



MBG SAFE Model: Risk-Based Integrated Food Safety Governance Framework in the Supply Chain of the Free Nutritious Meal Program in Indonesia

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Abstract

Background. The Free Nutritious Meal (MBG) program is a national-scale nutrition intervention characterized by mass food production and distribution, which is at high risk if capacity growth is not balanced with competence, infrastructure, and process control.

Objectives. This study aims to identify the root causes of food safety incidents in the MBG supply chain and develop an integrated prevention model for MBG SAFE.

Methods. This study uses a qualitative-descriptive design through a desk review and policy analysis of official documents from the National Nutrition Agency, regulations, incident reports, and scientific literature on HACCP, food handler training, food safety culture, and digital traceability. The analysis used source triangulation, upstream-downstream process mapping, 5M+1E classification, and gap analysis between normative requirements and operational practices.

Results. The results show that these incidents cannot be explained solely by the low level of education among implementers. The root cause is an inconsistent competency system, including competency inequality, kitchen capacity that is not proportional to production load, time pressure, weak supplier verification, non-compliance with time-temperature controls, distribution delays, and supervision that is not fully data-based. The MBG SAFE model is proposed through nine pillars: supplier assurance, position-based competency certification, SPPG capacity accreditation, HACCP per menu, food digital passport, time-temperature control, independent food safety officers, early warning and rapid response, and multi-level audits and enforcement.

Conclusion. The novelty of the research lies in integrating competencies, capacity, breakpoint control, batch traceability, and stop-the-line authority into a single MBG governance architecture.

Implementation. This model can serve as a basis for developing audit instruments, empirical research, and measurable toxicity prevention policies.

Keywords: MBG; food safety; SPPG; HACCP; competence; digital traceability; supply chain



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INTRODUCTION

The Free Nutritious Meal (MBG) program is designed to expand access to nutritious food for students and vulnerable groups while driving the local economy. The program is expanding rapidly. The National Nutrition Agency (BGN) reported that the number of Nutrition Fulfillment Service Units (SPPG) increased from 190 units in January 2025 to 19,188 units in early January 2026, then to 21,102 units on January 20, 2026. The expansion increases the program's benefits but also increases risk exposure if quality control, food safety, and competence do not develop at the same pace (National Nutrition Agency [BGN], 2026a, 2026b).

Food production for thousands of recipients is fundamentally different from household cooking or small catering. Codex Alimentarius treats mass catering as a risky activity because food is produced in large quantities, stored, transported, and consumed by groups that are often vulnerable, including children. Therefore, safeguarding requires hazard analysis, establishing critical control points, monitoring, corrective action, and consistent documentation (Codex Alimentarius Commission, 1993).

Incident data show that food safety issues are not isolated incidents. BGN recorded 4,711 affected recipients as of September 22, 2025, while the November 2025 report mentioned 441 exceptional incidents with 11,640 affected beneficiaries. In 2026, the Head of BGN said more than 80% of the incidents evaluated involved violations of standard operating procedures, including storage, material receipt, kitchen capacity, temperature, distribution, and consumption deadlines (Hindayana, 2025; Sudaryono, 2026). Differences in figures across periods and sources also show the urgency of integrating case definitions and uniform national databases.

The published cases show a variety of causes. The incident in Palu is suspected to be related to cross-contamination of yellowtail fish; the incident in West Bandung is associated with high nitrite levels in melons and lotek; the incident in Semarang is suspected to be related to certain ingredients and the cooking process being too early; while the case of Sidoarjo shows non-compliance with consumption time limits. The pattern shows that risks can arise from ingredients, suppliers, labor, methods, capacity, time, temperature, and distribution (BGN, 2025a, 2025b, 2026c).

The government has strengthened its control foundation through the requirement of the Sanitation Hygiene Suitability Certificate (SLHS), BGN Regulation Number 4 of 2026 on the Food Safety and Food Quality Assurance System, BGN-BPOM collaboration, and the development of digital systems. However, administrative compliance does not automatically result in safe work behavior. In January 2026, only about 32% of SPPGs reported meeting the SLHS. In September 2026, BGN temporarily closed 1,999 kitchens that had not registered for SLHS, indicating an implementation gap (BGN, 2026d, 2026e; Republic of Indonesia, 2026).

The literature shows that training improves food handler knowledge and practice, but its impact will be limited without management, facilities, supervision, and safety culture support. Meta-analyses found positive effects of training on knowledge, attitudes, and practices, while catering policy studies show HACCP-based programs can reduce microbial contamination. Thus, MBG solutions are not enough as one-time training; they must integrate competencies, process design, capacity, technology, leadership, and enforcement (Insfran-Rivarola et al., 2020; Levy et al., 2022; Pai et al., 2024).

Problem Formulation

1. What are the dominant root causes of food safety risks throughout the MBG supply chain?
2. What is the relationship between the competence of the actors, the capacity of the SPPG, time pressure, supplier quality, and SOP compliance?
3. What policy and operational models can suppress toxicity that can be systematically prevented?

Research Objectives

This study aims to analyze the root causes of MBG food safety incidents, map the upstream–downstream governance gap, and formulate the MBG SAFE model as an integrated, empirically testable prevention framework.

Research Novelty

The novelty lies in integrating five elements that have tended to be treated separately: position-based competencies, production capacity accreditation, HACCP per menu, digital traceability per batch, and stop-the-line authority. The model not only measures document compliance, but also relates actual capacity, time-temperature data, supplier risk profile, and distribution termination decisions.

Research Gap

Study/approach	Main focus	Limitations for MBG contexts	Research position
Insfran-Rivarola et al. (2020).	Effectiveness of food handler training	Haven't integrated kitchen capacity, distribution, and batch traceability yet	Combining competence with system control
Levy et al. (2022).	Food safety and HACCP policies in catering	Focus on general microbiological impacts	Implement HACCP per menu and per SPPG
Pai et al. (2024).	Food safety culture and leadership	Not yet specific to the national public program	Incorporating Food Safety Officer and stop-the-line independence
Lai et al. (2025).	Digital traceability governance	Focus on commercial food chains and interoperability	Developing a digital passport of MBG food from suppliers to schools
BGN Policy 2025–2026	SLHS, SOPs, food safety and quality	Implementation is not yet uniform; event data is not fully open per batch	MBG SAFE integrative architecture and risk KPIs

METHODS

Research Design

This study uses a qualitative-descriptive design through desk review and policy analysis. This design was chosen because the research aims to formulate a conceptual model by synthesizing secondary evidence, rather than estimating causal relationships through primary surveys. The analysis unit includes policies, supply chain processes, incident reports, and food safety control mechanisms in MBG.

Data Sources and Selection Criteria

The data sources consist of: (1) official publications of BGN and SIPGN; (2) government and BGN regulations; (3) government reports or credible media that cite official statements; (4) WHO and Codex guidelines; and (5) scientific articles on HACCP, training, food safety culture, mass catering, and digital traceability. Documents are selected if they are relevant to the period January 2025–September 2026 for the context of MBG or are the main scientific reference for food safety theory.

Analysis Procedure

1. Extraction of information regarding dates, locations, number of victims, materials/menus, investigation results, confirmation status, and corrective actions.

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2. Mapping the supply chain from producers/suppliers to consumption in schools.
3. Classification of root problems using the Man, Machine, Method, Material, Measurement, and Environment (5M+1E) framework.
4. Analysis of the gap between normative standards and operational implementation.
5. Synthesis of the MBG SAFE model, performance indicators, implementation stages, and research propositions.

Validity and Limitations

Validity is supported by triangulation across official sources, regulations, incident reports, and scientific literature. The study explicitly distinguishes between initial allegations, operational findings, and laboratory-confirmed causes. The main limitation is the lack of an open database that consistently presents all incidents with laboratory results, portion denominations, and the number of SPPGs involved. Therefore, the study results are a conceptual policy model that requires field validation.

DISCUSSION

Scale and Risk Development

Indicator	2025	2026	Interpretation
SPPG operates	190 at the beginning of the program; 19,188 at the beginning of Jan 2026	21,102 on Jan 20; about 27 thousand in mid-2026	Very fast growth increases the need for competence and supervision
Incidents/casualties	4,711 affected as of Sep 22; 11,640 in 441 KLBs as of Nov 11	5,482 fatalities in 71 incidents from Jul 22–Sep 3	Definitions and data periods are different; need a unified database
SLHS	Obligations set	About 32% in Jan; 1,999 kitchens temporarily closed in Sep because they had not registered	Huge gap between policy and implementation

The very rapid growth of SPPGs poses risks in the scale-up process. Facilities, trained personnel, suppliers, auditors, and information systems do not necessarily develop at the same rate. This explains why compliance with SOPs should be read not only as a matter of individual discipline, but also as a consequence of capacity design and operational pressures.

Published Event Cause Mapping

Events	Key findings	Category 5M+1E	Status
Palu, August 2025	Suspected cross-contamination in yellowtail fish	Material, Method, Man	Initial conjecture; awaiting lab results on initial release
Banggai Islands, 2025	Skipjack fish from a new supplier is associated with indigestion	Material, Method	Supplier factors identified; laboratory details are not published
West Bandung, September 2025	High nitrite levels in melons and loteh; 1,315 students affected	Material, Measurement	Declared by the BGN investigation team
Semarang, July 2026	Guessing certain ingredients and cooking too early	Method, Material, Measurement	Initial investigation
Sidoarjo, 2026	Food exceeds consumption limits due to late delivery and consumption	Method, Man, Environment	Violations of the SOP when identified
Events 2026	More than 80% were attributed to violations of SOPs; animal protein side dishes and spoiled vegetables were dominant	Whole 5M+1E	BGN aggregate conclusion

Root Cause Diagnosis

Dimensions	Manifestations	Systemic root problems	Security impact
Man	Uneven competence; discipline and weak rejection decisions	Training is not always based on practice and position assessments	Misconception, sanitization, cooking, and distribution
Machine	Limited tool, space, cooling, and vehicle capacity	The determination of the number of portions is not completely based on accredited capacity	Food cooked too early or the temperature is out of control
Method	SOPs available but inconsistent or unrealistic	Production targets, schedules, and distribution distances are out of sync	Time–temperature violations and cross-contamination
Material	Defective materials, new suppliers, unstable quality of animal protein	Supplier verification and receipt checks are not yet uniform	Biological and chemical hazards come in from the upstream

Measurement	Time, temperature, batch, and complaint records are fragmented	Traceability is not end-to-end and data is not yet real time	Late deviations are discovered; investigation is slow
Environment	Water, sanitation, weather, distance, and school conditions vary	National standards have not always been adjusted to local risk profiles	The risk of contamination and delays increases

The findings lead to a competency-system mismatch. Perpetrators may know the SOP but still fail if the number of portions exceeds capacity, materials arrive late, vehicles are unavailable, or schools are too far away. Conversely, adequate facilities also do not guarantee safety without competence, leadership, and safety culture. Therefore, a single intervention through training is not enough.

Model MBG SAFE

TAIL	SPPG	DISTRIBUTION	SCHOOL/RECIPIENT
Verified suppliers Batch and Quality of Materials	Accredited capacity HACCP per menu Certified competencies	Time–temperature control Hygienic vehicles A Collection of Essays	Admission check Consumption limits Complaint reporting
Supplier Assurance	Food Safety Control	Full Traceability	Early Warning & Enforcement

MBG SAFE is a multi-layered gate system. Food can move to the next stage only if the requirements for materials, capacity, time, temperature, documentation, and personnel are met. If any critical limit is violated, the Food Safety Officer may hold or stop the batch without considering the target number of servings.

Pillar	Operational design
1. Supplier and Source Assurance	List of verified suppliers, risk-based inspections, material specifications, cold chains, and supplier performance scores.
2. Position-based competency certification	Training, practical exams, work observations, periodic certifications, and task restrictions for officers who have not graduated.
3. SPPG capacity accreditation	Maximum capacity is set based on space, equipment, power, water, vehicle, distance, and time–temperature capability.
4. HACCP per menu	Biological, chemical, and physical hazards are mapped for each menu along with critical limits, monitoring, and corrective actions.

5. Digital Food Safety Passport	The batch identity contains the material's origin, supplier, time of receipt, process, temperature, distribution, school, and consumption limit.
6. Time–temperature control	Use of thermometers, digital recordings, consumption limit labels, and delay alarms.
7. Independent Food Safety Officer	Officials have the authority to reject materials and stop-the-line without conflict with production targets.
8. Early warning and quick response	Integrated complaints; split termination, batch blocking, school tracing, and sampling.
9. Multi-level audits and enforcement	Sudden audits, capacity reductions, suspensions, revocation of accreditation, and permanent closure.

Model Performance Indicators

Indicator	Policy targets	Formulas/definitions
SPPG with active SLHS	100%	SPPG with active SLHS / all active SPPG
Certified critical officer	100%	Officers pass the assessment/officers at critical positions
Digitally tracked batch	100%	Batch with complete data / whole batch
Time–temperature compliance	$\geq 99.5\%$	Stage meets the limit / all stages are monitored
Production exceeds capacity	0%	Actual portion > accredited capacity
Complaint response time	≤ 30 minutes	Report time to termination of distribution
Confirmed incidents	Towards zero	Confirmed victims per one million servings
Repetition of the root of the problem	0%	Incidents with the same root of the problem after corrective action

Competencies Are Important, but Not the Sole Explanation

The findings support the view that some actors are not fully prepared to carry out safe mass food production. However, citing low levels of education as the main cause will simplify the problem. Research on food safety training shows that interventions can improve knowledge and practice, but their impact on real practice is smaller than the impact of increased knowledge. Recent collective catering studies also show that training outcomes vary by job role. This means competency programs need to be task-specific and supported by field observation and system support (Centonze et al., 2026; Insfran-Rivarola et al., 2020).

In the context of MBG, workers may be aware of prohibitions beyond consumption limits, but production pressures or vehicle delays may encourage them to violate. Therefore, accountability should be shared between individuals and system design. The head of the SPPG is

responsible for operational decisions, while the BGN and local governments ensure capacity, the number of recipients, distance, infrastructure, and supervision remain within realistic limits.

From Administrative Compliance to Risk Control

SLHS is an important prerequisite, but an annual certificate cannot replace daily monitoring. BGN Regulation Number 4 of 2026 has directed the system to control, supervise, monitor, and evaluate food safety and quality. MBG SAFE translates the mandate into a measurable operational gateway at the batch level. Thus, the audit not only checks the documents, but also tests whether capacity, temperature, time, suppliers, and corrective actions are truly under control (Republic of Indonesia, 2026).

The HACCP approach is relevant because it protects the process before harm occurs. A meta-analysis of catering policies found that food safety interventions, including HACCP, were associated with a 28.6% reduction in microbes, although evidence quality remained limited. The findings support implementing a simple, menu-based, auditable HACCP at each SPPG (Levy et al., 2022).

The Role of Safety and Authority Culture in Stopping the Process

A food safety culture places safety as an organizational value, not just formal compliance. Leadership, organizational commitment, communication, and worker engagement determine whether officers dare to refuse ingredients or stop distribution. Because production targets can create conflicts of interest, Food Safety Officers need to have independence and protection when exercising stop-the-line authority (Pai et al., 2024).

Digital Traceability as a Governance Infrastructure

Digital traceability is not only a record-keeping technology, but also a governance mechanism that determines who records, who verifies, and who makes decisions. Supply chain studies show that traceability systems succeed when technology aligns with actor roles and institutional governance. Upstream–downstream integration remains weak because of technical fragmentation and low interoperability. Therefore, MBG digital passports must use batch identities and national data standards that are connected to SIPGN, suppliers, SPPGs, schools, health agencies, and BPOM (Lai et al., 2025; Zhang & Li, 2025).

Other research for HACCP: These findings align with international standards such as ISO 45001:2018, the ILO Occupational Safety and Health Convention No. 155, and national regulations PP No. 50 of 2012 on Occupational Safety and Health Management Systems (SMK3), emphasizing that hazard identification, risk assessment, and continuous control must be implemented comprehensively to reduce workplace accidents and ensure industrial sustainability (Widagdo & Trisolvena, 2026).

Policy Implications

1. The number of recipients assigned to the SPPG should be locked based on accredited capacity, not uptake targets or partner requests.
2. The new SPPG is mandatory to go through the commissioning phase and gradually increase the portion.
3. Suppliers of animal protein and high-risk ingredients should be audited more frequently and can be blocked across SPPGs.
4. Schools must have the authority and procedures to reject food that is late, smelly, discolored, unlabeled, or of inappropriate temperature.
5. Public dashboards should display SLHS status, accreditation, audit dates, number of nonconformities, and corrective action status without displaying personal data.
6. Incident data needs to use standard definitions: conjectured, probable, confirmed; outpatient, inpatient; victims, incidents, kitchens, batches, and the number of portions exposed.

Implementation Roadmap

Stages	Time	Main agenda	Exterior
Stabilization	0–3 months	Risk mapping; capacity setting; supplier verification; critical position certification; consumption limit labels	National risk list and kitchen shutdown unfeasible
Standardization	4–6 months	HACCP per menu; QR batch; surprise audit; district/city response team	Minimum traceability and risk-based audits
Integrations	7–12 months	SIPGN–BPOM–Dinkes Integration; dashboard; SPPG accreditation; periodic sample tests	National early warning system
Optimization	Years 2–3	Predictive analytics; benchmarking; performance incentives; cost-benefit evaluation	Reduced incidents per million servings and continuous improvement

Widyani et al (2026). The study results indicate that the Koperasi Merah Putih has the potential to act as a supply chain coordinator through production aggregation, logistics management, and information management. Information technology support, government policies, and logistics infrastructure strengthen the cooperative's ability to improve FSCM performance. Optimal FSCM performance subsequently contributes to increased food security and food system sustainability. The developed conceptual model is expected to serve as a basis for further empirical research and a reference for formulating cooperative-based food policies. Idris & Hermawan (2025) applied LCMM to a Lean Management readiness assessment and offered a structured diagnostic framework for SOEs seeking to enhance Lean adoption in the construction sector. Lean Management and Lean Construction have been widely recognized as effective approaches to improving efficiency, reducing waste, and enhancing organizational performance. However, the readiness of construction organizations—particularly State-Owned Enterprises (SOEs)—to implement Lean Management remains insufficiently explored, especially in developing countries. This study contributes theoretically by extending the application of LCMM to Lean Management readiness assessment and practically by offering a structured diagnostic framework for SOEs seeking to enhance Lean adoption in the construction sector.

CONCLUSION

Food safety incidents in the MBG Program are not solely caused by a lack of education or individual incompetence. The root cause is a mismatch among actor competencies, facility capacity, production load, time pressures, supplier quality, and measurement and monitoring systems. In other words, the main problem is an incompatible competency system, exacerbated by the risk of rapid expansion. The MBG SAFE model offers comprehensive prevention through supplier assurance, competency certification, capacity accreditation, HACCP per menu, food digital passport, time-temperature control, independent Food Safety Officers, early warning, and multi-level enforcement. The main principle is that the target number of servings should not come at the expense of food safety. Batches that do not meet the requirements must be detained and must not be distributed. The model still requires empirical validation. The next study is recommended to use a mixed-methods design on cross-regional SPPG samples, testing the influence of

competence, capacity, safety culture, traceability, and HACCP compliance on incidents per one million portions.

Implications of advanced research and hypotheses

H1: The food safety competence of the perpetrators has a positive effect on compliance with the SPPG SOP.

H2: Production capacity suitability moderates the relationship between competence and SOP compliance.

H3: HACCP compliance negatively affects the level of food safety incidents.

H4: Digital traceability positively affects the speed of detection and corrective action.

H5: Food safety culture mediates leadership's influence on operational compliance.

H6: Time pressure and production load positively affect process deviation.

H7: Food Safety Officer independence weakens the effect of target pressure on process irregularities.

Ethical Statements and Conflicts of Interest

This study uses publicly available secondary data and does not directly involve human subjects. The author states that there is no conflict of interest. This section needs to be adjusted to the provisions of the destination journal.

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