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Certificates or Safety? Unpacking the Effectiveness of Food Safety Management Systems

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Abstract

Purpose: *This review aims to evaluate recent evidence on the real-world effectiveness of food safety management systems (FSMS), including third-party certification, HACCP programs, and training initiatives, particularly in developing countries, with a specific focus on the case study of Uzbekistan.*

Methodology: *A structured strategy was used to examine 16 academic papers and five additional reports published between 2018 and 2025. The findings were divided into three categories: certification outcomes, HACCP efficacy, and training impacts, and then applied particularly to Uzbekistan.*

Findings:

- *Certifications like ISO 22000 and BRC notably improved compliance and correlated with fewer food safety incidents.*
- *HACCP implementation reduced hazards significantly, but these improvements were sustainable only with regular audits.*
- *Targeted, hands-on training sessions substantially improved employee knowledge and safe handling practices, particularly when led by qualified managers.*
- *Organizational culture, managerial commitment, and effective regulatory oversight were critical for achieving meaningful results.*

Focus region: *Uzbekistan's recent legislative initiatives, in conjunction with foreign support, present a considerable opportunity to adopt rigorous, risk-based safety monitoring and strengthen its safety culture, despite obstacles including periodic foodborne outbreaks and insufficient inspection resources.*

Practical implications: *Policymakers should prioritize genuine safety outcomes over mere certification, engage in practical training and technology solutions for small businesses, leverage safety data to target inspection efforts, and incorporate food safety culture explicitly into national regulations.*

1. Introduction

Foodborne diseases remain a significant global public health challenge, disproportionately affecting populations in low- and middle-income countries. According to the World Health Organization (WHO), an estimated 600 million cases of foodborne illnesses and 420,000 related deaths occurred in 2010 alone, with the heaviest burden borne by children under five and communities in Africa and Southeast Asia (WHO, 2015). These diseases are not only a health concern but also a critical obstacle to achieving food security, reducing poverty, and facilitating equitable trade.

Amid growing concerns about food safety and supply chain integrity, the adoption of food safety management systems (FSMS), such as Hazard Analysis and Critical Control Points (HACCP) and ISO 22000, as well as third-party certification schemes, have emerged as a cornerstone of modern food governance. Food safety systems are designed to make preventive practices part of everyday operations, keep hazard controls consistent, and improve traceability throughout the food supply chain. At the same time, there's growing recognition that training food handlers and enforcing regulations play an equally important role in reducing contamination risks and ensuring that standards are followed.

But even with all the attention these tools are getting, there's still a big question mark over how well they actually work in the real world. Do certification programs truly help lower the number of foodborne illness outbreaks? Is HACCP practical—and effective—at all levels, from small businesses to large-scale operations? And does training really lead to better safety practices on the ground, or does the knowledge stay in the classroom? What's still not well understood—especially in developing and emerging economies—is how food safety regulations actually relate to the number of incidents that occur, given the wide differences in institutional capacity. This review sets out to examine the available evidence on how well food safety management systems (FSMS), HACCP, certification schemes, training programs, and regulatory frameworks are working to improve food safety and reduce contamination risks. It covers studies across the food industry, fresh produce, and food service sectors, with a particular focus on countries with developing or transitioning economies. Drawing from both peer-reviewed and grey literature, the article places special emphasis on the policy and institutional conditions under which these interventions succeed or fail. The article also includes a dedicated section that looks closely at the food safety situation in Uzbekistan and the wider Central Asian region, outlining key policy challenges unique to this context.

By bringing together insights from across the literature, the review aims to support the development of smarter regulatory strategies, targeted capacity-building efforts, and more effective donor interventions, particularly in places where the risks are high, but the potential for improvement is even higher.

2. Methodology

This article adopts a structured narrative review approach to examine the impact of various food safety interventions—such as certification programs, HACCP systems, training initiatives, and regulatory measures—on food safety outcomes. The goal is not just to summarize what science says but to draw out practical lessons and policy insights, especially those that can benefit low- and middle-income countries.

2.1. Scope of the review

The review draws on a wide range of sources published within the last five to ten years, including peer-reviewed journal articles, systematic reviews, meta-analyses, case studies, institutional reports, working papers, and book chapters. Priority was given to studies that:

- Evaluated the impact or effectiveness of food safety certification (e.g., ISO 22000, GlobalG.A.P., BRC, HACCP),
- Assessed food safety training outcomes, behavior change, or capacity-building effects,
- Examined the implementation of FSMS in various settings (industry, food service, agriculture),

Studies were selected to cover a diversity of regions, especially those from developing and transition economies. The sectors included span the food industry, fresh produce chains, and food service operations. Special attention was paid to extracting evidence relevant to Central Asia, including Uzbekistan, where such analyses are limited but highly needed.

2.2. Sources and data collection

This review is grounded in 16 peer-reviewed journal articles and grey literature, including strategic documents from the WHO, regional assessments, and government-commissioned reports. The peer-reviewed studies were sourced from major academic databases such as ScienceDirect, PubMed, and Wiley Online Library. Meanwhile, the grey literature was gathered from official platforms like the WHO, FAO, the CAREC Institute, and national food safety agencies.

Each source was carefully reviewed to understand its main goals, the strength of its methodology, and its key findings on the effectiveness of food safety management systems (FSMS). Whenever possible, the analysis focused on measurable outcomes—such as reductions in foodborne outbreaks, improvements in audit scores, and shifts in food handler behavior after training. At the same time, qualitative insights—like implementation challenges, institutional weaknesses, and cultural factors influencing food safety—were also considered to provide a fuller picture and ensure the findings are useful for shaping policy.

2.3. Analytical approach

Rather than conducting a meta-analysis, the review employs a thematic synthesis approach. The sources were categorized according to the primary intervention they examined: (1) certification schemes, (2) HACCP implementation, and (3) food safety training. Each group of studies was then analyzed for consistency, context specificity, and relevance to developing country settings. Particular attention was given to cross-cutting enablers and barriers to success, including managerial culture, institutional enforcement capacity, the cost of compliance, and access to training. A dedicated section focuses on Central Asia and Uzbekistan, combining regional institutional assessments with country-specific findings. The final sections discuss overarching trends and formulate evidence-informed policy recommendations.

3. Effectiveness of food safety certification schemes

Food safety certification schemes like ISO 22000, BRC, IFS, and GLOBALG.A.P. have become widely used tools for improving food safety and building consumer trust—especially in the context of international trade. These certifications generally

require businesses to formalize their food safety procedures, implement preventive hazard controls, and submit to regular audits by accredited bodies. While certification is often seen as a badge of quality and compliance, its actual impact on food safety can vary a lot depending on the setting—particularly in developing and transitioning economies, where implementation challenges are often more complex. The narrative-style review by Panghal et al. (2018) aims to explain why ISO 22000 (the flagship Food Safety Management System that combines ISO 9001 quality principles with HACCP) was developed, its structure, and what it delivers to firms along the food chain. The authors sift through the academic and standards literature to map ISO 22000's core building blocks—prerequisite programs, operational PRPs, and HACCP plans—and to compare them with earlier stand-alone GMP, HACCP, and ISO 9001 approaches. Their desk-based synthesis reveals that ISO 22000 offers an auditable, globally harmonized framework capable of achieving “once-certified, accepted worldwide” reach, providing companies with a single scheme that satisfies regulators and buyers while driving internal improvements in hygiene, traceability, and customer confidence. At the same time, the review flags persistent gaps: vague guidance on prerequisite programs, heavy documentation burdens and overlap with sister specifications—all of which can slow uptake and erode the standard's original promise of simplification. The authors recommend periodic revision of ISO 22000 (now underway) and closer alignment with Global Food Safety Initiative benchmarks to maintain both the rigour and user-friendliness of the scheme.

Păunescu et al. (2018) set out to explore why Romanian food businesses decide to certify to ISO 22000, what slows them down, and what they gain once the plaque is on the wall. The study framed three objectives—mapping motivations, pinpointing obstacles, and quantifying benefits—and addressed them through a questionnaire survey sent to 327 firms along the national food chain, yielding 43 valid responses. Using factor analysis and multiple linear regression, the authors identified two dominant motivation factors (internal improvement/differentiation and external compliance) and three clusters of implementation difficulties, the most significant being employee qualification gaps, high setup costs, and legal-compliance burdens. Despite these hurdles, certification delivered clear dividends: safer products, fewer foodborne risk incidents, higher consumer confidence, and even better sales. Regression results showed that sales growth, new market access, and continuous staff skill upgrades were the strongest predictors of improved business performance (adjusted $R^2 = 0.97$). In short, ISO 22000 is effective—but only after firms invest in people, resources, and a commitment to management.

Drawing on 116 confidential case studies from 27 food sector categories in 36 developed and 80 developing-country SMEs, Lee et al. (2023) set out to illuminate what changes inside a small or medium food enterprise once it adopts a formal Food Safety Management System (FSMS). Using a structured survey completed by on-site food-safety professionals, the team captured “before” and “after” snapshots of each firm's certification status, prerequisite programs, HACCP practices, cultural and managerial factors, and broader sustainability and traceability activities. McNemar and Wilcoxon tests revealed large, statistically significant post-implementation increases in virtually every safety indicator. International FSMS

uptake rose from 17% to 64% in developed economies and from 27% to 48% in developing economies; overall third-party certification climbed from 34% to nearly 60% worldwide. Prerequisites such as GMP, GHP, and equipment design controls achieved an 80% adoption rate following implementation, and HACCP elements (oPRPs, CCP definition, monitoring, and verification) reached or surpassed a 90% adoption rate in most regions. Soft-factor gains were equally striking: food-safety culture and managerial leadership scored above 80% post-implementation, while worker training, KPI tracking, crisis management, food defence, and food fraud plans all expanded sharply. The most significant remaining pain points were cost, complexity, and limited customer familiarity with FSMS—constraints felt most keenly by African, Latin American, and South Asian firms. Nonetheless, the authors conclude that FSMS certification delivers clear, measurable improvements in both technical controls and organizational culture, and can narrow the food-safety gap between developing and developed markets when paired with targeted capacity-building support.

Rincón-Ballesteros et al. (2024) investigate whether the institutional context—Spain versus 14 Latin American countries—impacts the translation of managerial motivations into an effectively implemented Food Safety Management System (FSMS). They surveyed 2,389 BRC Global Standard-certified agro-food plants and obtained 574 valid responses (351 from Spain, 223 from Latin America). A structured Likert questionnaire captured four motivation clusters—ethical, efficiency, commercial, and legitimacy—and rated FSMS performance across HACCP, management-system, and best-practice domains. Multi-group structural-equation modelling revealed that context matters: in Spain, ethical responsibility toward consumers was the only significant driver of high FSMS scores, whereas in Latin America, commercial imperatives (export access and sales growth) were the strongest positive drivers, and legitimacy-seeking (adopting standards mainly to appease external pressures) undermined performance. Altogether, the motivation variables explained 12% of the variance in implementation in Spain and 19% in Latin America, underscoring the moderating effect of regional environments on certification outcomes.

Benlamlih et al. (2025) investigate whether a company's food-safety culture truly impacts the performance of certified Food Safety Management Systems (FSMS) in Morocco. Using a structured questionnaire, they collected data from quality and food safety managers in 60 agri-food firms that were already certified to ISO 9001, ISO 22000, or FSSC 22000. Nine latent culture variables—ranging from employee priorities and risk awareness to management involvement—were measured with 44 Likert-scale items and analyzed with PLS-SEM after reliability and dimensionality checks. The modelling shows that three cultural elements exert the most significant influence on system effectiveness: (i) employee awareness and knowledge of food-safety risks, (ii) the involvement and role of management and supervisory staff, and (iii) employee priorities and attitudes. Awareness of risks and managerial involvement yielded medium-sized positive effects on overall FSMS evaluation and performance, as well as on effective complaint management, while modestly strengthening employee priorities and confidence in the FSMS. The authors

conclude that even in already certified plants, embedding a strong, participatory safety culture is pivotal for translating paper compliance into operational performance, and they advocate for weaving explicit culture requirements into Moroccan food-safety regulations.

Zheng et al. (2023) address a macro-level question that has seldom been empirically tested: *Does the broader adoption of third-party food-safety certification correspond to fewer foodborne disease cases, and can certification data help predict future outbreaks?* They assembled panel datasets covering certification counts from 2015 to 2020, regulatory variables, and economic controls for all U.S. states and 30 European countries. Then, they ran fixed-effects regressions linking certification uptake (e.g., SQF, PrimusGFS, BRC, ISO 22000, FSSC 22000) to reported illness counts. In the United States, certifications to SQF, PrimusGFS, BRC, or FSSC 22000 were each negatively associated with outbreak illnesses. In Europe, ISO 22000 and FSSC 22000 showed similar protective associations. A second analytical strand applied decision-tree and random-forest algorithms, models that included certification variables, predicted state-level U.S. illness totals with ~75% test accuracy. Feature-importance plots ranked BRC adoption as the single most influential predictor after GDP. The authors conclude that certification datasets are a valuable, underutilized signal for public health surveillance and that higher certification density is consistently linked to lower outbreak burdens across two continents.

Sasikumar Nair et al. (2023) aimed to investigate the extent to which international certification can enhance food safety performance in a developing-country microenterprise. The authors audited a 25-employee Kerala snack factory twice—first in 2019, before the factory adopted ISO 22000:2018 and the U.S.-mandated Foreign Supplier Verification Program (FSVP), and again in 2021, six months after obtaining third-party certification. Using a bespoke 70-item checklist that merged all ISO 22000 and FSVP clauses, they scored conformity across ten domains (regulatory compliance, HACCP-based food-safety plan, process controls, sanitation, personnel hygiene, premises, allergen management, pest control, packaging/labeling, and visitor control). Pre-certification results revealed that only half of the requirements (50%) were met, with the weakest areas being the formal food safety plan, allergen controls, and packaging label accuracy. Following certification, overall conformity increased to 97%; nine of the ten domains achieved full compliance, and only two pest control items remained outstanding. Statistical testing (McNemar χ^2 and Cochran's Q) confirmed that the improvement was highly significant ($p < 0.001$). At the same time, a 97.14% pass rate demonstrated that integrated ISO 22000 + FSVP certification can transform even manual, low-tech operations into exporters capable of meeting U.S. and EU standards. The authors conclude that, despite the upfront costs, voluntary certification offers small Indian processors a practical pathway to international markets and provides regulators with an audit-ready tool for tracking progress.

Rihawi (2024) evaluates how adopting the updated ISO 22000:2018 Food Safety Management System reshapes day-to-day performance in complex plants that operate multiple production streams. Using a mixed-methods design, the study

tracked three medium-sized Syrian facilities—dairy, meat processing and bakery—for twelve months before and after certification. Quantitatively, key performance indicators, including downtime, non-compliance incidents, throughput, and customer complaints, were recorded monthly. Qualitatively, semi-structured interviews with quality managers, production supervisors, and line operators captured implementation hurdles and perceived gains. Shapiro–Wilk tests confirmed data normality, after which paired *t*-tests (or Wilcoxon tests for non-normal variables) showed statistically significant improvements across the board: downtime fell 14-19 %, and non-compliance incidents dropped 44-46 % in single-line plants and 54 % in a multi-line setting. Correlation analysis further linked higher staff-training hours to steeper performance gains. Interviewees cited smoother audits, stronger traceability, and a reputational boost as additional benefits, although they acknowledged upfront costs and the complexity of coordination. Overall, the findings suggest that ISO 22000:2018 certification can yield substantial operational and safety benefits, even in facilities with multiple product lines.

4. Effectiveness of HACCP implementation

Hazard Analysis and Critical Control Points (HACCP) is widely recognized as the gold standard for preventive food safety, endorsed by the Codex Alimentarius and required by law in many countries. Unlike traditional, rule-based regulations, HACCP takes a proactive approach—focusing on identifying, monitoring, and controlling biological, chemical, and physical hazards throughout the food production process. While the system is conceptually strong and well-supported in theory, its real-world implementation—particularly in settings with limited resources—has shown mixed results.

The study by Yang et al. (2019) aimed to evaluate the effectiveness of Hazard Analysis and Critical Control Point (HACCP)-based Food Safety Management (FSM) systems in small and/or less developed food businesses (SLDBs) in China. Recognizing the challenges these businesses face—such as financial limitations, lack of training, and inadequate infrastructure—the researchers applied a meta-analysis methodology to quantitatively synthesize data from 24 eligible studies published in Chinese between 1994 and 2015. The studies reviewed spanned a range of food sectors—including catering, bottled water, bakery, and meat processing—and focused on four key indicators: food handler hygiene, cleanliness of food-contact surfaces and environments, employees' food safety knowledge, and the safety of the final food products. The meta-analysis showed clear improvements across all areas following HACCP implementation. In fact, the pooled odds ratios (ORs) ranged from 6.39 to 10.58, pointing to a strong and statistically significant positive impact. Despite high heterogeneity and some publication bias, the results remained robust through subgroup and sensitivity analyses.

Radu et al. (2023) use a bibliometric lens to trace more than four decades of HACCP-related scholarship, analyzing 361 Scopus-indexed papers published between 1978 and 2022 with the *bibliometrix* R package and VOSviewer, and coupling those maps with a PRISMA-guided mini-review of 13 empirical implementation studies. Their science-mapping reveals a field that was virtually dormant until the early 1990s, then

expanded steadily, with the United States dominating output until 2012, before Italy emerged as the most prolific contributor. Network analysis now places the United Kingdom, the United States, and the Netherlands at the centre of global collaboration. Co-word clusters indicate that research continues to centre on core concepts such as foodborne diseases, hazard control, and supply-chain quality, while newer topics—such as mycotoxin testing and personal hygiene metrics—are only just beginning to emerge. Synthesizing the implementation literature, the authors identify chronic barriers—especially the cost and paperwork burden for SMEs, limited HACCP knowledge, and uneven regulatory support—yet they also catalogue the tangible gains firms report after adoption, from demonstrable product safety improvements to smoother internal workflows, expanded market access, and heightened consumer trust. The study concludes that although HACCP scholarship is maturing, it remains fragmented, and future work should focus on digital tools, cross-border risk management, and the measurable impact of evolving regulations—issues that will shape the next generation of food safety systems.

Levy et al. (2022) set out to close a persistent evidence gap: whether the food-safety policies most rolled out in catering settings—chiefly HACCP-based training programs and hand-hygiene campaigns—translate into measurable reductions in microbial contamination. Following PRISMA guidelines, they searched six multidisciplinary databases and screened more than 1,100 records, ultimately including eight uncontrolled before-and-after studies from OECD countries. All studies quantified colony-forming units (CFU) on food, hands or contact surfaces before and after the intervention. Fixed-effect pooling showed that these policies reduced overall microbial counts by an average of 28.6% (95% CI: –30.6% to –26.7%). Subgroup analyses revealed sharper drops for *Enterobacteriales* (–71.7%) and swabs taken from the hands of food handlers (–48.9%), whereas the effect waned to –12% when samples were collected more than a year after implementation, implying that refresher action is needed to sustain the gains. Although all included studies carried a critical risk of bias (no randomized trials), sensitivity checks confirmed the direction and magnitude of the effect. The authors conclude that HACCP-oriented training and hygiene policies are promising end-of-chain tools for preventing foodborne disease in catering, but call for better-designed, controlled trials to strengthen the evidence base.

Working with a small meat-processing enterprise located near Kazakhstan’s former Semipalatinsk nuclear test site, Baikadamova et al. (2024) set out to determine whether a tailored HACCP plan could mitigate chemical-radiological hazards that persist in this ecologically burdened region. Their before-and-after study tracked two production seasons (Nov 2022–Apr 2023 vs. Nov 2023–Apr 2024) and applied full HACCP methodology—hazard analysis, five critical control points (raw-material acceptance, blanching, cooking, cooling, packaging/storage), and verification via ICP-MS for heavy metals, gamma spectrometry for Cs-137, and chromatography for pesticide residues. Implementation paid off: lead fell 7 % (0.55 → 0.51 mg/kg) and arsenic 42 % (0.12 → 0.07 mg/kg); Cs-137 dropped 6 % (7.2 → 6.8 Bq/kg); and residual HCH and DDT declined roughly 10–20 %. Statistical analysis confirmed a strong link between HACCP adoption and reduced contamination levels ($p \leq 0.05$).

Notably, even in areas affected by radiation, facilities with strict process controls were able to outperform standard GMP practices and keep their products within national safety limits.

5. Impact of training on food safety outcomes

Insfran-Rivarola et al. (2020) aimed to quantify the impact of food safety and hygiene training on the knowledge, attitudes, and practices of food handlers across the “farm-to-fork” chain. Drawing on PRISMA guidelines, they searched five scientific databases for intervention studies published between 1997 and 2019, accepting randomized, quasi-experimental, controlled before-after and pre-post designs to capture real-world diversity. Thirty-one studies ($n = 10\text{--}194$ each) met the criteria, most of which were delivered through face-to-face lectures or demonstrations, and spanned schools, hospitals, processing plants, restaurants, and street vendors. Random-effects meta-analysis revealed a significant gain in knowledge (Hedges $g = 1.24$, 95 % CI 0.89–1.58), moderate improvement in self-reported attitudes ($g = 0.28$, 95 % CI 0.07–0.48) and a medium uplift in overall hygienic practice ($g = 0.65$, 95 % CI 0.24–1.06). When practices were split, self-reported behaviours showed a larger effect ($g = 0.80$) than observer-rated behaviours ($g = 0.45$), suggesting a potential social-desirability bias. Although heterogeneity was high and many studies carried some risk of bias, the funnel plot and Egger/Begg tests did not indicate serious publication bias. The authors conclude that structured training is an effective lever for safer food handling but recommend periodic refreshers and more rigorous study designs to sustain and verify behaviour change. In the systematic review by Cotter et al. (2023), the aim was to determine how rigorous food-safety training for frontline food handlers is conceived and executed when viewed through the ADDIE instructional design lens. A structured search of five scholarly databases (2005–2021) yielded 23 peer-reviewed intervention studies, all of which evaluated at least one learning outcome (knowledge, attitudes, or behaviours) among food handlers in commercial or industrial settings. The authors found that only about one-fifth of the studies (\approx approximately 22%) conducted a substantive needs analysis before designing the training. At the same time, the vast majority delivered short, face-to-face sessions (<8 h) grounded mainly in behaviourist principles. Evaluation quality was modest: two-thirds relied on uncontrolled pre/post designs, and barely one-quarter were randomized trials. Despite these methodological limitations, most programs improved food-safety knowledge (83%), with smaller but still frequent gains in behaviours (70%) and attitudes (30%). The authors concluded that training crafted through a systematic ADDIE-style process and assessed to at least Kirkpatrick Level 3 offers the most significant promise for durable behaviour change.

Kassa et al. (2010) asked whether putting a certified food-service manager at the helm trims sanitation problems in real kitchens. They retrospectively analyzed 1,034 health-inspection reports from 605 high-risk (category IV) establishments in Toledo/Lucas County, Ohio, collected over a 12-month window (March 2005 – February 2006). Facilities were divided into two groups: those with at least one Ohio-approved certified manager and those without. T-tests and ANOVA were used

to compare total, critical, and non-critical violations, while stratifying by restaurant type and chain size. Results showed that restaurants led by certified managers averaged fewer critical violations (1.75 vs. 2.08 per inspection, $p < 0.05$), even though they logged slightly more non-critical issues. Certification made no significant difference in institutional kitchens, such as hospitals or schools, which already displayed lower violation counts. Additionally, large chain outlets outperformed small independents regardless of their training status. The authors come to the conclusion that independent restaurants benefit the most from manager certification, and they recommend implementing the organized oversight procedures used by institutions and chains to improve public health outcomes further.

Adil (2023) aimed to evaluate the effectiveness of food safety training initiatives in Tanzania's food service sector. Using a low-cost desk study design, the researcher collated and analyzed secondary evidence from previously published studies and official reports accessed through online journals and libraries. The review shows that training programs measurably enhanced staff knowledge and day-to-day hygiene practices, drove better compliance with national food safety regulations, and were linked to fewer reported cases of foodborne illness. Nevertheless, Adil highlights persistent hurdles—most notably limited resources and difficulties in sustaining improvements over time—which call for tailored, long-term support strategies if the gains are to be maintained.

6. Focus Region: Uzbekistan

In recent years, Uzbekistan has faced ongoing issues with food safety, with outbreaks of foodborne illnesses affecting hundreds of its inhabitants each year. 518 individuals, including 194 children, were illened and two people died as a result of 65 documented food poisoning cases in 2022 alone (Daryo.uz, 2023). Despite authorities seizing over 5 million kg of low-quality food from markets that year, the recurrence of outbreaks suggests that enforcement alone is insufficient to address the issue. In the first part of 2023, 21 outbreaks affected 107 people, 22 of them children, underscoring the ongoing risks (Daryo.uz, 2023). The trend continued through 2023. Thirty-nine food poisoning episodes have been reported in Uzbekistan by August, affecting 414 people, including 86 children, and resulting in at least two fatalities (Kun.uz, 2023). 81 cases were caused by botulism, which frequently happens when home-canned foods are consumed. Low-quality components and improperly handled fast-food items were linked to a higher number of outbreaks. Numerous mass events took place in companies, schools, and weddings. Significantly, an epidemic at two kindergartens in July 2023 caused dozens of children to become ill as a result of dirty kitchens and antiquated equipment (Kun.uz, 2023).

Structural weaknesses in oversight mechanisms remain apparent. Only 1,512 of the 20,184 registered food outlets were examined by Uzbekistan's Sanitary-Epidemiological Service in 2024, or 7.5% of the total, and 664 of those facilities had violations (Kun.uz, 2025). This scant coverage reveals inadequate inspectorate capacity and a lack of regular monitoring. More than 147,000 kg of subpar food were taken out of distribution in the first four months of 2023 alone (Daryo.uz,

2023), highlighting the continued existence of safety hazards in spite of reactive enforcement measures.

The government created a new draft law, "On Food Safety," in early 2025 to replace the out-of-date 1997 statute after seeing the need for systemic change. The goal of the law, which was adopted on its first reading in the Legislative Chamber, was to align food safety governance with international best practices and scientific principles (UzDaily, 2025). The following important measures were suggested by the draft law:

- Clarifying governance roles and defining state policy priorities.
- Harmonizing domestic sanitary measures and production standards with global frameworks such as the WTO SPS Agreement and Codex Alimentarius.
- Introducing a unified electronic registry to track food circulation and eliminating redundant certifications to reduce the regulatory burden.
- Allowing dual shelf-life labelling ("best before" and "use by") and requiring warning labels for products "not recommended for minors."

However, controversy arose over the provision concerning the labelling of minor-restricted foods. Lawmakers criticized the ambiguity of terms like "school-age" and "marketing content," resulting in the draft's rejection for revision during a July 2025 vote. (Kun.uz, 2025). Despite this legislative impasse, Uzbekistan's reform trajectory continues with international support. In April 2025, the government and the Food and Agriculture Organization (FAO) of the United Nations launched a joint project to assess and strengthen the national food control system (FAO, 2025). At the inception workshop in Tashkent, FAO representatives acknowledged Uzbekistan's ongoing reform efforts, including the draft law. The project aims to develop a comprehensive national food safety strategy and action plan, improve inter-agency coordination, and shift toward science-based, risk-oriented oversight. These reforms aim not only to reduce domestic foodborne illnesses but also to enhance export competitiveness by aligning Uzbekistan's food safety standards with international expectations (FAO, 2025).

There are challenges and changes in Uzbekistan's food safety situation. Current vulnerabilities are reflected by the frequent outbreaks, scant inspection coverage, and enforcement gaps. Nonetheless, ongoing legislative initiatives and global cooperation demonstrate a growing commitment to systemic change. Long-term political will, more explicit regulatory definitions, increased resources for inspections, and a more thorough integration of public health will all be necessary to ensure successful transformation. Interestingly, several research studies and regional evaluations caution against relying too heavily on certification as a substitute for food safety. Giap (2022), certification is occasionally employed more as a marketing gimmick than as a legitimate tool for managing food safety in several Central Asian nations. The efficacy of the program is weakened in Uzbekistan, for example, where a large number of certified producers suffer lax enforcement or lack institutional support for compliance. Radu et al. (2023) also highlighted a geographic study gap in Sub-Saharan Africa and Central Asia, where there are few empirical studies despite the region's growing food safety concerns.

7. Discussion and policy implications

The review began by highlighting food safety systems, such as HACCP, ISO 22000, certification programs, and training, as key tools for improving food safety worldwide. The evidence now shows these systems can truly make a difference. Studies across multiple countries and companies have reported significant improvements following the adoption of these systems. For example, small and medium-sized enterprises (SMEs) saw increases in hygiene practices, hazard control, and food safety culture. At a broader level, research from the U.S. and Europe found that regions with more third-party certifications tended to report fewer foodborne illness outbreaks, suggesting real public health benefits when certification becomes widespread.

However, success is not guaranteed. How and why a company adopts these systems matters. A comparison between Spain and Latin America revealed that when companies implemented food safety systems driven by ethical responsibility, the results were better than when they did so to meet export requirements. Culture within the organization also plays a significant role. Companies where employees are aware of risks and where managers are actively involved tend to perform better, even if they are already certified. On the technical side, some standards are still too complicated or unclear—especially when it comes to supporting documents and overlapping requirements—which can discourage adoption or weaken results. These findings underscore the need for clearer, more user-friendly systems and a more profound commitment to integrating food safety into company values, rather than merely adhering to checklists.

HACCP remains one of the most trusted food safety systems globally, and the data backs this up. In small or less-developed food businesses, studies have shown significant improvements after HACCP is implemented, particularly in terms of cleanliness, food safety knowledge, and final product safety. In catering settings, microbial contamination decreased by nearly 30% after food safety policies were introduced, although the effect waned over time without regular refreshers. Other research has confirmed that HACCP not only brings cleaner food but also smoother workflows and increased consumer trust, as long as companies have sufficient capacity and support. An impressive example from Kazakhstan showed that a customized HACCP plan could even reduce chemical and radioactive contaminants in meat near a former nuclear test site. This demonstrates that when applied thoughtfully, HACCP is highly adaptable, even in harsh environments.

Even the best-designed food safety systems rely on trained personnel to operate effectively. Most training programs do improve food handlers' knowledge, and many also improve hygiene behaviors and attitudes. Nevertheless, many of these programs are short, and their quality varies. Too often, they focus on classroom lectures rather than hands-on learning, and they rarely measure whether changes last. A larger analysis showed that while knowledge improved strongly, actual hygiene practices saw only medium gains, and people tended to report better behavior than what observers saw. Crucially, there were fewer serious infractions at food establishments run by certified managers, particularly independent eateries. This implies that

effective leaders can make a big difference, particularly in environments with lax supervision. All things considered, training is not only beneficial but also necessary to ensure that food safety systems function in the actual world.

Together, the findings demonstrate that certification, HACCP, and training can deliver tangible improvements—but only when specific conditions are met. In countries with weak institutions, poor oversight, or limited capacity, these systems may ultimately be more about appearances than actual results. However, when there is strong leadership, solid training, and real investment in safety culture, the same tools can dramatically reduce risk, even in challenging contexts. For countries like Uzbekistan and others focused on expanding food exports, the key message is this: food safety systems are effective, but they require support to succeed. That support includes better enforcement, more innovative training, and a shift in culture from "just passing the audit" to genuinely protecting consumers.

In Uzbekistan, sanitary inspectors reach only 8% of registered food businesses, leaving most facilities unchecked and many hazards undetected. Governments should redirect scarce inspection resources toward the highest-risk products, processes, and regions, using outbreak data, certification records, and laboratory findings as targeting cues. Countries can also leverage reforms, such as Uzbekistan's draft Law on Food Safety, which proposes a single electronic registry and clearer agency roles, to streamline monitoring and reduce duplicative paperwork. Public-health agencies could go a step further by treating third-party certification logs as an "early-warning" layer; research across the U.S. and Europe shows that states with more certified sites tend to have fewer reported illness outbreaks.

Many LMIC firms still struggle with FSMS paperwork, high compliance costs, and limited technical know-how. Regular, hands-on training is therefore critical. Meta-analyses confirm that structured programs enhance knowledge and reduce contamination, but their effects fade without regular refreshers. Policymakers should co-fund modular courses for frontline workers and certify food-service managers, a step linked to fewer critical violations in independent restaurants. Parallel investments in regional laboratories and digital traceability will enable inspectors to verify hazards quickly and provide businesses with real-time feedback. Finally, regulators can embed "food-safety culture" requirements—such as management engagement, open reporting, and worker empowerment—into national guidelines, echoing evidence that culture is a decisive driver of FSMS performance.

Certification schemes deliver clear technical and cultural gains when companies adopt them for genuine improvement, but they underperform if treated as mere export badges. Authorities should therefore recognize credible schemes within inspection regimes—granting fewer audits or faster licensing to consistently high-performing certified plants—and audit the auditors to keep incentives honest. Linking tax rebates, low-interest upgrade loans, or priority access to export permits with demonstrable safety outcomes (not just certificates) can motivate SMEs to go beyond the minimum. Donors and development banks can amplify their impact by funding "last-mile" upgrades—such as sanitation stations, cooling equipment, or HACCP consultancy—so that small processors can reach the same standards as

larger exporters. In practice, even resource-poor plants have achieved near-total ISO 22000 compliance after targeted support, opening doors to EU and U.S. markets. Food safety is not a one-off law but a continuous improvement cycle. Uzbekistan's draft bill already mirrors Codex and WTO-SPS principles; yet, debate over vague labelling terms has stalled its passage. Legislators should build in periodic reviews, public consultations, and pilot phases so rules stay flexible and science-based. Publishing inspection statistics and outbreak dashboards will also keep both industry and regulators accountable, increase consumer trust, and help researchers fill the evidence gaps that still exist for Central Asia. By coupling smart enforcement, capacity enhancements, cultural change, and transparent governance, export-oriented countries can transform food-safety systems from paper shields into genuine public health safeguards—while gaining a competitive edge in global markets.

Conclusion

This review explored a fundamental yet challenging question: Do food safety management systems improve food safety? After reviewing recent research—including 16 academic studies and several additional reports—there is strong evidence that these systems indeed help, though their effectiveness depends greatly on how they are implemented.

- **Certification is effective—but only if it is genuine.** Certifications such as ISO 22000, BRC, and GLOBALG.A.P. have significantly improved food safety measures, reduced hazards, and enhanced staff engagement. However, the real benefits emerged when companies pursued genuine improvements rather than merely pursuing certification for market access, and when auditors maintained high standards.
- **HACCP remains essential.** HACCP effectively controls risks ranging from chemical residues in agricultural products to microbial threats in restaurants, and it has been demonstrated to reduce food contamination significantly. However, to sustain these gains over time, routine follow-up audits are essential.
- **Training changes results.** Effective training programs not only increased employees' knowledge but also significantly improved their hygiene and safety behaviours. The most impactful training was hands-on, practical, and led by certified managers rather than brief classroom sessions.
- **Context matters more than checklists.** Real progress is primarily dependent on dedicated leadership, a culture of support where employees feel free to express their concerns, and regulatory frameworks that effectively target high-risk sectors. Safety systems frequently remain primarily bureaucratic endeavors in the absence of these supporting variables.

Uzbekistan highlights these points clearly. Inconsistent legislation, insufficient inspection capacity, and recurrent foodborne illness outbreaks plague the country. Ongoing regulatory improvements, however, backed by global organizations like the FAO, present a promising chance to introduce digital monitoring, risk-based inspections, and a more robust food safety culture. When appropriately implemented, food safety can be utilized by Uzbekistan to enhance public health and enhance export prospects. If done superficially, there is a risk that the main problems will not be addressed and that additional paperwork will be created.

Looking ahead, research should examine digital monitoring tools, financial incentives for small enterprises, and long-term outcomes of widespread certification, especially in underrepresented regions such as Central Asia and Sub-Saharan Africa. Until then, the best strategy for safer food remains clear: practical standards, effective training, robust oversight, and courageous management decisions.

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