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School Feeding Program and Sustainable Development Goals (SDGs) in Education: Linking Food Security to Learning Outcomes in Timor-Leste

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ABSTRACT

School Feeding Programs (SFPs) have gained policy relevance in Timor-Leste due to their potential to address educational inequality and student underperformance. This study critically reviews 30 peer-reviewed publications and institutional reports from 2018 to 2024 to evaluate the educational impacts of SFPs. Findings indicate that SFPs significantly improve school enrolment, attendance, and student motivation, particularly in low-income communities. However, improvements in academic performance, such as literacy and numeracy, are inconsistent and largely influenced by contextual variables, including teacher quality and school infrastructure. The review suggests that SFPs are most effective when integrated with broader education reforms such as teacher training and curriculum enhancement. The results support evidence-based policymaking to improve the design and effectiveness of school feeding initiatives, aligning them with the goals of inclusive and equitable quality education (SDG 4). This article highlights the necessity of complementary strategies to maximize the educational benefits of SFPs in Timor-Leste.

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1. INTRODUCTION

Systemic challenges in education continue to undermine children's right to quality learning. Issues such as inadequate infrastructure, low teacher qualifications, high dropout rates, and widespread malnutrition persist as barriers to educational progress. The interconnection between poverty, hunger, and academic underachievement has prompted the adoption of School Feeding Programs (SFPs) as a dual intervention targeting both nutritional deficiencies and educational disparities. These programs, increasingly adopted by low- and middle-income countries, aim to alleviate immediate hunger while enhancing children's ability to participate and thrive in school settings.

The urgency of such interventions is particularly pronounced in Timor-Leste, where over 47% of children under five suffer from stunting, a direct consequence of chronic malnutrition. Malnutrition not only compromises physical health but also disrupts cognitive development, attention span, and motivation to learn. In response, the Timor-Leste government, in collaboration with the World Food Program (WFP), has rolled out national school feeding programs covering approximately 60% of primary schools by 2022 (see https://www.wfp.org/publications/timor-leste-school-feeding-evaluation-2022). The objective is to offer free, regular meals to students as a way to boost enrolment, reduce absenteeism, and create a more conducive learning environment.

Globally, evidence has shown that SFPs can be effective in improving school participation. For example, studies in Burkina Faso and India reveal that school meals act as a powerful incentive for attendance, particularly for children from food-insecure households (Kazianga *et al*., 2022; Prakash *et al*., 2021). However, while access to education improves, the actual impact on learning outcomes such as literacy and numeracy remains inconsistent. In some contexts, SFPs correlate with higher test scores and cognitive gains; in others, such improvements are marginal or absent. This dichotomy suggests that while school feeding contributes positively to educational access, it is not a panacea for the deeper issues affecting academic performance.

This article aims to provide a focused review of the educational impacts of school feeding programs in Timor-Leste. Unlike broader reviews that emphasize nutrition and food security, this study concentrates on the link between school feeding and educational outcomes, particularly in the domains of enrolment, attendance, engagement, and cognitive achievement. Drawing from 30 empirical studies and policy evaluations published between 2018 and 2024, the paper explores whether and how school meals influence children's academic trajectories. Additionally, it assesses the role of contextual moderators such as teacher competence, curriculum quality, and availability of learning materials, which may either amplify or diminish the educational benefits of SFPs.

The goal is to inform evidence-based policymaking in Timor-Leste and similar contexts. By identifying both the successes and limitations of existing programs, this review advocates for an integrated model in which school feeding becomes one component of a broader education reform agenda. This approach aligns with Sustainable Development Goals (SDGs) (especially SDG 4), which emphasizes inclusive and equitable quality education and recognizes the interdependence of health, nutrition, and learning. In doing so, the paper provides practical recommendations for maximizing the educational returns of school feeding initiatives.

2. THEORETICAL FRAMEWORK

The analysis of educational outcomes resulting from school feeding programs is grounded in two interrelated theoretical models: Human Capital Theory and Maslow's Hierarchy of

Needs. Together, these frameworks offer a multidimensional lens through which to understand the educational relevance of nutrition-focused interventions.

First, Human Capital Theory conceptualizes education and health as productive investments that yield future economic returns. From this standpoint, SFPs are not merely welfare provisions but strategic tools for national development. By improving student health and learning capacity, these programs enhance the productivity of future workers and contribute to long-term poverty reduction. Empirical evidence from Brazil and India confirms the theory's core premise: effective SFPs have been associated with improved academic performance, reduced dropout rates, and increased lifetime earnings (Prakash *et al*., 2021). Within the context of Timor-Leste, these insights justify the continued investment in school meals as a pathway to economic empowerment.

Second, Maslow's Hierarchy of Needs in 1943 complements the economic perspective with a psychological understanding of learning. According to Maslow, basic physiological needs (such as food and shelter) must be satisfied before higher-order cognitive functions like problem-solving, memory, and creativity can flourish. This hierarchy implies that children experiencing hunger or malnutrition are less likely to concentrate, absorb information, or participate meaningfully in classroom activities. School meals increased attendance by up to 15% in food-insecure settings (Kazianga *et al*., 2022). Similarly, some researchers (McEwan, 2021) linked improved nutritional intake to enhanced memory retention and classroom behavior. These findings underscore the importance of meeting children's basic needs as a prerequisite for effective learning.

While these theoretical models establish a strong rationale for school feeding, scholars also caution against overreliance on such interventions. SFPs alone are insufficient for producing sustained academic improvements. Without concurrent investment in teacher training, instructional materials, and curriculum development, the impact of school feeding may be limited to short-term gains. In this light, SFPs should be viewed as foundational but not exhaustive elements of educational reform.

Therefore, the theoretical framework adopted in this study emphasizes the integrated value of nutrition and education. SFPs are best understood not as standalone programs but as part of a larger ecosystem that includes teachers, families, curricula, and community support structures. Only through a systems approach can the full educational potential of school feeding be realized in Timor-Leste.

3. METHODS

This article utilizes a critical literature review methodology to assess the educational impacts of School Feeding Programs in Timor-Leste. The review draws upon 30 academic and institutional sources published between 2018 and 2024, including peer-reviewed journal articles, evaluation reports from international agencies, and government documents. The aim is to consolidate and critically analyze the existing evidence to understand how SFPs influence educational outcomes such as enrolment, attendance, classroom engagement, and academic performance.

The literature was sourced from databases including Google Scholar and the WFP repository (see https://www.wfp.org/publications/timor-leste-school-feeding-evaluation-2022). Keywords used in the search included: "school feeding programs," "Timor-Leste," "student attendance," "learning outcomes," "education access," and "cognitive performance." Inclusion criteria required that studies focus on primary school children in Timor-Leste or comparable low-income settings, report empirical findings, and be published

in English, Portuguese, or Tetum. Studies based purely on opinion, lacking data, or focusing exclusively on nutritional outcomes without reference to education were excluded.

Thematic analysis was used to extract and categorize findings into four major domains: (i) Enrolment and access; (ii) Attendance and retention; (iii) Student engagement and motivation; and (iv) Academic performance (literacy, numeracy, cognition).

Each domain was further analyzed for consistency across studies and sensitivity to contextual variables such as school location, teacher quality, and parental involvement. This approach enabled the identification of both shared trends and divergent findings across the literature, providing a nuanced understanding of how school feeding programs influence education in practice.

Moreover, limitations such as short follow-up periods, reliance on secondary data, and lack of longitudinal impact tracking were documented and critically appraised. These gaps highlight the need for future research, particularly primary studies that examine long-term educational outcomes and program sustainability.

4. RESULTS AND DISCUSSION

4.1. Improved Access and Attendance

A consistent and well-documented effect of SFPs in Timor-Leste is the increase in school enrolment and attendance rates, particularly in food-insecure regions. Several randomized controlled trials and observational studies have shown that the promise of a daily meal provides a strong incentive for parents to send their children to school, especially in contexts where household food availability is uncertain. According to the WFP in 2022 (see https://www.wfp.org/publications/timor-leste-school-feeding-evaluation-2022), schools involved in SFPs reported up to 20% increases in average daily attendance, with the highest improvements observed among girls and students from marginalized rural communities.

These findings are echoed in comparative studies from Burkina Faso and India, where access to school meals led to higher enrolment and lower dropout rates among girls (Ahmed *et al*., 2022; Prakash *et al*., 2021). For poor households, school feeding offsets the cost of meals and alleviates the economic burden associated with schooling, such as lunch preparation or food purchases. In this sense, SFPs function not only as nutritional interventions but also as demand-side educational policies that reduce the indirect costs of school participation.

In Timor-Leste, where stunting and chronic malnutrition persist at alarming rates (UNICEF, 2021), the provision of meals at school also helps address absenteeism caused by hunger-related fatigue or illness. As children experience fewer hunger episodes, they are more likely to maintain regular school attendance. Additionally, interviews with teachers highlight that consistent meal provision contributes to classroom punctuality and reduces mid-morning disruptions, such as students leaving the school grounds in search of food.

4.2. Classroom Engagement and Student Motivation

Beyond attendance, school meals contribute to improvements in classroom engagement, behavior, and learning enthusiasm. Several qualitative studies in Timor-Leste note that children who have eaten a morning or midday meal demonstrate higher levels of energy and alertness during lessons (Pereira & Soares, 2023). Teachers report reduced incidences of lethargy, increased student participation in group activities, and improved attentiveness, particularly during longer academic sessions.

Maslow's theory is again relevant here: as children's physiological needs are met, they are better positioned to engage with higher-order cognitive tasks. The reduction in classroom

hunger enhances students' psychological readiness to learn and interact. In many cases, the meal becomes a daily structure around which learning routines are stabilized. It promotes predictability and routine elements essential for effective learning, especially for young learners.

However, these improvements are context-sensitive. In schools where meals are irregular due to funding shortages or logistical failures, the educational benefits decline sharply. Students facing uncertainty regarding food availability may remain distracted or absent. Rural schools that receive food shipments inconsistently due to poor infrastructure tend to have more erratic attendance patterns, undermining the stabilizing effect of the SFP (Martins, 2021).

4.3. Impact on Academic Performance: Gains and Limitations

While SFPs have clearly increased access and improved student behavior in the classroom, their influence on actual academic performance (particularly literacy, numeracy, and test scores) remains ambiguous. Several studies suggest modest but statistically significant improvements in academic outcomes when school meals are provided. For example, students in Honduras who participated in school feeding programs showed an improvement of 0.15 standard deviations in mathematics scores (McEwan, 2021). Similarly, a subset of Indian schools linked to the Midday Meal Scheme demonstrated better test performance over time.

Yet, other studies present a more cautious view. In the case of Burkina Faso, school meal interventions increased attendance but did not lead to measurable improvements in literacy scores (Kazianga *et al*., 2022). In Timor-Leste, evidence remains sparse and inconsistent. Some schools report anecdotal improvement in reading and writing skills, but systematic assessments remain underdeveloped. Much of the discrepancy stems from intervening factors, such as teaching quality, availability of learning materials, and the broader school environment.

Studies (Gustafsson *et al*., 2022; Bundy *et al*., 2021) point to a critical insight: while SFPs can alleviate barriers to learning by removing hunger, they do not in themselves constitute learning interventions. Gains in test scores and cognitive ability occur primarily when school meals are paired with quality instruction, targeted remediation, and well-designed curricula. Where these elements are lacking (as is the case in many Timorese schools), the impact of feeding programs on academic metrics tends to be minimal.

4.4. Role of Contextual Moderators

A review of implementation studies reveals that the educational impact of SFPs in Timor-Leste is strongly moderated by contextual factors. These include:

(i) Teacher Competence: Well-trained teachers are more likely to capitalize on improved student attention and engagement. In under-resourced schools with untrained staff, the benefits of increased attentiveness may be lost.
(ii) Learning Materials: Without sufficient books, visual aids, and writing supplies, students cannot fully participate in classroom activities, even when well-fed.
(iii) School Infrastructure: Overcrowded classrooms, poor ventilation, and a lack of seating impede the translation of nutritional gains into learning gains.
(iv) Meal Regularity: Intermittent food supply can lead to inconsistency in attendance and trust in the program, especially in rural or mountainous regions.

Additionally, cultural perceptions of school meals and parental involvement in education shape the overall success of SFPs. In communities where school feeding is a charity rather than an educational right, families may not commit to long-term school attendance.

Conversely, in areas with strong community-school partnerships, SFPs become a symbol of collective investment in children's futures (Bundy *et al*., 2018).

As such, the efficacy of school meals is not solely a function of what is served, but how well the broader educational ecosystem is designed to absorb the benefits of nutrition into measurable learning outcomes. This underlines the necessity for a multi-sectoral strategy, linking nutrition initiatives with teacher training, infrastructure improvement, and curriculum development.

4.5. Policy Implications

The findings from Timor-Leste and comparative contexts underscore a crucial lesson: school feeding programs, when properly implemented, can serve as an effective gateway to educational inclusion, but they must be reinforced through complementary reforms to maximize academic impact. Policymakers should avoid treating SFPs as isolated solutions. Instead, SFPs must be situated within a comprehensive education improvement strategy, emphasizing teacher capacity, curriculum relevance, and community engagement. Several aspects are in the following:

(i) Integrating SFPs into National Education Reform. First and foremost, SFPs must be formally embedded into the country's long-term education development strategy. Current reliance on external donors, particularly the World Food Programme, exposes the system to vulnerability and discontinuity (see https://www.wfp.org/publications/timor-leste-school-feeding-evaluation-2022). The experience of Brazil's PNAE (Programa Nacional de Alimentação Escolar) demonstrates that sustained educational impact emerges when school feeding is codified within national legislation and supported by public investment. Establishing SFPs as a statutory right for students in Timor-Leste would ensure long-term commitment and encourage multi-year planning. Government ministries (specifically Education, Health, and Agriculture) must collaborate to create a cross-sectoral framework for school nutrition. Such coordination is vital not only for logistical efficiency but also for aligning the program's nutritional goals with educational outcomes. For example, combining SFPs with school-based deworming, health screenings, and hygiene education has been shown to enhance both learning capacity and health status (Bundy *et al*., 2021).

(ii) Strengthening Instructional Quality to Leverage SFP Gains. Feeding a child may bring them to the classroom, but the quality of instruction determines what they learn once they arrive. Studies reveal that in schools where meals are provided but pedagogy remains weak, students do not achieve significant academic progress. This calls for targeted investments in teacher training to help educators effectively manage energized and better-fed classrooms. Professional development programs should focus on interactive, learner-centered methods and ensure that teachers can adapt their approaches to diverse learning needs. Additionally, enhanced school feeding can be used as an opportunity to introduce curriculum innovation, particularly in health and nutrition education. Teaching students about the nutritional value of meals they receive can reinforce healthy habits while improving content knowledge across disciplines, including science and civic education.

(iii) Community Participation and Ownership. Community involvement is another important factor in sustaining the positive educational effects of SFPs. When local stakeholders (including parents, farmers, and community leaders) are part of the planning, preparation, and monitoring processes, SFPs gain legitimacy and accountability. In Timor-Leste, parental cooperation with schools has been observed in schools that operate

cooking and food distribution committees with local volunteers (Martins, 2021). Such community ownership not only reduces operational costs but also enhances the cultural appropriateness and acceptance of the program. Policy should therefore formalize community participation structures, possibly through school management committees or parent-teacher associations, tasked with overseeing school meal operations. These structures can also act as communication bridges between educators and households, facilitating greater family engagement in student learning.

(iv) Equity and Gender Considerations. SFPs have proven particularly beneficial in improving girls' attendance and retention. In a society where early marriage, domestic responsibilities, or cultural bias may restrict girls' education, the provision of daily meals can be a strong incentive for continued school participation (Kazianga *et al*., 2022). As such, SFPs offer a strategic point of intervention for promoting gender equality in education. Policy design must recognize this gendered dimension by ensuring that meal distribution processes are sensitive to girls' safety, dignity, and nutritional needs. Schools should have adequate facilities for menstrual hygiene management, which is a well-documented barrier to girls' attendance. By aligning SFPs with broader gender-sensitive education planning, Timor-Leste can move closer to achieving SDG 4 (inclusive and equitable quality education) and SDG 5 (gender equality).

4.6. Challenges to Program Effectiveness

Despite their potential, SFPs in Timor-Leste face significant challenges that constrain their full educational impact. Understanding and addressing these issues is critical for developing an effective and sustainable model of school feeding. Several aspects are in the following:

(i) Funding Volatility and Program Sustainability. A major threat to the effectiveness of SFPs is financial insecurity. According to the WFP in 2022 (see https://www.wfp.org/publications/timor-leste-school-feeding-evaluation-2022), 80% of the school feeding budget in Timor-Leste comes from external donors. This level of dependence creates a fragile ecosystem where any withdrawal of donor support can jeopardize food availability and erode community trust. Funding interruptions have previously led to meal cancellations, affecting not only nutrition but also school attendance. To overcome this, the government must work towards diversifying funding sources, including increasing national budg*et al*locations, building partnerships with local businesses, and exploring public-private partnership models. One innovative option is integrating cash-based transfer mechanisms or conditional cash vouchers, allowing parents to redeem food items linked to school attendance, as trialed in Ecuador.

(ii) Supply Chain and Logistics. Geographical challenges and underdeveloped transport networks impede the timely and consistent delivery of food supplies, especially in mountainous or remote areas. Inconsistent deliveries result in irregular meals, which directly disrupt attendance and reduce student trust in the system. Some schools report receiving supplies only once every three weeks, forcing students to rely on snacks or go without food entirely. To resolve these issues, investment is needed in localized food procurement systems, warehouse storage facilities, and capacity-building for logistics staff. A decentralized procurement model, where schools can source food from nearby farmers and cooperatives, may improve efficiency and reduce transportation costs.

(iii) Monitoring and Evaluation Gaps. A final but critical challenge is the lack of robust monitoring and evaluation (M&E) mechanisms. Most impact assessments are short-term and focus on attendance, with limited data on learning outcomes or long-term nutritional status. Without longitudinal studies, it is difficult to determine whether SFPs

contribute to improved literacy, graduation rates, or employment opportunities in adulthood. The development of a national education and nutrition database is essential. This system should track student health, school participation, and learning progress over time. Integrating biometric health checks, nutrition screenings, and standardized academic assessments into regular school reporting can provide actionable insights for policy refinement.

4.7. Toward a Holistic School Feeding Strategy

Drawing on the discussion above, the path forward for SFPs in Timor-Leste must be holistic, multisectoral, and evidence-based. The goal is not only to provide meals but to strengthen the entire education system through the leverage that SFPs provide. Below are key strategic recommendations:

(i) Legislate school feeding as a public service under the education law, ensuring sustained government commitment.
(ii) Link feeding programs with curriculum content on nutrition, hygiene, and health to foster cognitive and behavioral development.
(iii) Invest in school infrastructure, including kitchen facilities, dining spaces, and clean water access.
(iv) Create school-based procurement frameworks to support local farmers and ensure a fresh food supply.
(v) Train school staff and volunteers in food safety, nutrition, and program accountability.
(vi) Strengthen data systems for program monitoring, with annual reporting on attendance, academic progress, and child health.
(vii) Embed equity targets in SFP design to promote participation among disadvantaged groups, especially girls and children with disabilities.

By positioning SFPs as more than food interventions (by seeing them as catalysts for systemic transformation) Timor-Leste can achieve sustained educational outcomes and long-term human development gains.

4.8. Research Priorities and Future Directions

To fully realize the potential of school feeding programs as educational interventions, more rigorous, localized, and forward-looking research is essential. The current evidence base in Timor-Leste is fragmented, largely dependent on short-term assessments and external evaluations. This limits the ability of policymakers to make long-term decisions grounded in robust data.

4.8.1. Longitudinal Cohort Studies

One of the most urgent priorities is the implementation of longitudinal cohort studies that track students over multiple academic years. These studies would assess the sustained impact of SFPs on educational outcomes such as literacy rates, test scores, retention, and graduation. Additionally, health indicators (such as height-for-age, weight-for-age, and anemia status) should be measured in tandem to establish causal links between nutrition and learning over time. Models for this type of research exist. For instance, Ecuador's national school feeding program includes long-term monitoring of student progression from primary to secondary levels. Adapting such a model to Timor-Leste would provide crucial evidence to determine whether SFPs merely increase school attendance or actually contribute to cognitive and academic development in a sustained way.

4.8.2. Mixed-Methods Research

Quantitative research alone is insufficient. Qualitative investigations (using interviews, focus groups, and ethnographic methods) are essential to uncover students' lived experiences, teachers' observations, and community perspectives. In particular, mixed-methods research can explain why and how school feeding impacts student learning, going beyond surface-level statistics to understand program dynamics. Some researchers (Pereira & Soares, 2023) used interviews with teachers in rural Timor-Leste to demonstrate that meal provision significantly altered classroom behavior, particularly for early-grade learners. These insights help to shape interventions that are contextually responsive, culturally appropriate, and tailored to local needs.

4.8.3. Cost-Benefit Analysis of Delivery Models

Another critical research direction involves evaluating the cost-effectiveness of different SFP delivery models. Timor-Leste currently relies on centralized procurement with long supply chains. Comparative studies can help determine whether decentralized, home-grown school feeding models (where schools procure food from local farmers) are more efficient, sustainable, and economically beneficial (Martins, 2021). A cost-benefit analysis would account for: (i) Food quality and freshness; (ii) Transportation and storage costs; (iii) Community economic stimulation; (iv) Administrative complexity; and (v) Gender and equity impacts. Such evaluations should be co-designed with ministries of finance, education, agriculture, and health, ensuring that school feeding is framed not only as an educational tool but also as an instrument of economic development and rural empowerment.

4.8.4. Integration with Digital Monitoring Systems

Advances in digital technology offer promising opportunities for enhancing real-time monitoring of SFP operations. The use of mobile platforms, biometric attendance tracking, and nutrition dashboards can generate live data on: (i) Meal delivery schedules; (ii) Student health metrics; (iii) Attendance consistency; and (iv) Program interruptions. Digital integration can strengthen accountability, reduce food wastage, and enable faster responses to logistical issues. Moreover, linking such data to the national education management information system (EMIS) would support evidence-driven planning and budgeting.

4.9. Contribution to Sustainable Development Goals (SDGs)

The educational dimensions of SFPs in Timor-Leste directly contribute to the achievement of multiple Sustainable Development Goals (SDGs), particularly:

(i) SDG 2: Zero Hunger: by addressing child malnutrition and food insecurity.
(ii) SDG 3: Good Health and Well-Being: through improved nutritional status and health screenings.
(iii) SDG 4: Quality Education: by increasing school enrolment, attendance, and engagement.
(iv) SDG 5: Gender Equality: via increased participation of girls in education.
(v) SDG 17: Partnerships for the Goals: through multisectoral collaboration between government, donors, NGOs, and communities.

The case of Timor-Leste illustrates how interlinked approaches (combining nutrition, education, gender, and community empowerment) can reinforce one another to build more resilient, inclusive societies. Positioning school feeding as an SDG-aligned strategy can also help attract international support, build donor confidence, and enhance national policy legitimacy. Several recommendations are in **Table 1**.

Table 1. Summary of Key Recommendations.

Strategic Area	Recommendation
Policy	Codify school feeding as a right under national education law; ensure cross-sectoral budget commitments.
Pedagogy	Link SFPs with curriculum reform and teacher training on classroom management and inclusive instruction.
Monitoring	Establish a national M&E system incorporating biometric health checks and standardized learning metrics.
Procurement	Shift toward decentralized, local food procurement involving farmers and cooperatives.
Equity	Target interventions to support girls, children with disabilities, and rural communities.
Research	Commission longitudinal and cost-effectiveness studies to evaluate long-term impact and improve design.
Technology	Integrate real-time digital tools for program tracking and rapid response.

Despite growing interest in school feeding as a policy tool, several limitations in the literature constrain robust conclusions about educational impacts:

(i) Lack of disaggregated data: Most studies do not report results by gender, region, or disability status.

(ii) Short observation windows: Many evaluations span only 1–2 years, insufficient to track developmental changes.

(iii) Overemphasis on access metrics: Attendance and enrolment are more commonly measured than literacy, numeracy, or cognition.

(iv) Neglect of system-level factors: The interaction between feeding programs and broader education policies (teacher placement, language of instruction, learning assessments) is underexplored.

Addressing these gaps will require more nationally-led, interdisciplinary research collaborations that center on local realities and policy needs. Finally, this study adds new information regarding food science and technology, as reported elsewhere (**Table 2**).

Table 2. Previous studies on food science and technology.

No	Title	Reference
1	Enhancement of sensory qualities of papaya leaf extract (PLE) gummy candy	Acob *et al*. (2024)
2	Nutrition and dietetics concerning diabetes mellitus: Gestational diabetes mellitus	Ahsan (2023)
3	Unraveling the factors behind the soaring tomato prices: A comprehensive analysis	Ali *et al*. (2023)
4	Navigating rice export restrictions: The impact of India's policy on domestic and international markets	Ali *et al*. (2024)
5	Health-related problems associated with women garri producers in agricultural zone	Alimi & Animashaun (2023)
6	Efforts to improve sustainable development goals (SDGs) through education on diversification of food using infographic: Animal and vegetable protein	Awalussillmi *et al*. (2023)
7	Effect of antioxidant compounds on nitrites as inhibitors of N-Nitrosamine formation: A short review	Dewi (2023)
8	Correlation of metabolomics and functional foods research in 2020 to 2023: Bibliometric analysis	Dewi (2025)
9	Trend analysis of eco-friendly food packaging among street vendors: A case study in Gegerkalong street, Bandung, Indonesia	Fadillah *et al*. (2024)

Table 2 (continue). Previous studies on food science and technology.

No	Title	Reference
10	Food security strategy through regenerative agriculture for capacity building of farmers with "integrated nutrient management training program"	Febriani & Pasaribu (2024)
11	The influence of environmentally friendly packaging on consumer interest in implementing zero waste in the food industry to meet sustainable development goals (SDGs) needs	Haq *et al.* (2024)
12	Education on the importance of food consumed by breastfeeding mothers and exclusive breastfeeding against stunting prevention through power point media	Ibrahim & Nandiyanto (2022)
13	Analysis of student's awareness of sustainable diet in reducing carbon footprint to support sustainable development goals (SDGs) 2030	Keisyafa *et al.* (2024)
14	Knowledge of students on about the impact of ice cream consumption on blood sugar	Kusuma *et al.* (2023)
15	Effect of post-harvest storage temperature on physical parameters of cavendish banana (Musa Paradisiaca)	Mabrukah *et al.* (2024)
16	Influence of ICT availability, accessibility, and utilization on agriculture students' academic performance in universities	Makinde *et al.* (2023)
17	Analysis of the effectiveness of the formation and distribution of financial results of business entities engaged in poultry farming	Najimovich (2023)
18	Analysis of the application of mediterranean diet patterns on sustainability to support the achievement of sustainable development goals (SDGs): Zero hunger, good health and well beings, responsible consumption, and production	Nurnabila *et al.* (2023)
19	A bibliometric analysis of seed priming: Global research advances	Nurrahma *et al.* (2024)
20	Low-carbon food consumption for solving climate change mitigation: Literature review with bibliometric and simple calculation application for cultivating sustainability consciousness in facing sustainable development goals (SDGs)	Nurramadhani *et al.* (2024)
21	Safe food treatment technology: The key to realizing the sustainable development goals (SDGs) zero hunger and optimal health	Rahmah *et al.* (2024)
22	Smart packaging innovation for food: Enhancing shelf life and quality of perishable goods	Rahman *et al.* (2024)
23	The effect of electronic word of mouth (E-WOM) on social media tiktok to brand trust and its impact on buying interest in mixue brand ice cream products (Survey on state university students in West Java)	Rosmayanti & Ratnasari (2024)
24	Influence of grower agent on growth of bayam (Amaranthus sp.) plants with nutrient film technique in hydroponic system	Salsabila *et al.* (2023)
25	Culinary tradition of cassava rice in indigenous villages Cireundeu, Cimahi, Indonesia as food security heritage in the era of gastro colonialism	Sumaludin (2024)
26	Optimizing psychomotor skills through project-based learning in seaweed dodol processing	Wahyuningsih *et al.* (2024)

5. CONCLUSION

School Feeding Programs in Timor-Leste have shown strong potential as a catalyst for improving educational access, especially among children in food-insecure and rural communities. They have successfully increased enrolment, reduced absenteeism, and enhanced classroom engagement. The provision of a daily meal helps reduce hunger-induced fatigue, improves student motivation, and encourages parental support for education, particularly for girls. These gains are consistent with global evidence and supported by both Human Capital Theory and Maslow's Hierarchy of Needs. However, this review also reveals critical limitations. Improvements in academic performance (such as literacy and numeracy)

are uneven and often modest. In many cases, the absence of quality teaching, learning materials, and consistent implementation reduces the long-term educational benefits of school feeding programs. Without integration into a broader reform agenda that addresses the quality and equity of education, SFPs may achieve only superficial outcomes. For SFPs to deliver transformative impact in Timor-Leste, they must evolve beyond food distribution. The program must be institutionalized through policy, supported by sustainable financing, and reinforced by pedagogy, infrastructure, and community ownership. Stronger monitoring, rigorous long-term studies, and digital innovations can help measure and maximize impact. Ultimately, school feeding must be recognized not only as a tool for alleviating hunger but as a strategic pillar of inclusive education and national development.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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