective with public firms | Limited to publicly traded firms; influenced by broader market activity | Gomez and Marks (2020) |
| Partial budgeting | Business | Prevention value | Analyzes the incremental costs and benefits resulting from a change in food safety practices | Simple to implement for small-scale changes; focuses directly on differences between current and new practices | May not capture long-term or indirect benefits; limited if changes have broader impacts | Becot et al. (2021) |
| Deterministic modeling (for example, milk dioxin contamination impact model) | Business | Prevention value | Uses fixed economic data and predetermined assumptions to model the financial impact of food safety incidents | Provides clear quantitative estimates for worst-case scenarios; useful in sensitivity analysis | Relies heavily on assumptions that might not generalize; limited flexibility in dynamic settings | Lascano-Alcoseer et al. (2011) |
| Event study methodology | Business | Burden of failure | Evaluates the financial impact of food safety events by comparing firm performance before and after the event | Utilizes real market data; effective in capturing immediate financial impacts | May not reflect long-term benefits; sensitive to external market conditions | Kalaitzan-donakes, Ellison, and Serra Devesa (2024) |
| Panel data analysis with matching methods | Business | Prevention value | Uses econometric techniques to compare outcomes between firms with and without food safety investments | Controls for confounding factors; useful for drawing causal inferences from observational data | Requires extensive, high-quality data; results sensitive to model specifications | Liu et al. (2021) |
| Return on investment (ROI) | Business | Prevention value | Evaluates financial ROIs as a ratio of net benefit to total cost | Intuitive; widely understood in business; aligns with performance metrics | Rarely used directly in food safety; difficult to quantify nonfinancial benefits | Patrocínio, Madaleno, and Nogueira (2024) |

SOURCE: Original table for this publication.

Unlike burden-based models that emphasize the costs associated with food safety lapses, the ROI offers a forward-looking, business-oriented perspective. It allows companies to assess whether investments in an FSMS generate measurable returns relative to the costs. By translating benefits into a standardized financial format, the ROI can support internal decision-making, cross-departmental comparison, and accountability (Patrocínio, Madaleno, and Nogueira 2024).

Compared with cost-benefit analyses, which are widely used in policy making to assess public health outcomes (Bovay 2023; Golan et al. 2000), the ROI offers a more operationally immediate and internally actionable measure. It can be paired with performance indicators to support continuous improvement (GFSI 2018) and can potentially align food safety with strategic goals such as brand equity, export access, and supply chain continuity (Arshad et al. 2023). Its limited use in the FSMS literature appears to be less about conceptual fit than the methodological challenge of consistently measuring returns across contexts. Addressing this gap presents an opportunity to strengthen the business case for FSMS investment.

Implementing an FSMS typically involves costs in training, documentation systems, audits, and infrastructure upgrades. However, these costs are often viewed as regulatory overhead rather than strategic investments, particularly if the financial returns are not immediately visible (Arshad et al. 2023; Granja 2022). Beyond direct budget limitations, many firms face difficulties estimating the actual financial requirements of FSMS adoption. Fitzsimmons, Kinchla, and Allingham (2024) find that food safety training program participants initially believed upgrades were unaffordable. This is partly attributed to internal capacity gaps in cost estimation. Similarly, Arshad et al. (2023) report that, although food businesses anticipated long-term benefits, immediate financial constraints delayed implementation. Without adequate tools to weigh short-term costs against long-term value, firms risk forgoing changes that could significantly enhance competitiveness and resilience.

Substantial evidence supports the value-generating potential

of FSMS investments, particularly through indirect financial returns, which include cost avoidance (reduced recalls, fewer regulatory fines), efficiency gains (waste reduction, improved throughput), and strategic benefits (improved market access, brand differentiation). For instance, El-Tanboly et al. (2021) document that HACCP implementation at an Egyptian preserved foods company significantly reduced product waste and quality failures, and this translated into measurable operational savings. Duong, Nguyen, and Hoang (2023) find that, among 324 firms in China and Viet Nam, structured FSMS practices, such as internal audits and staff training, were positively associated with operational and financial performance. Similarly, Purwanto et al. (2020) demonstrate that integrating FSMS with quality and environmental systems improves profitability by reducing internal failures and enhancing customer satisfaction.

Despite these encouraging associations, formal ROI frameworks specific to FSMS are underdeveloped. While some studies and industry reports acknowledge the potential of measuring food safety investments, including in terms of cost savings and performance improvements, few provide detailed guidance on operationalizing such metrics. For example, the GFSI encourages the use of KPIs and other performance indicators as part of a strong food safety culture, but it offers limited methodological direction for linking these indicators to financial outcomes. Similarly, research on food safety culture, including that of Spagnoli et al. (2024), points to increased investment in preventive measures, but does not systematically address how these investments translate into quantifiable business returns.

Closing this gap will require that organizations develop tailored ROI models that reflect their unique operational contexts. In practice, this may involve tracking proxy indicators, such as reductions in product recalls, audit failures, noncompliance penalties, or customer complaints. By embedding ROI metrics into FSMS evaluations, businesses can strengthen internal accountability, more effectively communicate value to stakeholders, and reposition FSMSs as a source of strategic and financial advantage.

4.7 Key Performance Indicators

Firms use KPIs to assess their progress toward specific strategic or operational objectives. In food safety management, KPIs are quantifiable measures that serve as essential tools in monitoring the effectiveness of implementation and supporting steady improvement. They have the potential to validate ROIs. Effective KPIs align closely with business goals and are typically established within a framework, such as the SMART criteria (that is, to ensure that indicators are specific, measurable, achievable, relevant, and time-bound) or balanced scorecards, which facilitate multidimensional performance tracking (Bottani et al. 2023).

Within the food industry, KPIs are tailored to diverse areas, including the performance in production, supply chain resilience, regulatory compliance, and profitability. Routine indicators include supplier traceability, material quality, labor productivity, and value added output per worker (Hashmi and Zhang 2016; Mansour and Al-hamdani 2024). Broader business performance is often assessed through financial KPIs, such as indicators of profitability, customer satisfaction, and asset utilization, while measures of innovation capture the effectiveness of research and commercialization (Abeyasiriwardana, Jayasinghe-Mudalige, and Kodituwakku 2023). Bottani et al. (2023) propose that food industry

KPIs can be categorized by their supply chain function, stakeholder relevance, and performance output. They thus offer a structured lens for performance management.

If applied within an FSMS, KPIs become more specific in tracking program implementation, compliance, and performance outcomes. They include indicators on HACCP compliance, documentation accuracy, corrective action closure rates, and internal or external audit performance (Duong, Nguyen, and Hoang 2023). For example, microbial safety checks and internal audit scores function as operational KPIs, and indicators on the achievement of third-party certifications or the frequency of food recalls represent higher-level strategic outcomes (Qamar et al. 2024). Some KPI systems also integrate measures of sustainability that link food safety with environmental and social governance (Granja 2022; Runge and Gonzalez-Valero 2011).



5

A Proposed Model of the Return on Investment *in* Food Safety

The literature offers a broad consensus that, aside from regulatory compliance, FSMSs deliver substantial business value. Across sectors and regions, FSMS implementation is consistently linked with reduced operational risk, improved efficiency, and enhanced market access. Documented benefits include operational improvements, such as greater productivity, reduced waste, and less product nonconformance, as well as market-related advantages, such as access to premium or export markets and stronger customer satisfaction (Cahyaningrum, Priyandani, and Gusti 2024; Chen, Ping, and Liang 2023; El-Tanboly et al. 2021; Mekimah and Sayad 2020). However, these benefits are typically described in technical or qualitative terms rather than in financial measures. Despite the benefits of FSMS, cost remains a widely recognized barrier to

FSMS adoption, because of affordability issues, but also because of the difficulty to estimate implementation costs, translate benefits into monetary values, and justify the ROI (Arshad et al. 2023; Fitzsimmons, Kinchla, and Allingham 2024). No studies that directly calculate the ROI of FSMS implementation from a business perspective have been identified.

To address this gap, this paper introduces a risk-adjusted return on investment (RAROI) framework for FSMS investments to support food safety managers and food business operators in estimating the costs and potential returns of FSMS adoption. The framework is structured around a basic ROI calculation:

$$\text{ROI} = (\text{total gains} - \text{total costs}) / \text{total costs} \quad (5.1)$$

The model incorporates implementation-related costs and organizes gains across three dimensions: operational gains, market gains, and risk reduction. By translating food safety outcomes into financial measures, the model enables businesses to view FSMS as an investment with tangible returns. It facilitates informed decision-making,

supports value-based communication, and promotes regular improvement. The following subsections describe each element of the RAROI calculation using examples found in the literature and also propose estimation methods for FSMS implementation projects.

5.1 Costs

Cost inputs include the direct and indirect costs associated with FSMS implementation. These may include the costs of system design, training, recordkeeping infrastructure, audit preparation, and certification. Although cost is often a barrier, especially among SMEs, some studies have begun to benchmark these expenditures, thereby providing more transparency and aiding cost estimation. Ollinger, Moore, and Chandran (2004) analyze food safety investments in the US meat and poultry slaughter industries and demonstrate the existence of variation based on scale, regulatory

requirements, and operational complexity. Building on this, Viator et al. (2017) provide more recent cost estimates, capturing a range of expenditures, including HACCP plan development, microbial testing, equipment upgrades, and third-party audits (refer to table 2). Their findings demonstrate how investment levels vary by establishment size and product type, which has important implications for financial planning and ROI estimation.

Table 2

Cost of Developing, Validating, and Reassessing HACCP, SSOP, and Sampling Plans, by Entity Size

US\$ per plan

| Cost activity | Small establishments | Large establishments |
|------------------------------|----------------------|----------------------|
| HACCP plans | | |
| Develop plan internally | US\$13,540 | — |
| Develop plan with consultant | US\$17,770 | US\$43,080 |
| Validate plan | US\$10,832 | US\$8,666 |
| Reassess plan | US\$365 | US\$730 |
| SSOP plans | | |
| Develop plan internally | US\$13,540 | — |
| Develop plan with consultant | US\$10,270 | US\$43,080 |
| Validate plan | US\$10,832 | US\$8,666 |
| Reassess plan | US\$365 | US\$730 |
| Sampling plans | | |
| Develop plan with consultant | US\$6,542 | US\$87,240 |
| Validate plan | US\$32,496 | US\$46,997 |
| Reassess plan | US\$243 | US\$486 |

SOURCE: Adapted from Viator et al. 2017.

NOTE: — = A large establishment would not develop a plan internally without the use of a consultant. HACCP = hazard analysis and critical control point; SSOP = sanitary standard operating procedures.

Similarly, Fitzsimmons, Kinchla, and Allingham (2024) examine the cost burden of meeting standards on preventive controls for human foods and find that costs vary depending on existing compliance infrastructure and staff capabilities. They have developed a framework to estimate implementation costs through semistructured interviews. Table 3 presents the average costs associated with planning,

implementing, and managing the standards on preventive controls for human foods, as reported by small and medium processors interviewed in their study. Capturing these costs is essential for ROI calculations and in developing targeted financial and technical support strategies.

Table 3

Average Implementation Costs of Preventive Controls for Human Foods

| Stage | Category | Average cost |
|----------------|----------------------------|---------------|
| Planning | Training | US\$1,749.00 |
| | Training assignments | US\$1,329.00 |
| | Validation | US\$2,157.00 |
| | Consultation | US\$2,250.00 |
| | Total | US\$5,272.00 |
| Implementation | Manager labor hours | US\$2,358.00 |
| | Staff labor hours | US\$997.00 |
| | Equipment and facilities | US\$11,500.00 |
| | Audit and inspection | US\$3,167.00 |
| | Pest control | US\$1,867.00 |
| | Total | US\$8,731.00 |
| Management | Manager labor hours | US\$3,560.00 |
| | Staff labor hours | US\$2,063.00 |
| | Culture | US\$6,007.00 |
| | Training and certification | US\$1,980.00 |
| | Total | US\$7,929.00 |

SOURCE: Adapted from Fitzsimmons, Kinchla, and Allingham 2024.

NOTE: Average cost refers to averages across respondent small and medium processors who reported respective costs in the source study.

These empirical studies provide critical reference points for the cost input of the RAROI framework for FSMS. By identifying typical cost categories and demonstrating how expenditures vary by business size, operational complexity, and regulatory context, the studies of Fitzsimmons, Kinchla, and Allingham (2024), Ollinger et al. (2004), and Viator et al. (2017) offer practical benchmarks. Integrating these findings into the model allows for more accurate cost estimation tailored to various types of food businesses. Robust cost estimation strengthens the financial credibility of ROI assessments and helps inform investment planning.

Table 4 provides a consolidated view of typical FSMS cost components and proposed methods for estimating each category. This reference tool is designed to help food business operators identify relevant cost drivers, apply consistent estimation techniques, and improve the accuracy of ROI calculations. By clarifying the costs that should be included and how to calculate them, table 4 supports more well informed financial planning and investment decision-making.

Table 4

Guidance for Estimating Implementation Costs

| Cost category | Estimation method | Tips / notes |
|---|---|---|
| Training and certification | Number of employees × cost per training session | Include course fees, travel, materials, trainer costs |
| Certification | Quote from certifier based on site and scope | Include preassessment, audit, and recertification fees |
| External consulting | Hourly rate × estimated hours | Request quotes from at least two consultants |
| Internal labor | Time spent × hourly wage (plus overhead) | Include standard operating procedure updates, meetings, and coordination time |
| Audit preparation | Preaudit + main audit fees | Confirm whether certifier offers bundled services |
| Facility upgrades | Supplier or contractor quotes | Include sanitary design, heating, ventilation, and air conditioning, drains, and partitions |
| Equipment and technology | Market price or vendor quote per item | Include tools, monitors, digital logs, and so on |
| Software systems | Setup cost + annual subscription | Include license renewals and user fees |
| Packaging and labeling | Design + reprinting costs | Account for obsolete packaging write-offs |
| Personal protective equipment and safety gear | Unit cost × quantity × replacement frequency | Include uniforms, gloves, masks, boots |
| Product testing | Cost per test × number × frequency | Request quotes from certified labs |
| Utilities and resource costs | Estimate the increase from maintenance team | Water, energy, and chemicals during ramp-up |
| Change management | Materials + facilitation + human resources time | Include workshops, posters, and team briefings |

SOURCE: Original table for this publication.

5.2 Benefits

5.2.1 Operational Gains

The first dimension of returns to FSMS involves improvements in productivity and process efficiency, as well as operational gains, such as reductions in waste, downtime, and resource use. Firms adopting FSMS have reported improved product quality, cost savings from more efficient production, streamlined procurement and quality assurance processes, and fewer disruptions during inspections, leading to time and resource savings (Fitzsimmons, Kinchla, and Allingham 2024; Radu et al. 2023). Although such outcomes

are often not monetized in the literature, they represent real cost-saving opportunities and are essential to understanding the financial returns of FSMS adoption.

Case studies of the International Finance Corporation (IFC) illustrate the operational gains of FSMS implementation. Operational gains reported by IFC clients following FSMS implementation include cost savings derived from reduced waste, reduced energy and water use, increased productivity, improved crop and process management, and production efficiency gains. Table 5 summarizes selected IFC projects; operational gains are expressed in monetary terms.

Table 5

Operational Gains Realized through Selected IFC FSMS Implementation Projects

| Company | Country | Type of food | FSMS | IFC support | Operational gains |
|---------------|-----------------------------|--------------------------------|---|---|--|
| PRAN Group | Bangladesh | Fruits and vegetables | BRC Global Standard for Food Safety | Assessment, training, coaching, capacity building, PRAN Assurer Scheme among farmers | US\$1.5 million cost savings because of reduced loss |
| Twiga Foods | Kenya | Fruits and vegetables | GLOBALG.A.P. | Certification, land management, irrigation, farmer financing | US\$100,000 cost savings because of reduced food loss |
| BEL GA JSC | Viet Nam | Poultry | GLOBALG.A.P. Integrated Farm Assurance | Certification for 54 poultry houses, breeder farm training | US\$307,000 cost avoided |
| PAN Foods | Viet Nam | Processed foods | FSSC 22000 | Food safety assessments and training, contamination control, supplier program | US\$30,000 cost savings over two years because of reduced nonconforming products |
| Nafoods Group | Viet Nam | Passion fruit and other fruits | GLOBALG.A.P., FTI, Rainforest Alliance Sustainable Agriculture Standard | Food safety advisory, cost-saving tools (FMEA, cost of nonquality analysis), information and communication technology integration | US\$233,000 realized because of 53 tons of reduced food loss |
| Kaufland | Bulgaria, Moldova, Romania | Fresh fruits and vegetables | GLOBALG.A.P. | Training and mentoring program among farmers based on GLOBALG.A.P. | US\$66,000 in realized cost savings because of improved processing performance |
| Gaselia Group | Côte d'Ivoire, Guinea, Mali | Beverages | Food safety manuals, standard operating procedures, FMEA | Assessment, Advice, training, coaching and mentoring on food safety, training on quality tools | US\$500,000 total cost savings |
| MHP | Ukraine | Poultry and grain | GLOBALG.A.P. | Assist with GLOBALG.A.P. implementation | US\$700,000 saved from better crop management, improved operations |

SOURCE: Original table for this publication.

NOTE: FMEA = failure mode and effects analysis. FTI = Fairtrade International. GLOBALG.A.P. are standards based on good agricultural practice. Refer to GLOBALG.A.P. (dashboard), Agraya GmbH, Cologne, Germany, https://www.globalgap.org/uk_en/.

While operational gains are less frequently quantified financially in the literature, case studies and quantitative analyses illustrate that FSMS implementation yields outcomes with clear financial implications. Case studies have demonstrated a range of operational benefits, including reduced downtime, lower water and energy consumption, decreased labor inputs, increased productivity, reduced waste and product loss, improved production efficiency, and fewer product nonconformances (Cahyaningrum, Priyandani, and Gusti 2024; El-Tanboly et al. 2021; Mekimah and Sayad 2020). These outcomes represent tangible cost-saving opportunities. Complementing these qualitative insights, quantitative studies provide empirical support for such gains. For example, Purwanto et al. (2020) identify significant associations between FSMS implementation, increased productivity, and reduced product nonconformance.

Similarly, Rihawi (2024) reports on reductions in downtime and noncompliance incidents among meat, dairy, and bakery firms following ISO 22000 adoption. The documented operational improvements demonstrated in these studies point to measurable economic benefits.

The above studies do not assign direct financial values for the outcomes. More analysis is therefore needed to convert the operational gains into monetary terms. Table 6 summarizes operational improvements regularly linked to FSMS implementation and proposes illustrative formulas to estimate the monetary value of the benefits, thereby providing a practical framework for the financial estimation of operational gains.

Table 6

Proposed Financial Estimation of Operational Gains

| Operational gain | Description | Proposed monetization formula |
|--------------------------------|--|--|
| Reduced downtime | Equipment or processes: less time out of operation | $(\text{Downtime hours reduced/year}) \times (\text{hourly revenue loss or labor cost})$ |
| Reduced water use | Lower consumption of water resources | $(\text{Liters of water saved/year}) \times (\text{cost per liter})$ |
| Reduced energy consumption | Lower electricity, gas, or fuel use | $(\text{kWh or BTUs saved/year}) \times (\text{cost per unit of energy})$ |
| Reduced labor requirements | Decrease in staff time required for processes | $(\text{Hours saved/year}) \times (\text{average hourly wage})$ |
| Increased productivity | Greater output, same inputs | $(\text{Additional units produced/year}) \times (\text{profit margin per unit})$ |
| Reduced product loss or waste | Less product discarding or rejecting | $(\text{Units of waste reduced/year}) \times (\text{cost per unit produced})$ |
| Improved production efficiency | More rapid throughput or better capacity utilization | $[(\text{Output increase} - \text{input increase})/\text{input}] \times (\text{revenue per unit or cost saved})$ |
| Reduced nonconformance | Fewer defective products | $(\text{Incidents avoided/year}) \times (\text{average cost per incident: rework, scrap, or downgrade})$ |

SOURCE: Original table for this publication.

5.2.2 Market Gains

The second dimension of returns to FSMS captures the contribution of an FSMS to market value. FSMS certification can enhance a company's competitive position, especially in export markets or high-value supply chains. Arshad et al. (2023) find that certified smallholder producers are more likely to gain access to premium markets and enter longer-term buyer contracts. Hoyos-Vallejo and Chinelato (2025) show that food safety performance positively influences consumer trust and brand loyalty, particularly in e-commerce. FSMS can serve as a signal of credibility to retailers, consumers, and investors and contribute to pricing

power, customer retention, and supply chain integration. While benefits such as brand loyalty and trust are difficult to quantify, firms can estimate the added revenue associated with market expansion through new customer acquisition, access to premium markets, and entry into export markets.

IFC case studies demonstrate the financial returns resulting from market gains made possible by FSMS implementation. Market gains reported by IFC clients include sales increases, the achievement of premium pricing, expansion into local, urban, and export markets, and improved brand trust, market access, and market position. Table 7 summarizes selected IFC case studies and reported market-related financial gains following FSMS implementation.

Table 7

IFC Case Studies and FSMS-Related Market Gains

| Company | Country | Type of food | FSMS | IFC support | Market gains |
|---------------|----------------------------|--|---|---|--|
| PRAN Group | Bangladesh | Fruits and vegetables | BRC Global Standard for Food Safety | Assessment, training, coaching, capacity building, PRAN Assurer Scheme among farmers | US\$233 million sales increase; US\$920,000 increase in farmer sales (suppliers); 134 export countries |
| Mali Shi | Mali | Shea butter | ISO 22000 | Technical and management training, food safety audit training, coaching | Premium pricing; market expansion |
| Twiga Foods | Kenya | Fruits and vegetables | GLOBALG.A.P. | Certification, land management, irrigation, farmer financing | Increased supply to urban areas |
| Luna | Ethiopia | Meat | FSSC 22000 | Equipment upgrade, veterinary care, training | First exports to Gulf Cooperation Council with vacuum-packed meat |
| BEL GA JSC | Viet Nam | Poultry | GLOBALG.A.P. Integrated Farm Assurance | Certification of 54 poultry houses, breeder farm training | US\$25 million sales increase |
| PAN Foods | Viet Nam | Processed foods | FSSC 22000 | Food safety assessments and training, contamination control, supplier program | US\$19.5 million incremental sales increase over two years; improved brand trust and market access |
| Nafoods Group | Viet Nam | Passion fruit and other fruits | GLOBALG.A.P., FTI, Rainforest Alliance Sustainable Agriculture Standard | Food safety advisory, cost-saving tools (FMEA, cost of nonquality analysis), information and communication technology integration | US\$390,000 increase in farmer sales |
| Kaufland | Bulgaria, Moldova, Romania | Fresh fruits and vegetables | GLOBALG.A.P. | Training and mentoring program among farmers based on GLOBALG.A.P. | US\$10.3 million increase in supplier sales |
| Korzinka.uz | Uzbekistan | Retail food stores and in-house production | FSSC 22000 | Assessment, action planning, pilot program, training | 10.5% sales increase; strengthened local market position |

SOURCE: Original table for this publication.

NOTE: FMEA = failure mode and effects analysis. FTI = Fairtrade International. GLOBALG.A.P. are standards based on good agricultural practice. Refer to GLOBALG.A.P. (dashboard), Agraya GmbH, Cologne, Germany, https://www.globalgap.org/uk_en/.

Case studies and empirical analyses in the literature depict the market gains associated with FSMS implementation. Similar to operational improvements, market gains are often described qualitatively rather than quantified in monetary terms. Reported market benefits typically involve sales growth, expanded access to premium or export markets, and increased customer satisfaction, brand loyalty, and trust (Cahyaningrum, Priyandani, and Gusti 2024; Chen et al. 2022; El-Tanboly et al. 2021; Mekimah and Sayad 2020). For example, Weifang Artisan Foods, a Chinese vegetable producer, reported a 400 percent increase in exports within two years of the implementation of the BRC

Global Standard for Food Safety, the International Featured Standards, and the GLOBALG.A.P. standards, and Edfina Company, an Egyptian preserved foods manufacturer, reported a 2000 ton export volume increase following HACCP implementation (El-Tanboly et al. 2021; GFSI 2020). Capturing these impacts systematically and monetizing them would enable businesses to build stronger and more accurate cases for FSMS investment.

Table 8 overviews typical FSMS-related market gains and practical approaches to estimating the associated financial value.

Table 8

Estimating the Financial Value of FSMS-Related Market Gains

| Type of market gain | Description | Proposed method of financial estimation |
|----------------------------------|--|---|
| Increased sales | Growth in revenue attributed to FSMS implementation | Post-FSMS revenue, minus pre-FSMS revenue, adjusted for market trends |
| Premium pricing | Ability to charge higher prices postcertification | $(\text{Premium price} - \text{standard price}) \times \text{units sold}$ |
| Market expansion | Entry into new markets or increased market penetration because of FSMS | Additional revenue from new markets directly linked to FSMS certification |
| Longer-term contracts | Extended duration or increased value of contracts because of FSMS | Difference in revenue/value of contracts pre- and post-FSMS implementation |
| Enhanced brand loyalty and trust | Improved customer retention and repeat purchases | $\text{Increased customer retention rate} \times \text{average customer lifetime value post-FSMS implementation}$ |

SOURCE: Original table for this publication.

5.2.3 Risk Reduction

One of the primary financial benefits of FSMS implementation is a reduction in risk exposure to food safety incidents. Accordingly, the third dimension of returns to a RAROI framework focus on risk reduction. This dimension captures the avoided costs associated with food safety failures, including product recalls, regulatory penalties,

reputational damage, and supply chain disruptions. While these mitigation outcomes may be difficult to quantify precisely, they represent real financial value in the form of avoided losses.

Table 9 summarizes selected food safety incidents and illustrates the financial risk exposure that individual food businesses have faced.

Table 9

The Financial Impact of Selected Food Safety Incidents

| Year | Country | Company | Food type | Cause of incident | Estimated impact | Citation |
|------|---------------|---------------|-----------------------------------|--|--|--|
| 2015 | Hungary | Greenyard | Frozen vegetables | Listeria | US\$35 million in recall costs; 35% stock loss | FreshFruitPortal.com (2018) |
| 2015 | India | Nestlé | Maggi noodles | Excessive lead and MSG | US\$45 million direct loss; major drop in market share | Knowledge at Wharton (2015) |
| 2015 | United States | Chipotle | Various menu items | Multiple outbreaks of <i>E. coli</i> , <i>Salmonella</i> , and norovirus | US\$6.31 billion stock decline | Kalaitzandonakes, Ellison, and Serra Devesa (2025) |
| 2016 | Israel | Unilever | Breakfast cereals | <i>Salmonella</i> | US\$23 million in lawsuits; 30%–50% sales drop | Dovrat (2016) |
| 2016 | Netherlands | Mars | Chocolate bars | Plastic contamination | Tens of millions of euros | Chaudhuri (2016) |
| 2017 | South Africa | Tiger Brands | Processed meats: polony (bologna) | <i>Listeria</i> | Potential costs of US\$67.5 million+ | FSN (2018) |
| 2018 | France | Lactalis | Infant formula | <i>Salmonella</i> | Hundreds of millions of euros | de La Hamaide (2018) |
| 2018 | United States | Fresh Express | Romaine lettuce | <i>E. coli</i> | US\$276 million–US\$343 million | Spalding et al. (2023) |
| 2022 | Belgium | Ferrero | Kinder Chocolate products | <i>Salmonella</i> | US\$60 million recall cost | Whitworth (2022) |
| 2022 | France | Nestlé | Frozen pizza | <i>E. coli</i> | US\$250 million in lawsuits | Reuters (2022) |
| 2024 | United States | McDonald's | Onions for hamburgers | <i>E. coli</i> | 5.1% stock decline (~US\$14.7 billion) | Baertlein and Kumar (2024) |
| 2024 | United States | Boar's Head | Deli meats | <i>Listeria</i> | US\$3.1 million class-action settlement | Janney (2025) |

SOURCE: Original table for this publication.

An FSMS can help reduce the probability and severity of such incidents. For example, firms with well-documented hazard control systems and traceability protocols are more likely to identify contamination early, issue targeted recalls, or avoid full-market withdrawals. These preventive controls translate to measurable cost avoidance. Estimating these avoided costs requires a structured approach incorporating consideration of probability and consequence. The three main approaches to the estimation are qualitative, quantitative, and semiquantitative.

A qualitative approach to estimating risk reduction relies on subjective expert assessments to characterize the risk level before and after food safety–related interventions, including HACCP, FSMS, and improvement initiatives. For simplicity, risk might be characterized by a categorization of low, medium, or high, or on a scale that translates into probability ranges, similar to a failure modes and effects analysis. A simple qualitative approach is accessible and rapid, especially in the case of small firms or early assessments, but it is short on accuracy and precision. A qualitative approach also does not involve a quantification of risk avoidance in monetary terms, making it less useful in calculating cost avoidance in ROI models.

A fully quantitative approach would offer greater precision through the application of statistical methods and financial data to estimate the likelihood and cost of a potential food safety incident. To use a quantitative method, however, companies would have to analyze historical failure rates, simulate probability distributions, or use predictive models to calculate the cost avoidance associated with risk reduction. Thus, while a fully quantitative approach may offer more

credible data-driven outputs, it is resource-intensive and relies on robust incident data and modeling expertise. Implementation is therefore unfeasible for most companies.

The semiquantitative approach may provide a practical compromise between the relative ease of the qualitative approach and the cost estimation capabilities associated with the quantitative approach. The semiquantitative approach combines structured reasoning with available data, literature, and expert opinion to estimate the probability of incidents and the potential cost if an incident occurs. A simplified semiquantitative approach to the estimation of avoided loss involves multiplying the estimated likelihood of a food safety incident by the expected economic impact. For instance, based on data of the US Food and Drug Administration (FDA 2025), there has been an average of approximately 265 food recalls a year in the United States. Divided across the roughly 65,000 estimated registered food and beverage facilities, this results in an average annual incident probability of 0.3 percent per firm. Firms would need to apply a risk reduction factor based on an estimation of the expected effectiveness of their food safety interventions, for example, a 50 percent risk reduction rate. Combined with average recall costs, which may range from US\$8 million to more than US\$300 million per event, the estimated annual cost avoidance per firm associated with risk reduction interventions reaches from US\$12,000 to US\$450,000, depending on sector, scale, and product category (Hussain and Dawson 2013; Spalding et al. 2023).

To quantify these savings, businesses may rely on the following formula:

$$\text{Estimated cost avoidance} = (\text{baseline incident probability} \times \text{average incident cost}) - (\text{postintervention incident probability} \times \text{average incident cost}) \quad (5.2)$$

Table 10 illustrates the approach using FDA incident frequency data and published cost ranges. It shows how an

FSMS or other food safety intervention may reduce exposure to high-cost events.

Table 10

Example Estimation of Risk Reduction through FSMS Implementation

| Variable | Description | Example value |
|---------------------------------------|--|---|
| Baseline incident probability | Historical or industry average probability of a food safety incident | 0.3% (based on FDA data) |
| Average incident cost | Estimated cost of a food recall or similar event | US\$8 million–US\$300 million (based on the literature) |
| Postintervention incident probability | Expected probability after FSMS or intervention implementation | 0.15% (estimated 50% reduction based on the planned intervention) |
| Estimated cost avoidance (low) | $(0.3\% \times \text{US\$8 million}) - (0.15\% \times \text{US\$8 million})$ | US\$24,000 |
| Estimated cost avoidance (high) | $(0.3\% \times \text{US\$300 million}) - (0.15\% \times \text{US\$300 million})$ | US\$900,000 |

SOURCE: Original table for this publication.

Estimates based on FDA data and the literature offer a simplified method of illustration (refer to table 10). However, these estimates reflect incident rates among US companies that are required to have an FSMS. The likelihood and severity of risk vary significantly depending on the food product, the nature of the hazard, the robustness of controls, a company’s market reach, and other contextual factors. For example, the implications of a pathogen-related recall at a multinational meat processor are vastly different from the

effects of a complaint about foreign material in the product of a local dry goods producer. Similarly, the value of risk reduction depends on the scale of the potential reputational, regulatory, or financial damage of a realized risk. Thus, the simplified method may underestimate the risk faced by firms that lack an FSMS or overestimate the costs at companies operating in different regions. For this reason, companies should tailor their estimation approach to the specific circumstances (refer to table 11).

Table 11

Estimating Risk Reduction: A Comparison of Approaches

| Approach | Description | Advantages | Limitations |
|------------------|---|---|---|
| Qualitative | Uses descriptive terms and expert judgment to assess risk reduction (low, medium, high; 1 to 10, and so on) | Simple, rapid, low cost, useful if data are limited | Subjective; lacks precision; no cost estimates |
| Quantitative | Uses statistical data and modeling to calculate exact probabilities and impacts of risk reduction | Highly precise and data-driven; supports detailed returns on investment analysis | Data-intensive, requires modeling expertise; may not be feasible for most companies |
| Semiquantitative | Combines expert judgment with numeric estimates of probability and cost; uses available data | Balances rigor and feasibility; adaptable to various contexts; more defensible than qualitative alone | Still relies on expert judgment; ranges can be broad; lacks some precision |

SOURCE: Original table for this publication.

The semiquantitative approach is the most appropriate for companies aiming to communicate the value in financial terms of risk reduction from food safety investments.

5.2.3.1 Example Cost Avoidance Estimate

The following is a hypothetical example provided for illustrative purposes. It demonstrates how a company could use a tailored semiquantitative approach to estimate potential cost avoidance from food safety interventions.

The hypothetical example involves a food company sourcing turmeric from Asia, where lead contamination has been documented, primarily because of postharvest adulteration with industrial pigments. The food company is evaluating whether to invest in improvements, such as enhanced supplier controls, a raw material testing program, or a full FSMS. It wants to estimate the financial value of avoiding a major food safety incident through risk reduction to support the business case. By combining internal knowledge with the results of publicly available research and industry benchmarks, the company can develop a simplified model to estimate cost avoidance.

Based on internal assessments and external research, such as the study of Forsyth et al. (2019), which finds that the use is widespread of lead chromate in turmeric sourced from

Asia because of color enhancement practices, the company estimates a 5 percent annual probability of a significant food safety incident (such as rejected shipments, recalls, or regulatory enforcement) in the absence of controls. This baseline risk reflects sourcing from a high-risk geographic area, limited supplier oversight or traceability, and a lack of formal certification or of a structured food safety program.

The company considers investing in a combination of controls, such as supplier controls, training programs among farmers and processors, HACCP-based preventive measures, and third-party certification (for example, the BRC Global Standard for Food Safety or ISO 22000). A combination of these interventions is expected to reduce the likelihood of an incident by 95 percent, lowering the estimated annual risk to 0.25 percent.

To assess the financial impact of a major food safety incident, the company can conduct a recall simulation based on its turmeric product line and export exposure. The modeled cost of a significant incident includes the retrieval and destruction of contaminated product, laboratory testing and investigation, regulatory interaction and crisis communication, contract penalties or market loss, and long-term reputational harm. In this hypothetical case, the total estimated cost avoidance from risk reduction is US\$5 million.

$$\text{Cost avoidance} = \frac{\text{(preintervention risk} \times \text{risk reduction)}}{\text{incident cost}} = \frac{(5\% \times 95\%) \times \text{US\$5,000,000}}{\text{US\$5,000,000}} = \text{US\$237,500} \quad (5.3)$$

In this hypothetical scenario, the company could expect to avoid approximately US\$237,500 per year in potential food safety-related costs by reducing risk through the implementation of the planned food safety interventions.

This hypothetical example illustrates how a semiquantitative method can help companies justify food safety investments

by translating risk reduction into measurable financial value. While the inputs are estimated, the approach supports better decision-making by positioning food safety as a strategic investment with tangible ROI.

5.3 Baseline Data

To support the practical application of the RAROI model, it is recommended that firms begin by establishing a formal FSMS baseline. This approach includes documenting current food safety costs, regulatory risks, product loss rates, and customer access conditions before implementation. A structured baseline allows firms to track changes, estimate the potential ROI, and validate the results through the outcomes. Even partial estimates, if consistently collected, can support better decision-making.

While not all FSMS-related benefits can be monetized, many can be translated into financial terms. For impacts that lend themselves to quantification, the RAROI framework supports using ROI as a strategic lens for FSMS implementation. It does not require that all outcomes be expressed as precise values, but it does provide a defensible structure for identifying, estimating, and validating value. This foundation also enables the integration of performance tracking mechanisms, which is addressed in the following subsection.

5.4. Validating RAROI with KPIs

To support ROI tracking, FSMS-related KPIs can be mapped to the core components of the RAROI model: cost control, operational gains, market value creation, and risk reduction. Each category can benefit from a mix of leading indicators that predict or signal future performance and lagging indicators that measure results already achieved. For example, implementation success might be assessed through leading indicators, such as standard operating procedure completion rates and employee training participation, and lagging indicators, such as audit results or certification status. Cost tracking might involve early variance-to-budget measures as leading indicators and

actual project cost comparisons as lagging indicators. Risk reduction could be captured through internal audit performance and nonconformity tracking (leading), alongside recall costs or regulatory penalties (lagging) (Duong, Nguyen, and Hoang 2023; Rihawi 2024).

Table 12 maps KPIs to the FSMS ROI framework. Each KPI is categorized by type, return dimension, and a suggested method for assessing financial relevance. The guidance can help businesses identify and track measures aligned with RAROI estimation efforts.

Table 12

Example KPIs to Track and Validate FSMS Value

| KPI | Type (leading/lagging) | RAROI component | Financial relevance (US\$) | Recommended frequency |
|--|------------------------|------------------|--|-----------------------|
| Preventive maintenance completion rate | Leading | Operational gain | Cost of avoided downtime or repair | Monthly |
| Process compliance audit score | Leading | Operational gain | Reduction in rework/waste costs | Monthly |
| Product waste (% and US\$) | Lagging | Operational gain | US\$ lost product = unit cost × waste volume | Monthly |
| Rework or rejection rate | Lagging | Operational gain | Labor + material costs of rework | Monthly |
| On-time certification renewal | Leading | Market gain | Value of retained contracts or avoided disruptions | Quarterly |
| Customer inquiry conversion rate | Leading | Market gain | Revenue per converted customer | Monthly |
| New market-driven sales | Lagging | Market gain | Revenue from new market access | Quarterly |
| Customer retention rate | Lagging | Market gain | Customer retention rate gain | Annually |
| Internal audit frequency and score | Leading | Risk avoidance | Proxy for lower incident probability | Monthly |
| Near-miss reporting rate | Leading | Risk avoidance | Input for incident probability model | Monthly |
| Audit nonconformities | Lagging | Risk avoidance | Cost per nonconformity event | Per audit |
| Insurance premium reduction | Lagging | Risk avoidance | US\$ savings from lower premium | Annually |

SOURCE: Original table for this publication.

If KPIs are aligned with FSMS objectives and tracked, they can offer a transparent and evidence-based method for validating the ROIs on food safety. This structured approach supports not only regulatory compliance, but also long-term strategic value creation



6

The ROI of FSMS in Practice

6.1 Nafoods Case Study

Nafoods Group, a leading Vietnamese exporter of passion fruit and other tropical fruits, was seeking to improve process consistency, reduce spoilage, and meet increasingly rigorous export standards. To achieve these goals, it implemented a multistandard FSMS incorporating certifications of GLOBALG.A.P., Fairtrade International, and the Rainforest Alliance Sustainable Agriculture Standard.

With the support of IFC Food Safety Advisory Services, Nafoods became familiar with and used technical tools, including failure mode and effects analysis, cost of nonquality analysis, and traceability systems based on

information and communication technologies. These interventions aimed to strengthen internal control, enhance responsiveness, and minimize food loss across the value chain.

The total investment for implementation was US\$300,000. This effort led to immediate operational gains, including US\$233,000 in realized cost savings (refer to table 13). An additional US\$484,000 was expected based on ongoing improvements. The food loss was reduced by 53 metric tons during implementation, and more reductions and continued improvements were expected.

Table 13

ROI Summary: The Nafoods Case Study

| ROI element | Description | Value (US\$) |
|------------------------|---|---------------|
| Implementation cost | FSMS certification, advisory services, information and communication technology tools | US\$300,000 |
| Operational gains | Savings from reduced food loss and greater efficiency | US\$233,000 |
| Market value increase | Improved export access and product quality | Not monetized |
| Risk reduction | Reduced recall risk; improved traceability and supply quality | Not monetized |
| Total quantified gains | Operational gains only | US\$233,000 |
| Estimated ROI (%) | $(\text{Total gains} - \text{cost}) / \text{cost} \times 100\%$ | ~78% |

SOURCE: Original table for this publication.

The program also contributed to a US\$390,000 increase in farmer income on the market side, reflecting the enhanced quality of supply and better contractual integration with the Nafoods sourcing network. The FSMS elevated the firm's risk management capabilities, particularly in recall prevention and traceability, a critical factor for exporters managing perishable products in competitive global markets.

The immediate ROI was 78 percent. Additional reductions in food loss and cost savings are expected to increase the ROI substantially. The case illustrates how targeted FSMS upgrades, particularly if aligned with cost-saving analytics and digital tools, can drive substantial financial and operational improvements, while enhancing supply chain resilience and supplier equity.

6.2 PAN Foods Case Study

PAN Foods, a Vietnamese food processing company, adopted an FSSC 22000 FSMS to improve internal food safety capacity, reduce product nonconformance, and build stronger supplier relationships. The company recognized that meeting international safety and quality standards was essential to supporting food safety, quality assurance, and business expansion.

With assistance from IFC, PAN Foods received technical assistance in food safety assessments, contamination control, supplier management, and employee training.

This support laid the groundwork for a structured FSMS rollout emphasizing internal systems and upstream supplier engagement.

The total implementation cost was US\$60,532, and the company recorded US\$30,000 in operational savings over two years, primarily by reducing nonconforming products and the associated waste (refer to table 14). These process improvements also contributed to more predictable workflows and better internal quality control.

Table 14

ROI Summary: The PAN Foods Case Study

| ROI element | Description | Value (US\$) |
|--------------------------|--|----------------|
| Implementation cost | FSSC 22000 certification, training, contamination and supplier control | US\$60,532 |
| Operational gains | Cost savings from reduced nonconforming products | US\$30,000 |
| Market value increase | Sales growth over two years because of improved brand trust and access | US\$19,500,000 |
| Risk reduction | Improved risk management across operations and the supply base | Not monetized |
| Total quantifiable gains | Operational + market gains | US\$19,530,000 |
| Estimated ROI (%) | $((\text{Total Gains} - \text{Cost}) / \text{Cost}) \times 100\%$ | ~32,208% |

SOURCE: Original table for this publication.

The most significant impact was commercial. During two years, PAN Foods reported an incremental US\$19.5 million increase in sales, attributed to strengthened brand credibility and greater access to premium domestic and export markets. These data reflect top-line growth, but they also indicate how FSMS adoption can enable strategic business positioning.

Risk reduction was another notable outcome. Through

supplier controls and internal process safeguards, PAN Foods enhanced its ability to manage food safety risks and regulatory compliance, minimizing the likelihood of costly disruptions, such as recalls or shipment rejections.

This case demonstrates the impact of FSMS on operational stability and market competitiveness, illustrating how even modest investments can generate strong financial returns if they are tied to a clear growth strategy.

6.3 Edfina Case Study

Edfina, a prominent Egyptian food processor, faced persistent operational inefficiencies and quality control issues. More than 400 tons of product were lost annually before FSMS adoption. In response, the company implemented an FSMS based on HACCP and supported by equipment upgrades and workforce training. This intervention targeted key production areas and led to quantifiable improvements: cutting packaging time for tomato paste in half and reducing the loss in jam production by 43 tons (with a 6 percent capacity gain). Similar efficiencies were observed in juice filling and frozen

vegetable lines. The cumulative annual savings from these interventions totaled LE 382,622 (El-Tanboly et al. 2021).

FSMS adoption enabled Edfina to access regulated international markets. The company exported 2,000 tons of frozen vegetables and 25 tons of fruit drinks to Europe and the United States, transactions valued at LE 73,000 and LE 7.6 million, respectively (refer to table 15). These export outcomes underscore the role of the FSMS in supporting market value creation through traceability, safety documentation, and compliance with international buyer requirements.

Table 15

ROI Summary: Edfina Case Study

| ROI model component | Details | Note |
|---------------------|--|--|
| Implementation cost | LE 138,430 (training, tools, monitoring) | Includes full FSMS rollout supported by HACCP upgrades |
| Operational gains | LE 382,622 annual savings; 60.5 tons of reduced product loss; improved process control | Efficiency gains across tomato paste, jam, juice, and frozen vegetable lines |
| Market gains | LE 7,673,000 from frozen vegetables + LE 73,000 from fruit drink exports | Enabled entry into European and US markets through FSMS certification |
| Risk reduction | No product recalls recorded; enhanced preventive controls | Risk exposure minimized through improved practices; not directly monetized |
| Calculated ROI | $5,819\% = (LE\ 8,055,622 - LE\ 138,430) / LE\ 138,430 \times 100$ | Calculated from total gains (LE 8,055,622) relative to cost |

SOURCE: Original table for this publication.

The total investment in FSMS implementation, including training and monitoring tools, was LE 138,430. Combined with operational and export-related financial gains (LE 8,055,622), this results in an estimated ROI of 5,819 percent. While no risk reduction was calculated, the reduction in production waste represents a tangible narrowing in food safety risk exposure and improved process control. Overall, the Edfina case exemplifies how FSMS can simultaneously

deliver cost savings, regulatory alignment, and revenue expansion, making it a high-value strategic investment.

Although no formal KPIs were mentioned in the Edfina case study, an example set that could have strengthened outcome tracking and ROI validation is proposed in table 16. Each KPI is linked to a specific pillar in the FSMS ROI framework and includes one leading and one lagging indicator to represent both process and outcome.

Table 16

Proposed KPIs to Support ROI Validation, Edfina

| RAROI component | Objective | Leading indicator | Lagging indicator |
|-------------------|---|---|---|
| Cost | Stay within planned implementation budget | % of budget spent per phase (tracked monthly) | Final implementation cost vs. projection (LE 65,200) |
| Operational gains | Reduce material and processing waste | Tracking weekly reduction in packaging waste | Annual operational savings from reduced waste (LE 382,622) |
| Market value | Increase sales through new markets | Number of buyer inquiries or approvals initiated post-upgrade | Export revenue generated postcertification (LE 7.6 million) |

SOURCE: Original table for this publication.

The Edfina case illustrates how FSMSs, such as HACCP, can deliver a strong ROI. By applying structured KPIs to each RAROI component, food businesses can enhance their ability to manage resources, track performance, and validate and communicate the value of FSMS implementation to

internal and external stakeholders. This structured approach creates a foundation for continuous improvement and future benchmarking.

7

Discussion *and* Conclusion

This study reinforces a central insight: implementing an FSMS is not merely a regulatory requirement, but a strategic business decision that can generate measurable operational and financial returns. Across the literature, FSMS adoption has been associated with productivity gains, reduced waste and nonconformance, and improved access to premium and export markets. Enhanced customer satisfaction and brand reputation have also been reported as downstream benefits of effective food safety practices (Abebe et al. 2020; Cahyaningrum, Priyandani, and Gusti 2024; Chen et al. 2022; El-Tanboly et al. 2021; Mekimah and Sayad 2020).

Despite these benefits, cost remains among the barriers to FSMS implementation that are most typically cited. The perceived or actual financial burden can delay or deter investment among many businesses, particularly those operating with limited margins or in resource-constrained settings. By providing a structured method for estimating costs and returns, the RAROI framework helps firms evaluate affordability, prioritize interventions, and make informed choices about where and how to allocate resources. It also supports more transparent communication with investors and internal decision-makers on the financial rationale for FSMS implementation.

While the benefits of an FSMS are well documented, the strategic value is often underrecognized. In many food businesses, FSMSs continue to be viewed primarily through

the lens of regulatory compliance rather than long-term investment. This framing can limit internal alignment, reduce prioritization in resource planning, and obscure the broader business case for FSMS implementation.

Studies have examined FSMS outcomes, but few monetize the benefits or calculate the ROI. Most existing methodologies for evaluating the returns to food safety-related investments rely on qualitative case studies or focus narrowly on public health measures. These approaches are frequently not associated with clear financial indicators or omit the benefits of greater market access and risk avoidance. As a result, food business operators may struggle to apply the findings to financial planning. The RAROI model presented in this paper addresses these limitations by offering a structured, business-oriented framework tailored to operational realities.

The model is structured around a basic ROI formula—total gains, minus total costs, divided by total costs—and organizes benefits into three categories: operational gains (that is, productivity and efficiency), market gains (for example, customer access and pricing leverage), and risk reduction (for instance, avoided product recalls, regulatory penalties, or reputational damage). The framework enables firms to evaluate an FSMS as a long-term investment by converting food safety outcomes into financial measures.

Positioning FSMS in financial terms facilitates more informed

decision-making. It supports alignment between food safety goals and business strategy and allows stakeholders, including executives and investors, to understand the commercial value of robust safety systems. It also creates a stronger case for targeted investment, internal accountability, and continuous improvement.

Several practical steps can enhance the application of this framework, as follows:

- First, RAROI principles should be integrated into FSMS planning, performance monitoring, and reporting.
- Second, capacity-building programs should include cost estimation, financial tracking, and ROI communication training.
- Third, additional research is needed to improve the quantification of risk-based cost avoidance, including the monetary value of averted food safety incidents or loss of market access.

To support the use of RAROI, IFC has developed the “Risk-Adjusted Return on Investment Workbook for Food Safety Management Systems” (World Bank 2025), a practical guide to help food business leaders understand the concepts and calculate RAROIs for FSMSs or other implementation projects.

It is critical to acknowledge the ethical and legal foundations of food safety. Protecting public health is a nonnegotiable duty. Firms should not use ROI calculations to justify delaying corrective actions, reducing investment in core safety systems, or avoiding certification requirements. The RAROI model is intended to support responsible, transparent business decisions, not to replace regulatory compliance.

It is also important to recognize the limitations of financial modeling. Some of the most meaningful benefits of an FSMS, such as preventing a product recall or an outbreak of foodborne illness, may not appear in short-term measures, but can carry a significant long-term impact. RAROI estimates should reflect these outcomes, even if they are based on assumptions or benchmark data. Estimates must be documented, conservative, and subject to regular review. While larger companies may have the data to support more detailed analysis, small firms can use this model with reasonable estimates to support business cases and planning decisions.

FSMS implementation offers a pathway to compliance and competitiveness. If framed appropriately, the value of an FSMS can be expressed in financial language that resonates with decision-makers. The RAROI framework introduced in this paper contributes to a more well informed, investment-oriented approach, strengthening the business case for FSMSs in an evolving global food economy.

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Risk-Adjusted Return *on* Investment: Workbook *for* Food Safety Management Systems

(For Illustrative Purposes)

Section 1

Introduction

Food safety is more than a regulatory requirement; it's a foundation of operational stability, brand integrity, and long-term business growth. Yet, many food businesses still struggle to measure or demonstrate the business value of investments in food safety.

About This Workbook

This workbook introduces the risk-adjusted return on investment (RAROI) model, a practical framework designed to help you quantify the financial and strategic benefits of implementing a Food Safety Management System (FSMS) or other specific food safety-related interventions.

The workbook is designed for the following:

- Food business operators
- Food safety and quality assurance managers
- Risk and compliance leaders
- Financial and operational decision-makers

Whether you are planning to implement a new FSMS, obtain certification, or improve your organization's food safety performance, this tool will help connect safety initiatives to measurable business outcomes.

Using this workbook, you will learn to do the following:

- Gather and interpret baseline data related to food safety performance
- Estimate the total cost of implementing or improving an FSMS
- Identify gains in operational efficiency, market access, and risk reduction
- Track key performance indicators (KPIs) to monitor ongoing impact
- Communicate the return on investment (ROI) to leadership using clear, evidence-based methods
- The RAROI model

The RAROI model offers a structured approach to evaluating food safety investments. It breaks down the components of the returns into four measurable categories, as follows:

- Implementation costs: training, system upgrades, certifications, audits, and labor or time investments
- Operational gains: reductions in waste, downtime, rework, and efficiency improvements
- Market gains: expanded market access, customer retention, pricing power, or certifications
- Risk reduction (cost avoidance): the costs avoided by preventing food safety incidents, such as recalls, legal action, regulatory penalties, and reputational damage

The model formula is as follows:

$$\text{RAROI} = \left(\frac{\text{operational gains} + \text{market gains} + \text{risk reduction}}{\text{implementation costs}} \right) / \left(\frac{\text{implementation costs}}{\text{costs}} \times 100 \right)$$

The model allows businesses to shift the conversation about FSMS and other food safety-related investments from the cost of compliance to the value of investment.

How to Use This Workbook

Each section includes the following:

- Plain-language guidance and explanations
- Templates and worksheets for data collection and calculation

- Key takeaways for building a compelling case for food safety investment

You can use the RAROI model to accomplish the following:

- Support business case development
- Track progress
- Align food safety objectives with operational and financial strategy

Section 2

Ethical Considerations and RAROI Model Limitations

Before applying ROI thinking to food safety, it is important to acknowledge its ethical foundations and the practical boundaries of financial modeling. The RAROI model is a tool to support thoughtful, responsible business decisions, not a shortcut around essential safety practices or compliance standards.

Definitions and Assumptions

Food safety is first and foremost a legal and moral obligation. No business should ever delay or reduce investment in basic food safety systems based on ROI projections. Protecting public health is a nonnegotiable duty. The RAROI model can help articulate the business value of food safety, but it should never be used to downplay the ethical and legal necessity of food safety.

RAROI is a communication framework. It translates the impact of food safety into financial and strategic terms, which is particularly useful in engaging executives, investors, or cross-functional leaders. However, leaders should not use RAROI as a justification to delay necessary corrective actions or to minimize risk management.

Some of the most valuable outcomes, such as risk avoidance, are difficult to quantify. The avoidance of a recall, outbreak, or regulatory penalty may not be visible in quarterly metrics, but prevention efforts potentially save a business hundreds of thousands of dollars or more. These benefits carry strategic weight and should be reflected in ROI estimations and long-term planning.

Any ROI estimate depends on assumptions. Projections about savings, growth, or risk probabilities must be documented and regularly revisited. This model provides structure, not certainty.

While larger organizations may have the data and systems to support precise calculations, smaller businesses may need to rely on estimates or industry benchmarks. That's okay, as long as the assumptions are clear and the model is used as a guide, not a guarantee.

Key Takeaways

- RAROI is a tool to support food safety, not replace core responsibilities.
- ROI insights should complement, not override legal and ethical decision-making.
- Not all returns are financial or immediate, but may be strategically vital.
- Assumptions should be realistic, conservative, transparent, and revisited if needed.

Section 3

Understanding ROI in Food Safety

What Is ROI?

ROI is a financial metric used to evaluate the profitability or value of an investment. In the context of food safety, it helps quantify how much benefit a business gains from investing

in systems, training, technology, and processes that improve food safety outcomes.

This workbook uses a tailored version of the traditional ROI equation, the RAROI model, that captures gains and savings specific to food safety management, as follows:

$$\text{RAROI} = \left(\frac{\text{operational gains} + \text{market gains} + \text{risk reduction}}{\text{implementation costs}} \right) / \left(\frac{\text{implementation costs}}{\text{costs}} \times 100 \right)$$

Many food businesses consider food safety investments as regulatory necessities, not as potential sources of return.

Measuring ROI allows you to accomplish the following:

- Shift the narrative from cost to value
- Make informed decisions about where and how much to invest
- Communicate clearly with senior management and stakeholders
- Build internal support for continuous food safety improvement

What Return Looks Like in Food Safety

Table 3.1 summarizes the key types of returns captured by the RAROI model, along with examples of how each area can contribute measurable value.

Table 3.1

Key types of returns captured by the RAROI model

| Key food safety returns | Examples of value or benefit |
|---------------------------------|--|
| Operational gains | Reduced downtime or fewer shutdowns Less rework and waste because of fewer quality deviations More rapid resolution of issues |
| Market gains | Gaining access to new customers or markets Meeting buyer or certification requirements Increased consumer or client trust |
| Risk reduction (cost avoidance) | Avoiding the financial impact of a recall Reducing the likelihood of regulatory fines or legal fees Preventing damage to your brand reputation |

Common Misconception



"If we've never had a major incident, we don't need to invest more in food safety."



The absence of past issues does not mean the risk is low. It may simply mean you've been fortunate. FSMS investments are about preventing future losses, not reacting to past ones. The cost of a significant food safety failure, including recall, regulatory fines, lawsuits, lost contracts, and brand damage, can be catastrophic.

RAROI helps you measure what you're protecting, not only what you've experienced.

Reflection Prompt



- What inefficiencies or food safety issues cost your business in time or money
- How often you experience downtime or product loss because of food safety issues
- The financial impact of reducing the issues by 50 percent

Worksheet Prompt



Estimate RAROI components (refer to table 3.2)

Table 3.2

Estimating the gains, benefits, and value of the RAROI components

| Type of gain | Example benefit | Estimated annual value |
|------------------|--|------------------------|
| Operational gain | Reduced product waste | |
| | Reduced downtime | |
| | Increased production efficiency | |
| Market gain | Access to premium buyers | |
| | Access to export market | |
| | Increased customer trust | |
| Cost avoidance | Avoiding a single recall | |
| | Reduced likelihood of regulatory fines | |
| | Protected reputation | |

Key Takeaways

- RAROI helps reframe an FSMS as a strategic investment, not merely a cost of compliance.
- The RAROI model aligns safety improvements with measurable business outcomes.
- Understanding RAROI establishes the foundation for collecting data and building your case for food safety investments.

Section 4

Collecting Baseline Data

Before measuring the return on food safety investments, you need a clear picture of your starting point. Baseline data help you accomplish the following:

- Identify current performance gaps
- Estimate the impact of improvements
- Establish a comparison point for tracking progress
- Build credibility into your ROI calculations

Collect data from across your operation, focusing on areas directly related to the RAROI components. Table 4.1 outlines key data points for establishing a baseline for evaluating RAROI.

Table 4.1

Key data points in establishing a baseline to evaluate RAROI

| Category | Key data |
|-----------------------------|--|
| Operational performance | Product loss because of spoilage or contamination Rework frequency Testing costs Supplier rejection rate Downtime because of food safety issues Audit nonconformities Corrective action response time Cost of discarded or reworked product Labor and material costs linked to quality incidents |
| Market and customer metrics | Annual sales volume Revenue by market segment (domestic vs. import) Revenue by buyer channel (wholesale, retail, local, premium, and so on) Customer satisfaction metrics |
| Risk and compliance | Costs because of recent recalls or near-misses Frequency of food safety incidents or complaints Past regulatory fines or audit failures Number of regulatory inspection–related corrective actions outstanding Average traceability time |

Tips for Data Collection

- Use recent 12-month data if they are available.
- Pull data from existing reports: audit results, production logs, quality assurance , customer feedback.
- Involve finance, operations, and quality teams to improve accuracy and completeness.
- Estimate conservatively if precise data are unavailable, but document any assumptions.

Worksheet: Baseline Data Snapshot



Fill in the current values for these key metrics (refer to table 4.2).

Reflection Prompt



Where are you currently losing value because of weaknesses in food safety?

- Think about waste, customer dissatisfaction, production delays, or reputational risks.
- What metrics do you already track that relate to food safety performance?

Table 4.1

Current cost and volumes of the key metrics

| Metric | Current cost/volume | Data source and notes |
|--|---------------------|-----------------------|
| Product waste (kg or %) | | |
| Rework incidents per month | | |
| Customer complaints (annual) | | |
| Audit nonconformities | | |
| Estimated cost of recent recall or quality issue | | |

Key Takeaways

- Baseline data are essential in measuring improvement and proving ROI.
- Focus on metrics that align with operational, financial, and reputational impacts.
- Use these data as your foundation throughout the RAROI modeling process.

Section 5

Estimating Implementation Costs

Understanding the full cost of implementing or upgrading an FSMS is critical for accurate ROI calculation. This cost represents the investment you are comparing against the gains captured in the RAROI model.

Break your costs into direct and indirect categories to obtain a complete picture. Table 5.1 outlines common direct and indirect costs to consider in estimating the investment required to implement an FSMS.

Table 5.1

The direct and indirect costs of FSMS components

| Cost category | Examples |
|----------------|--|
| Direct costs | Training and certification (staff and management) Consultant and auditor fees New equipment, sensors, and software for monitoring and compliance Infrastructure and facility upgrades Documentation, labeling, and packaging updates |
| Indirect costs | Staff time diverted to planning, training, and implementation Temporary slowdowns in production Efforts in change management (for instance, cultural or behavioral shifts) Maintenance and subscription costs for new systems |

Tips for Accurate Estimation

- Review quotes, past invoices, and project budgets
- Break large projects into components (for example, software + training + audit)
- Consult finance or procurement for historical cost references
- Don't forget ongoing costs, such as subscriptions or annual audits

Reflection Prompt



What are the one-time and ongoing costs you expect for your FSMS improvements?

- Which costs can be estimated easily?
- Where might you need to use conservative assumptions or seek input from others?

Worksheet: Implementation Cost Estimator



Use table 5.2 to estimate your costs.

Table 5.2

Estimating the costs of components

| Cost category | Estimated amount (US\$) | Notes and assumptions |
|--------------------------------------|-------------------------|-----------------------|
| Training and certification | | |
| Consulting and audit fees | | |
| Equipment and technology | | |
| Facility or process upgrades | | |
| Internal labor (time costs) | | |
| Annual maintenance and subscriptions | | |

Key Takeaways

- Accurately estimating implementation costs ensures credible RAROI analysis.
- Include both direct and indirect costs to reflect the true investment.
- Document assumptions and sources to improve transparency and consistency.

Section 6

Estimating Operational Gains

Operational gains are one of the most immediate and measurable returns from implementing or enhancing an FSMS. These gains reflect improvements in day-to-day performance, efficiency, and resource use.

Common areas where operational improvements lead to measurable savings or value include waste reduction,

efficiency enhancement, and process optimization. Table 6.1 outlines types of operational gains that can be realized through FSMS implementation, categorized by their nature and impact.

Table 6.1

The potential operational gains of FSMS implementation

| Operational gain category | Examples |
|--------------------------------|--|
| Waste and rework reduction | Fewer quality-related defects Less product loss because of spoilage or contamination Reduced reprocessing costs |
| Efficiency improvements | More rapid preoperational checks and product changeovers Shorter downtime related to quality issues Streamlined documentation and traceability |
| Labor and process optimization | Improved employee adherence to procedures Fewer corrective actions and less time spent addressing issues Time savings through digital tools and automation |

Tips for Estimating Operational Gains

- Use historical data to estimate time and cost savings (for instance, average downtime, rework volume)
- Quantify changes in hours of labor, materials use, or process steps
- Involve operations and quality assurance analysis teams to validate assumptions

Reflection Prompt



Where have you experienced friction, delays, or waste in your operations?

- Which improvements would free up staff time or resources?
- What would a 10 percent improvement in these areas be worth to your business?

Worksheet: Estimating Operational Gains



Identify and estimate potential gains from operational improvement (refer to table 6.2).

Table 6.2

Estimates of potential gains from operational enhancements

| Operational area | Estimated annual gain (US\$) | Basis and assumptions |
|--|------------------------------|-----------------------|
| Reduction in product waste | | |
| Fewer quality-related shutdowns | | |
| Improved employee compliance | | |
| Less time spent on rework or investigations | | |
| Efficiency gains through digitized processes | | |

Key Takeaways

- Operational gains can provide early and tangible returns on FSMS investments.
- Focus on efficiency, labor, waste, and productivity improvements.
- Use past data and team input to ground your estimates in reality.

Section 7

Estimating Market Gains

Market gains reflect the revenue growth or competitive advantage of associated with a successful FSMS. These gains may be less immediate than operational savings, but they often represent significant long-term value.

Table 7.1 outlines various market-related gains that are enabled through FSMS implementation, highlighting how food safety can support business growth and differentiation.

Table 7.1

Market-related gains enabled by FSMS implementation

| Market gain category | Examples |
|---|--|
| Access to new markets | <ul style="list-style-type: none"> Meeting food safety certification requirements (such as Brand Reputation Compliance Global Standards, Global Food Safety Initiative, Safe Quality Food) Entering export markets or larger retailer supply chains Qualifying for higher-value distribution channels |
| Customer trust and retention | <ul style="list-style-type: none"> Strengthening customer confidence and loyalty Supporting brand credibility and marketing claims Reducing churn because of product quality or safety concerns |
| Product differentiation and pricing power | <ul style="list-style-type: none"> Justifying premium pricing through transparency and safety practices Competing on more than only price Attracting partnerships with quality-driven buyers |

Tips for Estimating Market Gains

- Use sales projections tied to new certifications or market entry
- Estimate the lifetime value of retained customers
- Consider past lost opportunities because of a lack of certification or poor food safety performance

Reflection Prompt



- What new business could you pursue with stronger food safety credentials?
- Have buyers or partners required certifications or improvements in the past?
 - Could stronger food safety performance enhance your brand reputation or pricing?

Worksheet: Estimating Market Gains



Estimate potential revenue or value generated through market-related gains (refer to table 7.2).

Table 7.2

Estimates of the value of market gains

| Market gain area | Estimated annual value (US\$) | Basis and assumptions |
|---|-------------------------------|-----------------------|
| Improved retention of existing customers | | |
| Access to new export or retail markets | | |
| Eligibility for institutional or public tenders | | |
| Premium pricing for certified or safer product | | |

Key Takeaways

- Market gains reflect top-line business benefits enabled by food safety investment.
- Certifications and credibility can open doors to new opportunities.
- Think strategically about where safety performance aligns with brand and growth goals.

Section 8

Estimating Cost Avoidance (Risk Reduction)

Understanding the Value of Risk Reduction

While food safety investments often focus on compliance, one of their most important benefits is often invisible: the losses that don't happen. These prevented losses, known as cost avoidance, are a critical part of the return on food safety investments.

Risk reduction refers to the decrease in likelihood and severity of food safety incidents because of the implementation of an FSMS or related controls. An FSMS reduces exposure to serious disruptions, such as the following:

- Product recalls
- Regulatory action or fines
- Legal claims
- Reputational damage
- Loss of key customers or market access

Cost avoidance is the financial benefit of preventing a future food safety failure. It is calculated by estimating the following:

- How likely a major food safety incident is to occur
- What the cost of an incident would be if it occurred
- How much risk is reduced by implementing food safety controls
- What cost is avoided because of improved control

RAROI captures this value under the risk reduction component of returns (refer to table 8.1). Even if an incident hasn't yet happened, an FSMS protects the business from future losses that could be financially devastating.

Table 8.1

Risk, risk reduction, and cost avoidance

| Concept | Definition |
|----------------|---|
| Risk | The chance of a food safety incident happening (for instance, contamination, recall) |
| Risk reduction | The decrease in that risk because of an FSMS or other preventive measures |
| Incident cost | The costs associated with a major food safety incident, including recall costs, fines, legal settlements, loss of business, and so on |
| Cost avoidance | The money saved by not having to deal with a food safety failure |

Reflection Prompt



Take a moment to consider the following:

- What type of food safety incident would be most damaging to your business?
- Have you or similar companies in your market experienced recalls, rejections, or reputational harm?
- If a major event occurred, how much would it cost your company to respond?
- What controls do you currently have in place? Are they adequate?

Key Concepts

Avoiding a food safety incident is a ROI that is not immediately visible. An FSMS helps reduce both the likelihood and the impact of serious events, and that prevention has real financial value.

Next, you'll learn how to estimate that value using a simple, semiquantitative approach, even if you don't have detailed data.

Estimating the Baseline Risk of a Food Safety Incident

Before calculating the value of reducing food safety risks, you need to estimate your baseline risk or the likelihood of a significant food safety incident occurring without the interventions you're planning or evaluating.

This risk reflects the current state of your operations, supply chain, and controls before improvements are made.

The baseline risk is the annual probability that, without planned interventions, your company would experience a serious food safety incident, such as a product recall, regulatory enforcement, or public health alert.

You can estimate precontrol risk using one of the approaches indicated in table 8.2. Table 8.3 is a worksheet for the baseline risk estimation.

Table 8.2

Approaches to estimating precontrol risk

| Approach | Description | When to use |
|--------------------------|--|--|
| Industry benchmark | Use published data such as Food and Drug Administration (FDA) recall rates or sector averages. | If you have no internal incident data |
| Company history | Review your own incident logs, near misses, or audit failures. | If you've tracked this |
| Expert judgment | Estimate based on product, process, supplier risk, and known vulnerabilities. | For new facilities, products, or markets |
| Hazard-targeted estimate | Assess risk based on a specific known hazard in your supply chain (for example, lead in turmeric). | If a clear, evidence-based risk is known |

Table 8.3

Worksheet: baseline risk estimate

| Question | Your input | Basis and assumptions |
|---|--------------------------|---|
| What is your estimated annual risk of a major incident (before controls)? | For instance, 0.3% or 5% | Based on history, supplier risk, product category, or public data |
| What factors make your risk higher or lower than average? | | Describe regional, process, or hazard-specific elements |

Estimating Risk Reduction

The risk reduction rate is the percentage decline in the likelihood of a major food safety incident as a result of your food safety investment. This can be estimated based on the following:

- Historical experience with similar controls
- Expert input by quality assurance compliance teams
- Certification body or auditor recommendations

For example, a system based on hazard analysis critical control point (HACCP) might reduce risk by 50 percent–70 percent, while a full FSMS with supplier verification and audit oversight might reduce risk by 80 percent–95 percent (refer to the worksheet, table 8.4).

Table 8.4

Worksheet: risk profile estimate

| Variable | Your estimate | Basis and assumptions |
|-----------------------------------|---------------|--|
| Baseline incident probability (%) | | For example, 0.3% FDA or 5% high-risk sourcing |
| Expected risk reduction (%) | | For example, 50% (HACCP), 95% (full FSMS) |
| Post intervention probability (%) | | = Baseline × (1 – risk reduction %) |

Note: FDA = Food and Drug Administration. HACCP = hazard analysis critical control point

Estimating the Cost of a Major Food Safety Incident

Once you've estimated the likelihood of an incident, the next step is to calculate what an incident would cost if one occurred. Costs vary significantly, but even a small recall or regulatory fine can exceed hundreds of thousands of dollars.

Consider both direct and indirect costs. Be conservative in your estimates and clearly document your assumptions (refer to table 8.5).

Table 8.5

Worksheet: estimate of the financial impact of a food safety incident

| Cost component | Estimated amount (US\$) | Notes and assumptions |
|--|-------------------------|-----------------------|
| Product retrieval, rework, or destruction | | |
| Regulatory fines or penalties | | |
| Testing and investigation costs | | |
| Legal fees or settlements | | |
| Contract penalties or lost sales | | |
| Public relations and crisis management | | |
| Reputational damage (such as loss of future sales) | | |
| Operational downtime or disruption | | |

Total estimated incident cost: _____

Calculating Avoided Cost (Cost Avoidance)

Now that you've estimated the risk of an incident and the potential cost, you can calculate your expected annual cost avoidance using the following formula:

$$\text{Cost avoidance} = \left(\text{baseline risk} \times \text{risk reduction \%} \right) \times \text{estimated incident cost}$$

The following examples demonstrate how to use the estimates of initial risk, risk reduction, and the cost of a food safety incident to calculate the avoided costs because of the risk reduction associated with food safety investments.

Example 1 Simplified Estimate Using Data of the Food and Drug Administration

This example demonstrates how to estimate cost avoidance using publicly available data and broad industry averages. It's designed for situations where your company may not have detailed internal incident history or product-specific failure rates.

Food businesses can build a baseline model to illustrate the potential value of food safety risk reduction by using publicly available data, such as Food and Drug Administration recall statistics and published cost ranges. While this approach is simple and accessible, it has significant limitations. The risk estimate reflects the situation among US facilities that already operate under regulatory oversight, and the cost range varies significantly depending on product, market exposure, and incident type.

Use this method if internal data are unavailable and you need a high-level estimate to support early ROI discussions or planning. Understand that these figures are generic and may not apply to your business context, region, or food category.

The assumptions are as follows:

- Baseline incident probability: 0.3 percent (based on Food and Drug Administration data)
- Risk reduction: 50 percent (for instance, in a new HACCP program)
- Incident cost range: US\$8 million (low) to US\$300 million (high)
- Cost avoidance formula: (baseline risk × risk reduction %) × estimated incident cost
- Low estimate: $(0.3\% \times 50\%) \times \text{US\$8,000,000} = \text{US\$12,000}$
- High estimate: $(0.3\% \times 50\%) \times \text{US\$300,000,000} = \text{US\$450,000}$

Example 2 Detailed Product-Specific Estimate (Turmeric and Lead)

The second example illustrates how to estimate cost avoidance using product- and hazard-specific approaches. It is based on a company that sources turmeric from an Asian county, where studies have documented widespread lead adulteration because of the postharvest use of industrial pigments.

The company is considering implementing preventive measures, including a supplier assurance program and HACCP-based controls. It wants to estimate the value of this investment in terms of reduced risk exposure.

This method uses publicly available hazard research, internal knowledge of sourcing risks, and modeled costs from a potential recall. It provides a tailored and more credible financial estimate than an estimate based on industry-wide averages.

Use this method if you have a moderate understanding of your risk profile and want to make a defensible business case for food safety investment using realistic inputs.

Recommended for most users: combining targeted data with structured estimation improves accuracy and credibility.

The assumptions are as follows:

- Baseline incident probability: 5 percent (based on sourcing from a high-risk region)
- Risk reduction: 95 percent (based on proposed supplier and HACCP controls)
- Estimated incident cost: US\$5,000,000

$$\text{Cost avoidance formula: } (5\% \times 95\%) \times \text{US\$5,000,000} = \text{US\$237,500}$$

The resulting value is the expected annual savings associated with reduced risk exposure.

Putting It All Together: Calculating Cost Avoidance

Now that you've estimated your baseline risk, your expected risk reduction, and the potential cost of a major food safety incident, you're ready to calculate your estimated cost avoidance.

This final step combines your estimates quantifying how much financial loss your food safety investment could prevent annually.

Cost avoidance formula

You can calculate cost avoidance using either of these formulas, as follows:

Option 1: Simplified

Cost avoidance = (baseline risk × risk reduction %) × estimated incident cost

Option 2: Detailed

Cost avoidance = (baseline risk × incident cost) – (post-intervention risk × incident cost)

Both options lead to the same result. Choose the option that's easier for your team to use.

Table 8.6

Worksheet: final estimate of cost avoidance

| Input | Your estimate | Notes and assumptions |
|--|---------------|--|
| Baseline incident probability (%) | | For example, 0.3% (FDA) or 5% (high-risk sourcing) |
| Estimated risk reduction (%) | | For example, 50% (basic HACCP), 95% (full FSMS) |
| Post intervention probability (%) | | Auto-calculate: baseline × (1 – risk reduction) |
| Estimated cost of incident (US\$) | | Include product loss, fines, legal, and so on |
| Estimated annual cost avoidance (US\$) | | Formula: (risk × reduction) × cost |

Note: FDA = Food and Drug Administration. HACCP = hazard analysis critical control point

Cost avoidance because of risk reduction is one of the most important, yet often invisible financial benefits of food safety investments. By reducing the likelihood and severity of food safety incidents, your FSMS helps prevent losses that could otherwise be devastating.

Even if your company has never had a major food safety incident, understanding your risk exposure helps justify proactive investment and builds a stronger business case for action.

Key Takeaways

- Use credible assumptions based on internal data, public benchmarks, or known hazards.
- Be conservative in your estimates and transparent about your inputs.
- Even a small reduction in high-cost risk exposure can deliver substantial cost savings.
- Cost avoidance is a core return in the RAROI model. Track it and report it.

Section 9

Tracking and Evaluating KPIs

KPIs help you monitor the effectiveness of your FSMS and demonstrate measurable business value. The most valuable KPIs are the KPIs that can be linked to financial outcomes and used to forecast or prevent problems and issues. This section emphasizes leading and lagging indicators across the RAROI model.

To track progress and anticipate future performance, use both, as follows:

- Leading indicators: predictive measures that signal potential outcomes (for example, training compliance, hygiene scores)
- Lagging indicators: outcome-based measures that reflect past performance (for example, recalls, complaints, sales results)

Leading indicators are crucial to early intervention while lagging indicators validate long-term ROI.

Examples of Financially Relevant KPIs

Use table 9.1 to guide the selection of KPIs aligned with RAROI components.

Table 9.1

Financially relevant key performance indicators

| KPI | Type | RAROI component | Financial relevance (US\$) | Notes and frequency |
|--|---------|------------------|----------------------------|---------------------|
| Preventive maintenance completion rate | Leading | Operational gain | | Monthly |
| Process compliance audit score | Leading | Operational gain | | Monthly |
| Product waste (% and US\$) | Lagging | Operational gain | | Monthly |
| Rework or rejection rate | Lagging | Operational gain | | Monthly |
| On-time certification renewal | Leading | Market gain | | Quarterly |
| Customer inquiry conversion rate | Leading | Market gain | | Monthly |
| New market-driven sales | Lagging | Market gain | | Quarterly |
| Customer retention rate | Lagging | Market gain | | Annually |
| Internal audit frequency and score | Leading | Risk avoidance | | Monthly |
| Near-miss reporting rate | Leading | Risk avoidance | | Monthly |
| Audit non-conformities | Lagging | Risk avoidance | | Per audit |
| Insurance premium reduction | Lagging | Risk avoidance | | Annually |

Tips for Effective KPI Use

- Prioritize KPIs that align with RAROI components and financial outcomes.
- Use leading indicators to forecast risks or performance dips.
- Validate ROI estimates using consistent and tracked lagging indicators.
- Involve cross-functional teams to maintain reliable data.

Key Takeaways

- Use both leading and lagging indicators to capture a full picture of FSMS performance.
- Emphasize KPIs that can be tied to operational gains, market access, or cost avoidance.
- Translate technical indicators into business language to engage decision-makers.

Reflection Prompt



Which leading indicators could help you detect food safety issues early?

- Are there lagging indicators you can translate into financial terms?
- How can KPIs help you build a stronger case for continued investment in FSMS?

Section 10

Calculating and Presenting ROI

After estimating implementation costs, operational gains, market gains, and risk avoidance, the final step is to calculate your RAROI. This quantifies the business value of your food safety initiatives and supports stronger decision-making and stakeholder buy-in.

RAROI Formula

Use the RAROI formula to calculate the return on your food safety investment, as follows:

$$\text{RAROI} = \left(\frac{\text{operational gains} + \text{market gains} + \text{cost avoidance} - \text{implementation costs}}{\text{implementation costs}} \times 100 \right)$$

This gives you a percentage return, showing how much value your investment generates relative to the cost. Let's suppose the following:

- Operational gains = US\$50,000
- Market gains = US\$40,000
- Cost avoidance = US\$60,000
- Implementation costs = US\$75,000

$$\text{RAROI} = ((\text{US\$50,000} + \text{US\$40,000} + \text{US\$60,000}) - \text{US\$75,000}) / \text{US\$75,000} \times 100 = 100\%$$

This means that the business generates an additional dollar in value for every dollar invested in an FSMS.

Tips for Presenting ROI

- Use simple charts or tables to show inputs and results.
- Highlight both financial and strategic benefits (for example, market access, brand protection).
- Be transparent about assumptions and sources.
- Share scenarios: show conservative, expected, and best-case returns.

Worksheet: RAROI Calculation



Fill in your figures to calculate ROI.

Table 10.1

Worksheet: RAROI calculation

| | |
|-----------------------------|--|
| Operational gains (US\$) | |
| Market gains (US\$) | |
| Cost avoidance (US\$) | |
| Implementation costs (US\$) | |
| RAROI (%) | |

Reflection Prompt



How does your RAROI compare with other investments your business makes?

- What assumptions did you make, and how confident are you in these assumptions?
- How will you update this calculation as more data become available?

Key Takeaways

- The RAROI puts a number on the value of food safety investment.
- Calculating and sharing RAROI helps shift food safety from a cost center to a value driver.
- The RAROI should be updated periodically to reflect new data and trends in performance.

Appendixes

Appendix A. RAROI Calculation Worksheets

Table A.1

Implementation cost estimator

| Cost category | Estimated amount (US\$) | Notes and assumptions |
|--------------------------------------|-------------------------|-----------------------|
| Training and certification | | |
| Consulting and audit fees | | |
| Equipment, technology | | |
| Facility or process upgrades | | |
| Internal labor (time costs) | | |
| Annual maintenance and subscriptions | | |
| Other | | |
| | | |
| | | |
| Total implementation cost | | |

Table A.2

Operational gains estimator

| Operational area | Estimated annual gain (US\$) | Basis and assumptions |
|---|------------------------------|-----------------------|
| Reduction in product waste | | |
| Fewer quality-related shutdowns | | |
| Improved employee compliance | | |
| Less time on rework and investigations | | |
| Efficiency, digitized process component | | |
| Other | | |
| | | |
| | | |
| Total estimated operational gains | | |

Table A.3

Market gains estimator

| Market gain area | Estimated annual value (US\$) | Basis and assumptions |
|--|-------------------------------|-----------------------|
| Improved customer retention | | |
| Access to new export or retail markets | | |
| Eligibility for institutional tenders | | |
| Premium pricing for certified products | | |
| Other: | | |
| | | |
| | | |
| Total estimated market gains | | |

Table A.4

Risk reduction (cost avoidance) calculator

| Input | Your estimate | Basis and notes |
|------------------------------------|---------------|-----------------|
| Baseline incident probability (%) | | |
| Risk reduction (%) | | |
| Estimated incident cost (\$) | | |
| Post-intervention risk (%) | | |
| Annual cost avoidance (calculated) | | |

Table A.5

RAROI summary table

| Category | Estimated value (US\$) |
|---------------------------------|------------------------|
| Operational gains | |
| Market gains | |
| Cost avoidance (risk reduction) | |
| Implementation costs | |
| RAROI (%) (calculated) | |

Appendix B. FSMS KPI Tracking Template

Understanding how leading indicators drive FSMS outcomes can help your team proactively monitor progress and connect actions to results. Tracking leading and lagging

indicators supports continuous improvement and helps build a credible business case for continued investment in your FSMS. Use the examples shown in table B.1 for inspiration and then document your own leading and lagging pairs.

Examples of Leading and Lagging Indicator Pairs

Table B.1

Leading and lagging indicator pairs

| Component | Leading indicator (predictive) | Lagging indicator (outcome) |
|----------------|--|--|
| Implementation | Monthly FSMS cost tracking (vs. forecast) | Project cost vs. budget (over/under %) |
| Implementation | Internal audit completion rate | Certification achievement (for example, BRC, FSSC 22000) |
| Implementation | Staff completion of HACCP and food safety training | Decrease in implementation-related nonconformities |
| Implementation | Corrective action response time (internal audits) | Number of repeat findings in external audits |
| Operational | Preoperational check compliance (%) | Downtime because of quality/safety issues |
| Operational | Real-time digital logging of CCPs | Rework volume or scrap rate reduction |
| Operational | Equipment cleanliness audit pass rate | Product waste because of contamination |
| Operational | Adherence to SOPs (observed in line audits) | Labor time spent on corrective actions |
| Market | Number of certification projects in progress | Gaining access to new markets or buyers |
| Market | % of products with traceability to farm or source | Premium pricing secured for verified product lines |
| Market | Buyer satisfaction survey response rate | Customer retention rate |
| Market | Percentage of on-time customer audits passed | Sales growth in certified product categories |
| Risk reduction | Supplier audit scores above threshold | Supplier rejection rate |
| Risk reduction | Food safety risk assessment updates completed | Regulatory findings or sanctions |
| Risk reduction | Frequency of recall simulations or drills | Time to complete actual recall (if applicable) |
| Risk reduction | % of open CAPAs resolved within 30 days | Insurance premium adjustments based on risk score |

Note: BRC = British Retail Consortium. CAPA = corrective and preventive action. CCP = critical control point. FSSC = Food Safety System Certification. HACCP = hazard analysis critical control point. SOP = standard operating procedure.

Your Own KPI Pairs

Use table B.2 to define and track key indicators relevant to your food safety system.

Table B.2

Key leading and lagging indicators defined and tracked

| Component | Your leading indicator | Your lagging indicator | Notes or assumptions |
|----------------|------------------------|------------------------|----------------------|
| Implementation | | | |
| Operational | | | |
| Market | | | |
| Risk reduction | | | |
| Other | | | |

Appendix C. Data Collection Checklist

Operational Data

- Product waste logs (%/volume)
- Rework and rejection reports
- Downtime reports linked to food safety
- Internal audit and CAPA reports

Market data

- Sales by market or channel
- Certification requests
- Customer retention or churn data

Risk and incident history

- Recall logs (internal or external)
- Regulatory actions or fines
- Quality assurance investigation reports
- Insurance claims or premiums

Financial and cost data

- Recall or incident cost breakdowns
- Budget for FSMS implementation
- Quotes for equipment, training, or audits

People to involve

- Quality assurance and relevant food safety lead
- Operations manager
- Finance or controller
- Sales and customer liaison
- External consultants (if used)

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