NATIONAL AND INTERNATIONAL CAPACITIES IN SUPPLY CHAIN MANAGEMENT OF SCHOOL MEALS PROGRAM: A FOOD VARIETY-BASED ANALYSIS

Deatri Arumsari Agung[1], Dan Li[2], Rodney Asilla[3], Adrino Mazenda[3], Ni Putu Wulan Purnama Sari[4]*, Minh-Hoang Nguyen[5], Quan-Hoang Vuong[5,6]

[1] Faculty of Business, Widya Mandala Surabaya Catholic University, East Java, Indonesia

[2] College of Educational Science, Yan'an University, Yan'an, Shaanxi, China

[3] Faculty of Economic and Management Sciences, School of Public Management and Administration, University of Pretoria, Hatfield, South Africa

[4] Faculty of Nursing, Widya Mandala Surabaya Catholic University, East Java, Indonesia

[5] Centre for Interdisciplinary Social Research, Phenikaa University, Hanoi, Vietnam

[6] Adjunct Professor, University College, Korea University, Seoul, South Korea

*Corresponding author: wulanpurnama@ukwms.ac.id (Ni Putu Wulan Purnama Sari)

September 25th, 2024

(Original working draft V1, Un-peer-reviewed)

Abstract

Background: The school meals program has multiple objectives of education, nutrition, and value transfer. To ensure achieving the goal, total quality management (TQM) is implemented in the school meals program. Supply chain issues pose significant challenges to TQM implementation in the program execution.

Aim: This study aims to examine national and international capacities in supply chain management by analyzing the variety of food items delivered through the school meals program.

Methods: The Bayesian Mindsponge Framework, combining the reasoning strengths of Mindsponge Theory and inference advantages of Bayesian analysis, was employed on a dataset of 126 government representatives who manage large-scale school meal programs in 126 different countries.

Results: Findings showed that the method of obtaining supplies, whether through in-kind donations from local, regional, national sources, or national food reserves and purchasing from neighboring or distant countries, had a significant positive association with the variety of food items included in school meals or snacks. Conversely, obtaining supplies in-kind from neighboring or distant countries had a significant negative association with the food variety. Additionally, purchasing supplies from local, regional, or national food reserves had an unclear association with the food variety.

Conclusions: Findings underscore the importance of supporting the World Bank and World Food Programme's recommendation to rely more on local resources and capacities. Enhancing supply chain management at the national level is crucial for developing a long-term and sustainable school meals program.

"... he finally has a proper mansion. One that even has a food inventory."

—In "Mansion"; *Wild Wise Weird* (2024).

1. INTRODUCTION

School meal programs are a meaningful initiative as they provide meaningful avenues for the advancement and maintenance of healthy diets for children through their provision of access to nutritious foods (Cohen et al., 2021). Consequently, school meal programs are an essential social safety net for developing economies (Evans et al., 2021) and developed economies (Cohen et al., 2021). Observed benefits of school meal programs include increased student participation, improved learner performance (Schwartz & Rothbart, 2020), food security (Cohen et al., 2021) as well as positive life-long outcomes such as height, good early adult health, and enhanced educational attainment (Lundborg et al., 2022).

Focusing on various theories of change, school feeding programs have other benefits beyond health and nutrition, which include a positive impact on local economies through generating a consistent demand for locally produced food (Verguet et al., 2020), thereby making much-needed contributions to local socio-economic development (Aroesty et al., 2018). School meal ecosystems, therefore, comprise various elements, actors, and spaces (Franco & Fajo-Pascual, 2022) revolving around food distribution, processing, and consumption, policy, and cultural aspects, as well as governance of the school food systems, which include supply chains (Bryant et al., 2023). While literature identifies the role of local supply chains in enhancing optimal outcomes of school meal programs (Haß et al., 2018, Tregear et al., 2022), there still remains a gap in comparative understanding of the different outcomes of local and international supply chains on school meal programs.

School feeding programs date back to the growth of public education in Europe and America in the late 19th and early 20th centuries, where they were a response to child poverty and malnutrition that resulted from the Industrial Revolution (Evans & Harper, 2009). As global events shaped nations, newly decolonized and developing countries, pursuing an agenda of poverty eradication and investing in education, adopted social welfare programs such as school feeding to address these issues (Bundy et al. 2024). The evolution of the implementation of the school feeding program, especially in low- and

middle-income countries, has involved mitigation of short-term hunger and nutrient deficiency and improving attendance and school performance (Gelli et al., 2007). Secondary objectives have included the promotion of healthy eating habits as well as supporting local agriculture and economies (Wang & Fawzi, 2020).

Global statistics underline the significance of school meal programs. The World Food Programme (2022) estimates that, at the global level, 418 million children are beneficiaries of the school meal program, representing a 30 million increase from the 388 million beneficiaries before the COVID-19 pandemic. This affirms the role of school feeding programs as one of the largest and most widespread social safety nets in the world, especially in low-income countries where, beyond nutritional purposes, they are a form of social development strategy (Bundy et al. 2024) such as bridging gender gaps in education (Gelli et al., 2007). A multiplier effect of school meal programs has been the creation of approximately four million direct jobs in 85 countries, which equates to 1,377 jobs for every 100,000 children fed (World Food Programme, 2022). The majority of these jobs, which are focused on food preparation, benefit women-led enterprises (World Food Programme, 2022). It can be concluded that school meals are a function of a complex, far-reaching, and dense food system involving a wide scope of factors beyond education and nutrition, such as health, social safety, gender mainstreaming, employment, climate and biodiversity issues, and food production and supply chains (Pastorino et al., 2023).

School meal programs function as part of a larger food system ecology, which, beyond nutrition and health, also involves climate and biodiversity, gender, and food supply chains (Sidaner et al. 2012; Fitzsimmons, & O'Hara, 2019). With a specific focus on food supply chains, literature establishes that supply chains have a great impact on the effectiveness of school meal programs (Kretschmer et al., 2014), a fact which was prominently highlighted during the COVID-19 Pandemic (Coelho et al., 2022). Supply chains in school meal programs can deliver fresh or unprepared food products as well as ready-to-consume foods (MUFPP 2024).

Globally, local supply chains are potential avenues for schools and communities to optimally engage in establishing and maintaining a locally centered, resilient, and sustainable food system (Liu et al. 2023). International supply chains function to support school meal programs mostly through a supplementary approach to local supply chains, with a standout example being the World Food Programme's operational support to supply meals to vulnerable school-going children (World Food Programme, 2022). Supply chains have also been in the form of donations and financial assistance, majorly from higher- to lower- and middle-income countries (Watkins, 2024). Identified benefits of active local supply chains include the relatively quicker supply of fresher, tastier, more nutritious foods (Izumi et al. 2010a), increased consumption of (Izumi et al 2010b), and sustenance of livelihoods (Bateman et al. 2014). Other identified benefits are the establishment and maintenance of strong communal stakeholder relations that allow more active monitoring of food quality (Motta & Sharma, 2016) and the growth of local economies (Galloway et al. 2022). By contrast, non-local supply chains have proven to be

negatively disruptive, as seen in the reception of subsidized food aid to African countries from Europe and America, which undermined local agriculture (Devereux et al. 2018).

Given the identified potential of local supply chains, governments implementing school-feeding programs have placed considerable emphasis on prioritizing local supply chains for school meal programs (WFP, 2024). Countries across the globe have employed a variety of approaches to optimize the involvement of local food chains in school meal programs, such as the Home Grown School Feeding Programme (World Food Programme, 2017). School meal supply chains reflect the relative availability of resources, technical capacity, and supportive infrastructure supporting the optimal functioning of school meal programs (FAO et al., 2022). Consequently, school meal program objectives are mostly framed either as anti-hunger programs for low and middle-income countries or pro-education programs in high-income countries (Devereux et al., 2018).

Local school meal supply chains in high-income regions, such as Europe, lean more towards pro-education approaches compared to the anti-hunger approach in lower- and middle-income countries. These include local stakeholder involvement in determining food procurement, as well as more streamlined procurement (Piirsalu et al., 2022). Other features of these supply chains are the role of impactful public-private synergies in the actualization of school meal program initiatives (Farm Europe, 2022) while also placing great emphasis on short supply chains and sustainability of products in the supply chain (Tregear et al, 2022; Farm Europe, 2022; EPHA & HCWH, 2019).

In lower- and middle-income countries, local school meal supply chains have been designed to cater to the socio-economic, infrastructural, and capacity challenges that are particular to these countries (Drake et al. 2016). Here, school meal programs, as well as their attendant supply chains, reflect various countries' policies' mitigatory approach to these challenges (World Food Programme, 2016; Sekiyama et al. 2018: Octawijaya et al. 2023). This has included the identification of local supply chains and networks, which also link producers and retailers (The Hashemite Kingdom of Jordan, 2020). Policy streamlining smallholder-farmer-oriented procurement strategies (Republic of Rwanda, 2019), which, where possible, may include direct procurement (Bhalla, 2023), employing regional central procurement strategy for streamlined purchasing (Aliyar et al. 2015), as well as communal partnerships with local groups to provide meals (Aliyar et al. 2015).

School meal programs in lower- and middle-income countries are characterized by a multifaceted relationship with their local supply chains (Verguet et al. 2020). These relationships are further characterized by both benefits, discussed above, and challenges, such as poor storage, insufficient professional development, and upskilling opportunities (Drake et al. 2016). Other identified challenges are inconsistency in food production, resulting in erratic supply patterns (Mensah & Karriem, 2021), limited farmer capacity, limited institutional support for local produce, low produce storage life, climatic conditions and disasters, water security, delayed procurement processes, and Covid-19, (Perry et al. 2024).

Local supply chains have played a role in the evolution of school meal programs. While local supply chains have been crucial towards observable gains in transforming nutrition for school children, there have been challenges, including limited technical and financial capacity (Sekiyama et al. 2018) as well as supply chain disruptions, especially resulting from the COVID-19 pandemic (World Food Programme, 2021; Mensah & Karriem, 2021). There has also been a lack of sufficient comparative analysis on specific outcomes and the impact of both local and international supply chains in school meal programs (World Food Programme, 2021).

Thus, this study attempts to investigate the capacities of these supply chains on school meal programs. Specifically, it examines national and international capacities in supply chain management by analyzing the variety of food items delivered through the school meals program.

2. METHOD

2.1. Theoretical foundation and hypotheses

This study employs the mindsponge theory as its theoretical framework, which has been enhanced by integrating detailed worldviews and principles derived from quantum mechanics (Vuong & Nguyen, 2024a, 2024b). The mindsponge theory conceptualizes the brain as a mechanism for collecting and processing information, driven by specific goals and priorities determined by systemic needs. The term 'mindsponge' serves as a metaphor for comparing the mind to a sponge that eliminates incompatible values while assimilating new ones that resonate with its fundamental values (Vuong & Napier, 2015). To achieve the core objectives of the system, which involve enhancing survival, facilitating growth, and ensuring reproduction while also adhering to its fundamental priorities, the cognitive processes undertake subjective evaluations of costs and benefits. These assessments are structured to optimize perceived gains while effectively reducing perceived limitations (Vuong et al., 2023; Vuong et al., 2021).

The mindset, which comprises ingrained values, plays a crucial role in shaping the brain's output, as well as its input processing and filtering systems. Information is regarded as the fundamental component of information processing and can be used synonymously with concepts like ideas and values (Davies & Gregersen, 2014; Dyson, 1999). Ideas and values represent the mind's subjective interpretations of the information received. The evolution of one's mindset is primarily attributable to the brain's capacity to encode and retain information. When examined through the framework of information processing, the mindsponge theory provides a dynamic viewpoint on the cognitive operations of the human brain (Vuong, 2023). As information is processed through the mind's filtering mechanisms, it becomes assimilated into the mindset as accepted values. As a result, the composition of the mindset transforms over time to more accurately reflect mental representations of reality (Nguyen et al., 2023).

The information-processing mechanism of mindsponge theory posits that various elements can play a role in the accumulation of knowledge, which in turn affects one's psychology and behavior (Vuong et al., 2022). Among these elements, information availability pertains to the tangible presence of information in the environment, whereas information accessibility concerns one's ability to perceive and retrieve this information when it exists. The optimization process of information within this theoretical framework leads to behaviors that engage with external stimuli accordingly (Nguyen et al., 2023).

Effective food and supply management for school food principals or relevant staff is crucial in ensuring optimal food production and comprehensive nutrition education (Mawela & Van den Berg, 2018). The execution of school feeding initiatives entails monitoring products, services, and operational procedures to enhance productivity, reduce waste, and integrate feedback from educational institutions to improve these initiatives (Kobiruzzaman, 2020). Challenges within the supply chain significantly impact the food implementation aspect of the school meals program. Within this framework, various procurement methods for food suppliers—such as in-kind donations or purchases from national vendors as well as sources from other countries—have emerged as key motivators influencing the people in charge of school food in arranging the feeding modalities adopted by the school feeding program, along with the specific food items provided through the school meals initiative (Kouvari et al., 2023; Kretschmer et al., 2014; Masila et al., 2024; Sahinyazan et al., 2021).

In this context, the determination made by Ministry officials regarding the selection of food items included in school meals programs, such as grains-cereals, roots-tubers, legumes-nuts, dairy, eggs, meat, poultry, fish, green vegetables, other vegetables, fruits, oil, salt, and sugar—relies heavily on the cognitive processing of information. The absorbed information may include insights regarding the advantages in diversity, reliability, and productivity of food supplier management, such as sourcing supplies through in-kind donations from local, regional, or national entities, as well as purchasing supplies from nearby or distant countries. These aspects contribute to the officials' consensus or involvement in making decisions or taking actions relevant to the provision of food items within the school feeding program.

Conversely, if decision-makers perceive that sourcing supplies through domestic in-kind donations and national purchases is disadvantageous, unreliable, or presents challenges in tracking and production assurance, they are likely to favor alternative approaches. This shift in mindset can diminish their inclination to engage in practices related to the provision of food items integrated within the school food initiative. Based on this rationale, we have outlined the following Hypotheses (H):

> H1: Obtaining school meal supplies through in-kind donation from local, regional, national sources, or national food reserves is associated with the variety of food items delivered through the school meals program.

H2: Obtaining school meal supplies through in-kind donation from neighboring or distant countries is associated with the variety of food items delivered through the school meals program.

H3: Obtaining school meal supplies through purchasing from local, regional, national sources, or national food reserves is associated with the variety of food items delivered through the school meals program.

H4: Obtaining school meal supplies through purchasing from neighboring or distant countries is associated with the variety of food items delivered through the school meals program.

2.2. Model construction

2.2.1. Dataset

This study utilized a dataset of 126 government representatives who managed large-scale school meal programs in 126 countries. The dataset is about the results of a global survey on school meal programs in 2021, which can be accessed publicly at the Global Child Nutrition Foundation (GCNF) Global Survey of School Meal Programs database (GCNF, 2022). GCNF is a non-political and non-profit entity. GCNF global survey was partly funded by the United States Department of Agriculture (USDA). This survey asked about national or large-scale school feeding programs (or school meal or school nutrition programs), including programs that are managed or administered by the national, regional, or local government, as well as large-scale school-based feeding programs that are managed by a non-governmental entity but in coordination with the national government. It also includes programs that do not involve the government but reach a substantial proportion of students in the country.

A standardized questionnaire was used in data collection. This instrument was developed by GCNF. This survey included 11 sections. Four sections contain national-level questions, meaning that the respondents only need to complete these sections once for each country. The remaining seven sections contain program-level questions, meaning that the respondents completed these sections separately for each large-scale school feeding program in each country. Compared to the 2019 GCNF Global Survey of School Meal Programs, this 2021 global survey gathered updated information regarding 1) the scope of school feeding in each country in the most recently completed school year (2020-2021), 2) government financing of, and involvement in, school feeding, 3) nutrition-, education-, and gender-related aspects of school feeding, 4) agricultural and private sector engagement, 5) related health and sanitation topics, and 6) the impact of emergencies. Among all variables, there were only seven variables which were employed in the current study's statistical analysis to achieve the study objective (see Table 1).

There was no demographic data released on the GCNF Global Survey of School Meal Programs database, making the general characteristics of respondents remain confidential. The data of focal point contact information included country's name, survey started date, respondent's name, institution/department/office, job title, email,

telephone number, and other contact options; Ministry/Agency and other contact options; was collected for GCNF administrative purposes only and were not be made publicly available in its database.

2.2.2. Variable Selection and Rationale

In the current study, we employed five variables to construct the model, including one outcome variable and four predictor variables. The outcome variable, *FoodItems* functioned as the indicator of the variety of food items delivered through the school meals program. To comprehensively address the research objective, we integrated four predictor variables capturing the method of obtaining school meal supplies, such as: *InKindDomestic, InKindForeign, DomesticPurchase*, and *ForeignPurchase*. These variables represent obtaining supplies through in-kind donations or purchasing from national or international suppliers, determining the national and international capacities in supply chain management of school meal programs. These variables provide valuable information regarding the impact of supply acquisition methods on the variety of food items incorporated in school meals or snacks. Descriptions of these variables are shown in Table 1 below.

Table 1. Variable description

Variable's Name	Description	Data Type	Value
InKindDomestic	The confirmation on obtaining food supplies via in-kind donation from local, regional, elsewhere within the country, from national food reserves.	Binary	
InKindForeign	The confirmation on obtaining food supplies via in-kind donation from neighboring or distant countries.	Binary	
DomesticPurchase	The confirmation on obtaining food supplies via purchasing from local, regional, elsewhere within the country, from national food reserves.	Binary	0 = No 1 = Yes
ForeignPurchase	The confirmation on obtaining food supplies via purchasing from neighboring or distant countries.	Binary	
FoodItems	The confirmation on including varied food items in the school meals program: grains-cereals, roots-tubers, legumes-nuts, dairy, eggs, meat, poultry, fish, green vegetables, other vegetables, fruits, oil, salt, and sugar.	Binary	

2.2.3. Statistical Model

To test the association between the methods of obtaining food supplies and the variety of food items included in the school meals program, we formulated Model 1 with the following structure:

$$FoodItems \sim \text{normal}\left(\log\left(\frac{\mu_i}{1-\mu_i}\right), \sigma\right) \tag{2.1}$$

$$\log\left(\frac{\mu_i}{1-\mu_i}\right) = \beta_0 + \beta_1 * InKindDomestic_i + \beta_2 * InKindForeign_i + \beta_3 * DomesticPurchase_i + \beta_4 * ForeignPurchase_i \tag{2.2}$$

$$\beta \sim \text{normal}(M, S) \tag{2.3}$$

The probability around the mean $\log\left(\frac{\mu_i}{1-\mu_i}\right)$ is determined by the shape of the normal distribution, where the width of the distribution is specified by the standard deviation σ. μ_i indicates the probability that varied food is included in the school meals program reported by the government representative from the country i. $InKindDomestic_i$ indicates the respondent i's confirmation of obtaining food supplies via in-kind donation from local, regional, elsewhere within the country, or from national food reserves.; $InKindForeign_i$ indicates the respondent i's confirmation of obtaining food supplies via in-kind donation from neighboring or distant countries; $DomesticPurchase_i$ indicates the respondent's confirmation of obtaining food supplies via purchasing from local, regional, elsewhere within the country, or from national food reserves; $ForeignPurchase_i$ indicates the respondent's confirmation of obtaining food supplies via purchasing from neighboring or distant countries. Model 2 has six parameters, such as the intercept, β_0, the coefficients, $\beta_1 - \beta_4$, and the standard deviation of the "noise", σ. The coefficients of the predictor variables are distributed as a normal distribution around the mean denoted M with the standard deviation denoted S. The logical network of Model 1 is shown in Figure 1 below.
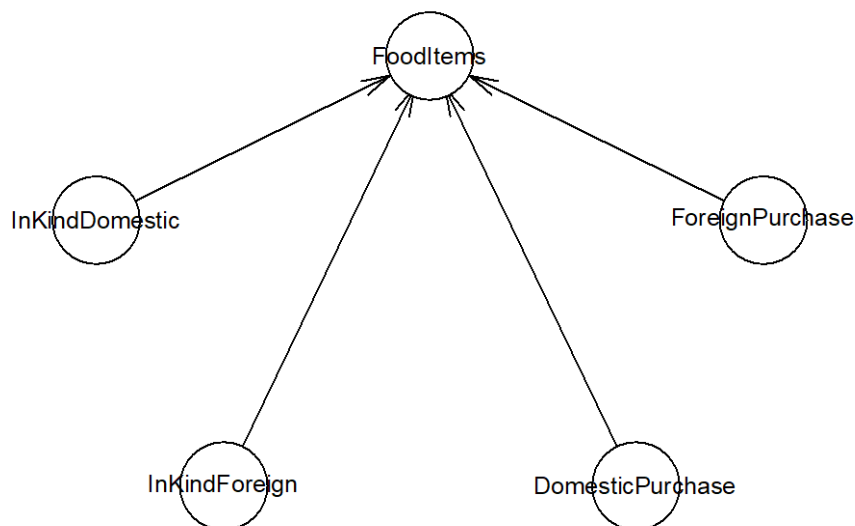

Figure 1. Model 1's logical network

2.2.4. Data Analysis and Validation

The Bayesian Mindsponge Framework (BMF) analytic is utilized here due to its integration of the inferential strengths of Bayesian analysis, particular its logical reasoning capabilities intrinsic to Mindsponge theory (Nguyen et al., 2022; Vuong et al., 2022). Both approaches exhibit a high degree of compatibility (Nguyen et al., 2022). Moreover, Bayesian inference probabilistically accounts for all characteristics, whether known or unknown, thereby enhancing the formulation of streamlined predictive models (Csilléry et al., 2010; Gill, 2014). Additionally, Bayesian analysis adeptly accommodates intricate structures like nonlinear regression and multilevel models, which are made possible through the application of the Markov chain Monte Carlo (MCMC) method (Dunson, 2001). Compared to frequentist approaches, Bayesian inference offers numerous benefits, including the application of credible intervals for interpreting results, as opposed to reliance on confidence intervals and p-values (Halsey et al., 2015; Wagenmakers et al., 2018).

The selection of an appropriate prior is crucial in the formation of a Bayesian model. For this study, we applied uninformative priors or a flat prior distribution to limit the available prior information for model estimation, reflecting the exploratory nature of our research (Diaconis & Ylvisaker, 1985). After successfully fitting the model, we applied Pareto-smoothed importance sampling leave-one-out (PSIS-LOO) diagnostics to evaluate the model's goodness of fit (Vehtari & Gabry, 2019; Vehtari et al., 2017). Leave-one-out (LOO) is computed as follows:

$$LOO = -2LPPD_{loo} = -2\sum_{i=1}^{n} \log \int p(y_i|\theta)p_{post(-i)}(\theta)d\theta$$

The posterior distribution $p_{post(-i)}(\theta)$ is formulated based on the data while omitting the data point i. In the PSIS method, k-Pareto values are employed for the computation of leave-one-out cross-validation, facilitating the identification of observations that exert a substantial influence on the PSIS estimate. Observations yielding k-Pareto values greater than 0.7 are deemed influential and may complicate the accurate estimation of leave-one-out cross-validation. It is generally accepted that a model demonstrates a good fit to the data when the k values fall below 0.5.

When the data aligns effectively with the model, we will then proceed to conduct convergence diagnostics and interpret the results. Both statistical and visual methodologies can be utilized to confirm the convergence of the Markov chains. Statistically, the effective sample size (n_eff) and the Gelman–Rubin shrink factor ($Rhat$) serve as key indicators for assessing convergence. The n_eff metric reflects the number of independent samples obtained during the stochastic simulation process. Convergence is generally deemed acceptable when n_eff exceeds 1000, thereby providing sufficient samples for dependable inference (McElreath, 2018). Conversely, the $Rhat$ value serves as the potential scale reduction factor; if Rhat exceeds 1.1, it indicates that the model has not converged. A Rhat value of 1 signifies convergence. Furthermore, visual verification

of the convergence of the Markov chains can be conducted using trace plots, Gelman–Rubin–Brooks plots, and autocorrelation plots.

The Bayesian analysis was performed using the open-access bayesvl package in R. The data and code segments pertaining to this preliminary analysis were uploaded to a preprint server to enhance data transparency, thus facilitating public scrutiny and reproducibility (Vuong, 2018): https://zenodo.org/records/13252985.

3. RESULTS

According to the results of the 2021 Global Survey of School Meal Programs conducted by the Global Child Nutrition Foundation (GCNF), grains-cereals was the most common food category among countries implementing school meals programs (served in 87% of programs), followed by oil (78%) and legumes (75%). Fruits and vegetables were less common (63-65%), and animal-source foods were served least often—though there was a high degree of variation across income groups. Poultry, for example, was served in 69% of programs in high-income settings but just 5% of programs in low-income settings. The gap was even larger for fruits, which were served in 97% and 22.5% of programs in high- and low-income settings, respectively—a difference of 74.5 percentage points. In high-income settings, children received an average of 8.3 different food categories, while this value dropped to 7.1, 6.5, and 5.2 in upper middle-income, lower middle-income, and low-income settings, respectively. Across regions, this value was greatest in South Asia/East Asia/Pacific and least in Sub-Saharan Africa (GCNF, 2022).

Across all regions and income groups, market purchases were the most common method through which school meal programs procured food supplies. These purchases primarily occurred in domestic markets, though 38% of programs purchased at least some food supplies from foreign countries. In-kind contributions from foreign and domestic settings were much less common at 23% and 21%, respectively, and were primarily reported by programs operating in low-income and lower-middle-income countries (GCNF, 2022).

Before interpreting the results of BMF analytics, it is necessary to evaluate how well Model 1 fits the data. As can be seen in Figure 2, we found no value exceeding the 0.5 threshold; the recommended value is below the 0.7 threshold. This indicates a good fit signal between the model and the data.
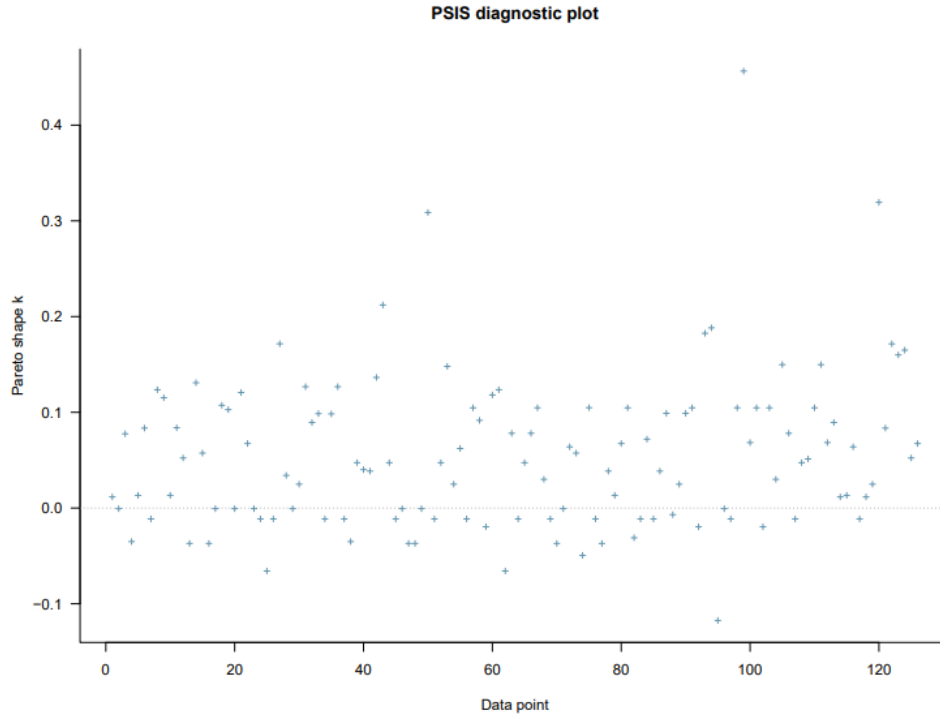
Figure 2. Model 1's PSIS-LOO diagnosis

The posterior distribution statistics of Model 1 are shown in Table 2. All *n_eff* values are greater than 1000, and *Rhat* values are equal to 1, so it can be assumed that Model 1's Markov chains are well-convergent. Table 2 below explains the posterior distribution statistics of Model 1, as illustrated in Figure 1.

Table 2. Estimated results of Model 1

Parameters	Mean	SD	n_eff	Rhat
a_FoodItems	0.69	0.10	6239	1
b_InKindDomestic_FoodItems	0.08	0.07	9278	1
b_InKindForeign_FoodItems	-0.13	0.07	9869	1
b_DomesticPurchase_FoodItems	-0.01	0.10	6316	1
b_ForeignPurchase_FoodItems	0.06	0.05	11115	1

The convergence of Markov chains is also reflected in the trace plots of Figure 3. In particular, after the 2000th iteration, all chains' values fluctuate around the central equilibrium.
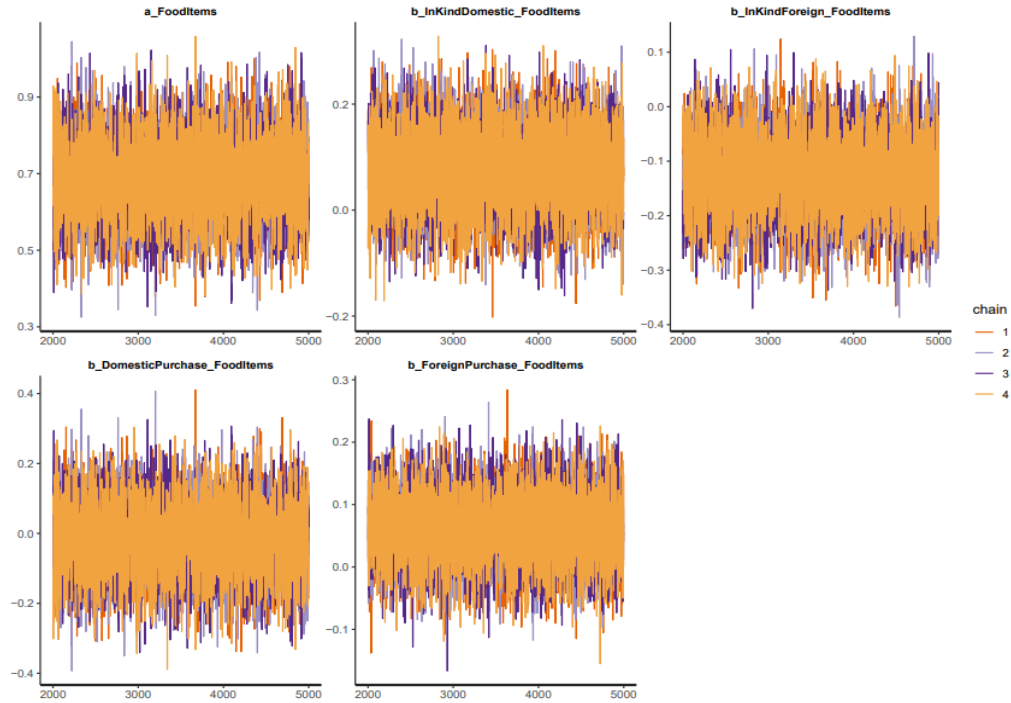
Figure 3. Model 1's trace plots

The Gelman-Rubin-Brooks plots and autocorrelation plots also show that the Markov chains have good convergence. Gelman-Rubin-Brooks plots are used to evaluate the ratio between the variance between Markov chains and the variance within chains. The y-axis demonstrates the shrinkage factor (or Gelman-Rubin factor), while the x-axis illustrates the iteration order of the simulation. In Figure 4, the shrinkage factors of all parameters rapidly decrease to 1 before the 2000th iteration (during warm-up). This manifestation indicates that there are no divergences between Markov chains.
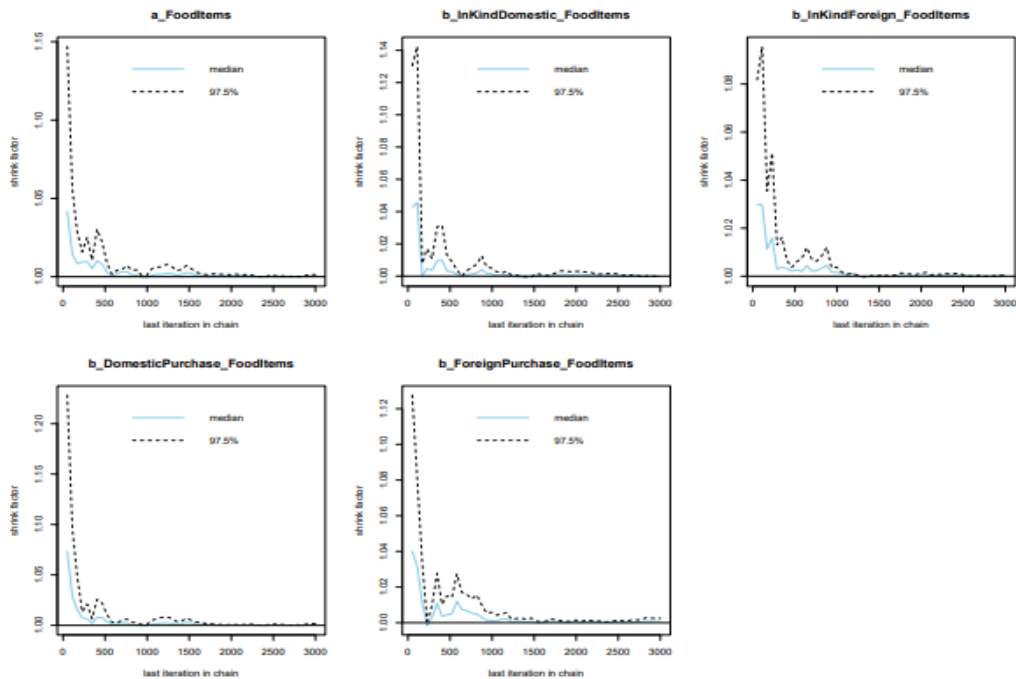

Figure 4. Model 1's Gelman-Rubin-Brooks plots

The Markov property refers to the memory-less property of a stochastic process. In other words, iteration values are not auto-correlated with the past iteration values. Autocorrelation plots are used to evaluate the level of autocorrelation between iteration values. The plots in Figure 5 show the average autocorrelation of each Markov chain along the y-axis and the delay of these chains along the x-axis. Visually, after several delays (before 5), the autocorrelation levels of all Markov chains swiftly drop to 0, indicating that the Markov properties are preserved and the Markov chains converge well.
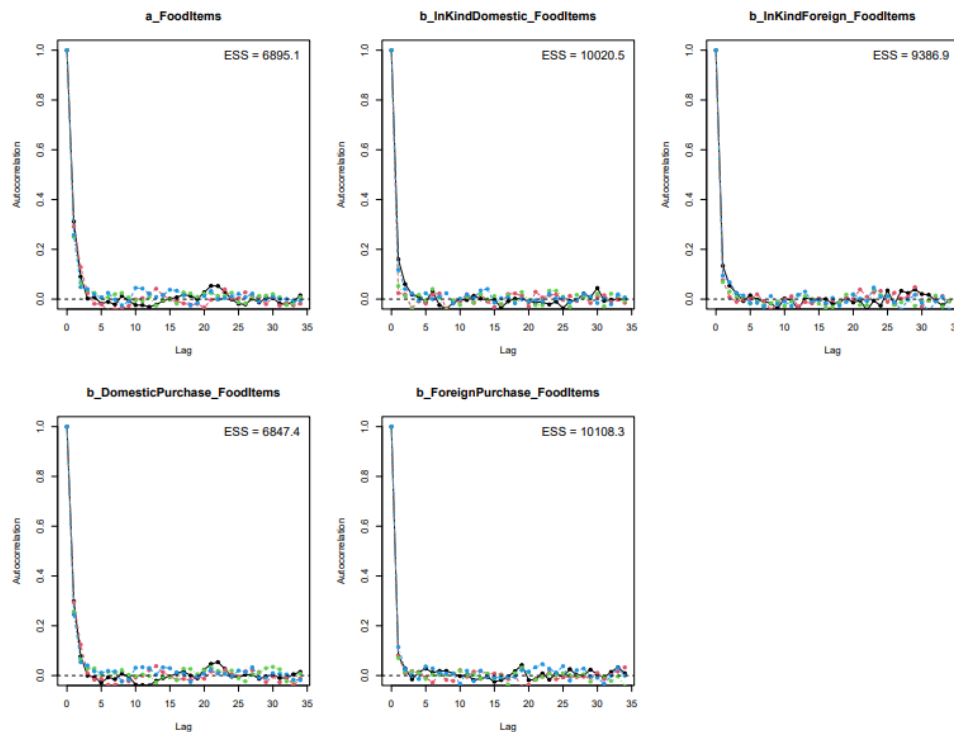

Figure 5. Model 1's autocorrelation plots

Since all the diagnostics confirm the convergence of Markov chains, the simulated results are eligible for interpretation. Figure 6 illustrates the estimated outcomes based on estimated coefficients by using Mean values for computation because they have the highest probability of occurrence. A proportion of the distributions of *b_InKindDomestic_FoodItems* and *b_ForeignPurchase_FoodItems* are located on the positive side of the *x*-axis, while the distribution of *b_InKindForeign_FoodItems* is fully situated on the negative side. These distributions signify the moderately reliable positive effect of *InKindDomestic* and *ForeignPurchase* on *FoodItems*, and the highly reliable negative effect of *InKindForeign* on *FoodItems*. In addition, the distribution of *b_DomesticPurchase_FoodItems* is situated in the neutral zone, indicating its unclear effect on the *a_FoodItems*.

The estimated results of Model 1 revealed that the method of obtaining supplies, whether through in-kind donations from local, regional, national sources, or national food reserves and purchasing from neighboring or distant countries, had a significant positive association with the variety of food items included in school meals or snacks. Conversely, obtaining supplies in-kind from neighboring or distant countries had a significant

negative association with the food variety. Additionally, purchasing supplies from local, regional, or national food reserves had an unclear association with the food variety (see Figure 6).
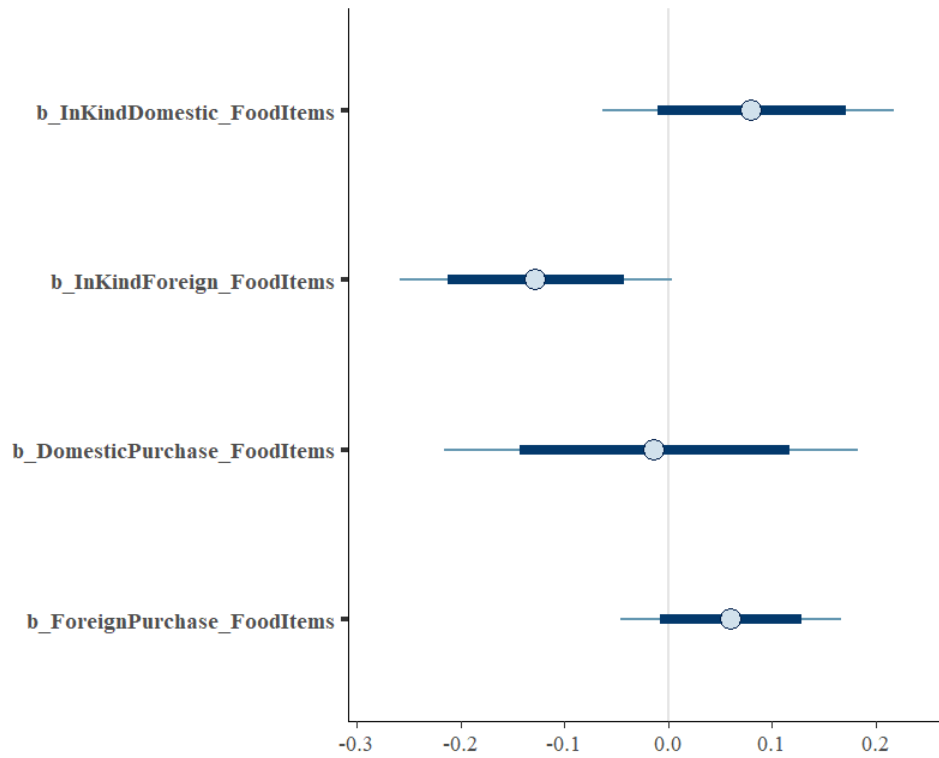

Figure 6. Estimated coefficients

Figure 7 shows the posterior distribution with Highest Posterior Density Intervals (HPDIs) at 95%. The found effects are clear, which suggests that the results are reliable.
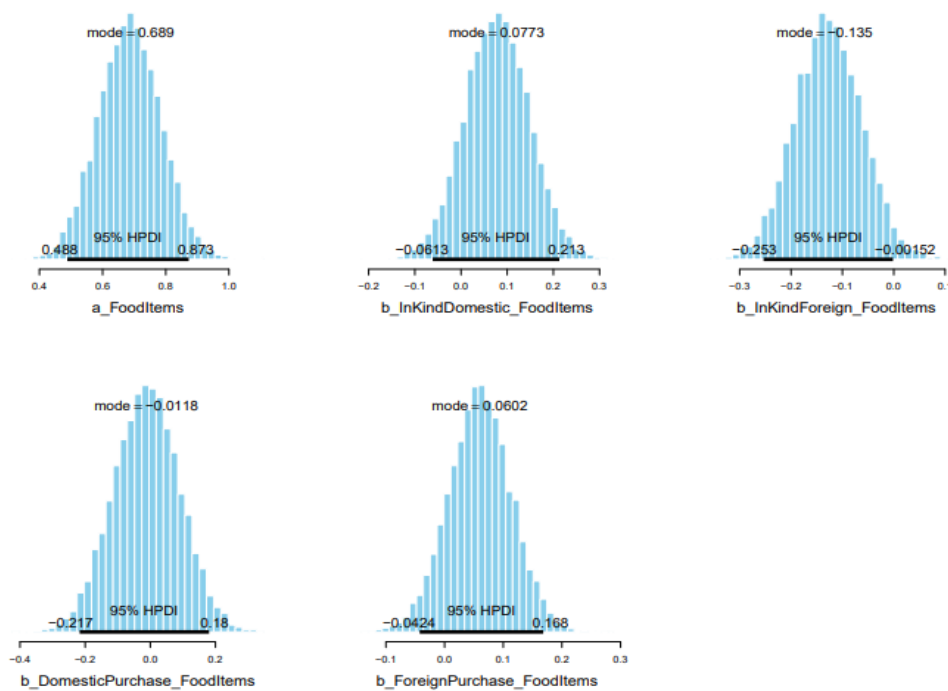

Figure 7. Distributions of posterior coefficients with HPDI at 95%

4. DISCUSSION

The transformation of a raw material into a value-added product through a sequence of actors, processes, and operational activities is known as a food supply chain (Dani, 2021). The food supply chain is the foundation of institutional food procurement, which refers to food purchasing and provision by organizations such as schools. Policymakers are becoming more and more aware of the need to address malnutrition (Xie & Brownell, 2020). The main objective of the food procurement mechanism is an efficient and uninterrupted supply of quality food (Sitao, 2018; Swensson, 2018) to support the goals of school meal programs through food fortification and a variety of food items (Wineman et al., 2022).

The application of TQM (Total Quality Management) in school meals program plays a significant role in ensuring the success of the food supply chain. Logistics is one of the dimensions of TQM, and the intricacy of the logistics process can be confirmed that it addresses many aspects, including purchasing, distribution, and transportation (Coelho et al., 2022). Logistics needs to pursue not only what food items will be delivered but, according to Salvatore et al. (2021), also how the products will be delivered. Further, they have demonstrated that purchasing strategies can affect the behavior of consumers by encouraging the consumption of healthy foods. On top of purchasing strategies, the ways of transporting food are also a crucial aspect (Salvatore et al., 2021). Williams et al. (2021) argued that the procurement approach was based on their menu items and food variety needs. Food donations from commercial actors or international contributors are two more sources of food that can occasionally be obtained. World Health Organization (2021) has highlighted that it is crucial to comprehend the nation's methods for obtaining and providing food and implementation procedures.

The most common avenue through which school meal programs of the 126 countries procured food was through domestic purchase, with 93% of countries accessing at least some food through this avenue. This was followed by foreign purchases (by 40% of countries). In-kind donations from other countries (by 25% of countries) and receipt of in-kind donations from within the country were the least common procurement choices (by 20% of countries) [GCNF, 2022].

This study examines national and international capacities in supply chain management by analyzing the food items delivered through the school meals programs in 126 countries. The granular interaction thinking of mindsponge theory was used in the study conceptualization, parsimonious model construction, and findings explanation, with the granular interactions thinking mechanism as the critical point (Vuong & Nguyen, 2024). We employed the Bayesian Mindsponge Framework in examining the method of obtaining school meal supplies, whether through in-kind donations from local, regional, national sources, or national food reserves and purchasing from neighboring or distant countries, and their associations with the variety of food items.

Our investigation yielded significant findings. First, we observed that almost all methods influence the diversity of food items in school meals or snacks. This outcome aligns with

the perspective that national and international capacities in school meal programs are influenced by a nation's information processing system, which is deeply ingrained in the collective mindset of the nation and serves as a crucial standard for evaluating new information or values pertaining to food variety in school meal programs (Vuong, 2023). This finding also supports the contention made by Wineman et al. (2022) that the contents of a food basket, or the variety of food items, correlate with the primary food procurement method.

Second, obtaining supplies in-kind directly from local, regional, or national food reserves significantly impacted the variety of food items available. This suggests that local food donations provide a wider range of food items than other sourcing strategies in the school meals supply chain. Regarding school food procurement, "local" typically refers to geographic proximity and interpersonal interaction, which can include parental involvement (Galloway et al., 2023). According to Wineman et al. (2022), in-kind supplies from the local community often come from parents providing food to their children's schools. This highlights parents as key contributors to food donations to schools. These findings contrast with Ndlovu et al. (2020), who argued that various factors, such as irregular deliveries and limited quantities and varieties of food items, have diminished the effectiveness of local food donations.

Third, the reliance on obtaining supplies in-kind from neighboring or distant countries has been found to have a significant negative impact on the variety of food items available. Research shows that while 46 countries primarily relied on domestic purchases for their school meal programs, 31 countries also received foreign in-kind donations as an alternative sourcing method (GCNF, 2022). However, it is essential to note that not all types of in-kind supplies result in a net positive outcome. Studies, such as the one by Wineman et al. (2022), have indicated that a reliance on foreign food donations, particularly from distant countries, is associated with less diverse menus. In supply chain management, several factors may negatively impact the variety of food items obtained from foreign countries. For instance, food losses are possible during logistic processes, such as spoilage during storage or transit to schools. While food donations have the potential to help reduce the current meal gap, there are drawbacks, including uncertainty about the types and timing of the received food items, concerns about perishability, and the risk of receiving undesirable supplies (Ahire & Pekgün, 2018). Because of these factors, some schools have shifted from accepting contributions in-kind to cash donations (Roothaert et al., 2021).

Fourth, the procurement of food items from foreign countries has had a significantly positive impact on the variety of available products. Research suggests that while receiving supplies in-kind from distant countries had a negative effect on the variety of food items, purchasing them brings about contrasting effects. McIntosh & Zeitlin (2024) emphasized that more significant sums of money can improve overall consumption and dietary diversity, making foreign sourcing preferable to accepting in-kind supplies. This sourcing strategy is mainly due to the challenges faced in local procurement. Issues such as seasonality, volume, and finding products at the best price made it impractical to

procure from local producers (Williams et al., 2021). Fitzsimmons & O'Hara (2019) confirmed that the typical problem with local sourcing strategies is the unreliable year-round availability of desired food items. Furthermore, many necessary food items were fresh and perishable with a short shelf life, and no local suppliers could produce the necessary volume of the same product (Coelho et al., 2022). Therefore, foreign suppliers can serve as a viable alternative.

Fifth, the procurement of supplies from local, regional, or national food reserves had an ambiguous impact on the variety of food items available. The findings indicate that local food procurement has benefits and drawbacks compared to other types of food assistance, such as in-kind food supplies, particularly regarding the assortment of food items. Increasing the availability of food items was one of the perceived benefits of purchasing locally (Williams et al., 2021). Local procurement is recognized for its ability to introduce fresh food items into school meals, enhancing the dietary diversity of students (Memirie, 2023). A previous study highlighted the benefits of local procurement in expediting the delivery process for schools, which is a significant advantage of this sourcing method (Hunter et al., 2020). However, the inconsistent supply of food items throughout the year presents a notable challenge. According to Chaves et al. (2023), inadequate logistics can significantly impact the availability of food items, affecting the variety of food items offered in schools. Mensah & Karriem (2021) also noted that most local farmers have limited land, which restricts their ability to grow additional fresh food items for school meal programs.

5. IMPLICATIONS

5.1. Theoretical Implications

This study contributes to the literature on supply chain management for school meal programs worldwide. This study's unique contribution is that it is one of the first to investigate the relationships between methods of obtaining supplies, whether through national and international in-kind donations and purchasing, with the variety of food items delivered in school meals program. This study found that almost all methods significantly affect the variety of food items in school meals, except for the method of purchasing supplies from local, regional, or national food reserves, which has an unclear association with the food variety and requires further investigation. Furthermore, this study stresses that obtaining supplies in-kind from local, regional, or national food reserves and purchasing from foreign countries will bring more variety in food items served to students. On the contrary, obtaining supplies in-kind from foreign countries will diminish the variety of food items served to students. In general, this study confirms a previous study (Wineman et al., 2022) where food basket contents or the variety of food items tended to be correlated with the primary avenue through which food was procured. Finding from this study also underscore the importance to support the recommendations from the World Bank and World Food Programme to rely more on local resources and capacities for sustainable school meals program.

5.2. Practical Implications

The practical implications offered by the study are two-fold. First, it is evident that a method combination of purchasing from distant countries and accepting food donations, for example, from parents and local communities, is the most effective strategy for ensuring diverse school meal supplies. However, due to cost and practicality concerns, countries will continue to depend primarily on local sources for their food supply. Therefore, this study recommends optimizing local suppliers, as previous research has shown that sourcing fresh food from a short supply chain is preferable (dos Santos et al., 2022; Salvatore et al., 2021; Xie & Brownell, 2020)). However, challenges associated with local procurement must be prevented and managed to ensure greater food diversity in school meals program.

Second, the study highlights the positive impact of food donations but also suggests that relying solely on in-kind supplies as the primary sourcing strategy for school meal programs may present challenges. In a food bank context, North & Pechmann (2024) noted that beneficiaries cannot address nutritional deficits and customize food donations, as they lack choice and voice in the selection process. Akkerman et al. (2023) further argued that the uncertainties surrounding donations, such as obtaining sufficient donations and donations of the desired product categories, pose significant issues. Additionally, food item availability and variety mismatches can present challenges in meeting nutritional goals.

6. STUDY LIMITATIONS

This study is not without limitations. The nature of the cross-sectional study has made the changing value of the variables studied unmeasurable over time. This study may portray a certain situation at one time to show a pattern of events but may not show the dynamic changes of the situation in the field. The questionnaire used is a self-reported questionnaire by design. It might be less objective for measuring variables. A qualitative study employing in-depth interviews among policymakers and stakeholders or parties involved in school feeding program execution is needed to fully understand the impacts of various methods in obtaining school meal supplies on the variety of food items delivered in school meal programs.

7. CONCLUSIONS

The method of obtaining school meal supplies, whether through in-kind donations from local, regional, national sources, or national food reserves and purchasing from neighboring or distant countries, is positively associated with the variety of food items delivered in school meal programs. Conversely, obtaining supplies in-kind from neighboring or distant countries is negatively associated with the food variety. Additionally, the association between the method of purchasing supplies from local, regional, or national food reserves and the food variety remains unclear, requiring further

investigation. Findings underscore the importance of supporting the World Bank and World Food Programme's recommendation to rely more on local resources and capacities. Enhancing supply chain management at the national level is crucial for developing a long-term and sustainable school meals program.

REFERENCES

Ahire, S. L., & Pekgün, P. (2018). Harvest Hope Food Bank Optimizes Its Promotional Strategy to Raise Donations Using Integer Programming. *Interfaces*, *48*(4), 291–306. https://doi.org/10.1287/inte.2018.0944

Akkerman, R., Buisman, M., Cruijssen, F., de Leeuw, S., & Haijema, R. (2023). Dealing with donations: Supply chain management challenges for food banks. *International Journal of Production Economics*, *262*, 108926. https://doi.org/10.1016/j.ijpe.2023.108926

Aliyar R, Gelli A and Hamdani SH (2015) A review of nutritional guidelines and menu compositions for school feeding programs in 12 countries. Front. Public Health 3:148.

Aroesty, T., Arshad, S., Chun, E., Gordon, J.L., Green, N., Hume, S., & Louis, G.E. (2018). School meals: Breaking the cycle of hunger and poverty. 2018 Systems and Information Engineering Design Symposium (SIEDS), 100-105.

Bateman J, Engel T, Meinen A. (2014) Understanding Wisconsin producer and distributor perceptions to inform farm to school programs and policies. J Hunger Environ Nutr. 2014;9(1):48–63.

Bhalla, G. 2023. The Role of social protection in strengthening local food systems and inclusive rural transformation. A case study of the Kenya Home-Grown School Meal Programme. Rome, FAO

Bryant, M., Burton, W., O'Kane, N., Woodside, J.V., Ahern, S., Garnett, P., Spence, S., Sharif, A., Rutter, H., Baker, T. and Evans, C.E., 2023. Understanding school food systems to support the development and implementation of food based policies and interventions. International Journal of Behavioral Nutrition and Physical Activity, 20(1), p.29.

Bundy, D., Gentilini, U., Schultz, L., Bedasso, B., Singh, S., Okamura, Y., Iyengar, H., & Blakstad, M. (2024). School Meals, Social Protection, and Human Development: Revisiting Trends, Evidence, and Practices in South Asia and Beyond. 10.1596/41431.

Chaves, V. M., Rocha, C., Gomes, S. M., Jacob, M. C. M., & da Costa, J. B. A. (2023). Integrating Family Farming into School Feeding: A Systematic Review of Challenges and

Potential Solutions. *Sustainability*, *15*(4), 2863. https://doi.org/10.3390/su15042863

Coelho, T. M., Moscon, J. Z., de Brito Junior, I., Alebrant Mendes, A., & Yoshizaki, H. T. Y. (2022). Public School Food Supply Chain during the COVID-19 Pandemic: A Case Study of the City of Vitória (Brazil). *Logistics*, *6*(1), 20. https://doi.org/10.3390/logistics6010020

Cohen, J. F., Hecht, A. A., McLoughlin, G. M., Turner, L., & Schwartz, M. B. (2021). Universal school meals and associations with student participation, attendance, academic performance, diet quality, food security, and body mass index: a systematic review. Nutrients, 13(3), 911.

Csilléry, K., Blum, M. G., Gaggiotti, O. E., & François, O. (2010). Approximate Bayesian computation (ABC) in practice. *Trends in Ecology and Evolution*, *25*(7), 410-418. https://doi.org/10.1016/j.tree.2010.04.001

Dani, S. (2021). *Food Supply Chain Management and Logistics: Understanding the Challenges of Production, Operation and Sustainability in the Food Industry* (2nd ed.). Kogan Page.

Davies, P., & Gregersen, N. H. (2014). *Information and the nature of reality: From physics to metaphysics*. Cambridge University Press. https://doi.org/10.1017/CBO9781107589056

Devereux, S., Hochfeld, T., Karriem, A., Mensah, C., Morahanye, M., Msimango, T., Mukubonda, A., Naicker, S., Nkomo, G., Sanders, D. & Sanousi., M. (2018), "School Feeding in South Africa: What we know, what we don't know, what we need to know, what we need to do" Food Security SA Working Paper Series No. 004. DST-NRF Centre of Excellence in Food Security, South Africa.

Diaconis, P., & Ylvisaker, D. (1985). Quantifying prior opinion. In J. M. Bernardo, M. H. DeGroot, D. V. Lindley, & A. F. M. Smith (Eds.), *Bayesian Statistics* (Vol. 2, pp. 133-156). North Holland Press.

dos Santos, E. B., da Costa Maynard, D., Zandonadi, R. P., Raposo, A., & Botelho, R. B. A. (2022). Sustainability Recommendations and Practices in School Feeding: A Systematic Review. *Foods*, *11*(2), 176. https://doi.org/10.3390/foods11020176

Drake, L., Woolnough, A., Burbano, C., & Bundy, D.A. (2016). Global school feeding source book: lessons from 14 countries.

Drake, L., Woolnough, A., Burbano, C., & Bundy, D. (2016). Global School Feeding Sourcebook: Lessons from 14 Countries. London: Imperial College Press.

Dunson, D. B. (2001). Commentary: practical advantages of Bayesian analysis of epidemiologic data. *American journal of Epidemiology*, *153*(12), 1222-1226. https://doi.org/10.1093/aje/153.12.1222

Duong, M.-P. T., Sari, N. P. W. P., Mazenda, A., Nguyen, M.-H., & Vuong, Q.-H. (2024). Improving the market for household livestock production to alleviate food insecurity in the Philippines. Animal Production Science, 64(7). https://doi.org/10.1071/an23349

Dyson, F. (1999). *Origins of life*. Cambridge University Press.

Evans, C.E.L. and Harper, C.E. (2009), A history and review of school meal standards in the UK. Journal of Human Nutrition and Dietetics, 22: 89-99. https://doi.org/10.1111/j.1365-277X.2008.00941.x

Evans, D.K. & Acosta, M.A. (2021) Education in Africa: What Are We Learning? Journal of African Economies, Volume 30, Issue 1, January 2021, Pages 13–54.

Fitzsimmons, J., & O'Hara, J. K. (2019). Market Channel Procurement Strategy and School Meal Costs in Farm-to-School Programs. *Agricultural and Resource Economics Review*, *48*(3), 388–413. https://doi.org/10.1017/age.2019.18

Franco, M., & Fajo-Pascual, M. (2022). School food systems. 10.1016/B978-0-12-821848-8.00146-3.

Galloway, C., Devine, S., Parison, J., & Jones, H. (2023). Procurement from local producers for food service in primary and secondary school settings: A scoping review. *Health Promotion Journal of Australia*, *34*(2), 316–327. https://doi.org/10.1002/hpja.618

Gelli., A, Meir., U, & Espejo, F. (2007) Does provision of food in school increase girls' enrollment? Evidence from schools in sub-Saharan Africa. Food Nutr Bull. 28:149–55. doi: 10.1177/156482650702800203

Gill, A., Williams, P., & Thompson, S. Perceived water conservation attitudes and behaviours in second-home island settings. Tourism and Hospitality Research 2010, 10, 141-151.

Global Child Nutrition Foundation. (2022). *Global Survey of School Meal Programs Database*. GCNF: Seattle. https://gcnf.org/global-reports/

Haß, J., Lischetzke, T., & Hartmann, M. (2018). Does the distribution frequency matter? A subgroup specific analysis of the effectiveness of the EU School Fruit and Vegetable Scheme in Germany comparing twice and thrice weekly deliveries. Public Health Nutrition, 21(7), 1375–1387. doi:10.1017/S1368980017003949

Halsey, L. G., Curran-Everett, D., Vowler, S. L., & Drummond, G. B. (2015). The fickle P value generates irreproducible results. *Nature methods*, *12*, 179-185. https://doi.org/10.1038/nmeth.3288

Hunter, D., Borelli, T., & Gee, E. (2020). *Biodiversity, food and nutrition. A new agenda for sustainable food systems.* Routledge. https://cgspace.cgiar.org/bitstreams/ff197f34-f3e7-4e1c-b016-483149b90a95/download

Izumi BT, Wynne Wright D, Hamm MW. Market diversification and social benefits: motivations of farmers participating in farm to school programs. J Rural Stud. 2010;26(4):374–82. a

Izumi, B.T., Alaimo, K., & Hamm, M.W. (2010). Farm-to-school programs: perspectives of school food service professionals. J Nutr Educ Behav. 2010;42(2):83–91. b

Kobiruzzaman MM. (2020). Principles of Total Quality Management and Eight Principles of TQM. https://newsmoor.com/total-quality-management-tqm-eight-principles-and-practices-of-tqm/

Kouvari, M., Diamantis, D. V., Katsas, K., Radaios, V., Veloudaki, A., & Linos, A. (2023). Nutritional Value of Meals Designed for a School-Based Food Aid Program and Comparison with Similar Commercial Products: An Example of Good Practice from the DIATROFI Program. *Children*, *10*(7), 1268.

Kretschmer A, Spinler S, Van Wassenhove LN. (2014). A school feeding supply chain framework: critical factors for sustainable program design. *Production and Operations Management*, **23**(6), 990–1001. https://doi.org/10.1111/poms.12109

Liu, X., Liu, C., & Bi, J. (2023). Shortening food supply chain in home-grown school feeding: experiences and lessons from south central China. International Food and Agribusiness Management Review, 26(4), 711-728.

Lundborg, P., Rooth, D. O., & Alex-Petersen, J. (2022). Long-term effects of childhood nutrition: evidence from a school lunch reform. The Review of Economic Studies, 89(2), 876-908.

Masila, N., Smith, K. J., Waddingham, S., & Jose, K. (2024). Comparative analysis of school food policies in Australian jurisdictions: Insights for more effective policy action. *Health Promotion Journal of Australia*.

Mawela A, Van den Berg G. (2018). Management of school nutrition programs to improve environmental justice in schools: A South African case study. *South African Journal of Clinical Nutrition*, **33**(2), 30–35. https://doi.org/10.1080/16070658.2018.1507208

McElreath, R. (2018). *Statistical rethinking: A Bayesian course with examples in R and Stan*. Chapman and Hall/CRC Press.

McIntosh, C., & Zeitlin, A. (2024). Cash Versus Kind: Benchmarking a Child Nutrition Program Against Unconditional Cash Transfers in Rwanda. *The Economic Journal*. https://doi.org/10.1093/ej/ueae050

Memirie, S. T. (2023). *School Meals Case Study: Ethiopia*. https://doi.org/https://doi.org/10.17037/PUBS.04671611

Mensah, C., & Karriem, A. (2021). Harnessing Public Food Procurement for Sustainable Rural Livelihoods in South Africa through the National School Nutrition

Programme: A Qualitative Assessment of Contributions and Challenges. *Sustainability*, *13*(24), 13838. https://doi.org/10.3390/su132413838

Motta, Victor & Sharma, Amit. (2016). Benefits and transaction costs of purchasing local foods in school districts. International Journal of Hospitality Management. 55. 81-87.

MUFPP (2024), SCHOOL MEALS the transformative potential of urban food policies

Ndlovu, S., Mpofu, M., & Moyo, P. (2020). Debunking the effectiveness of in-kind transfers in alleviating urban household food insecurity in Bulawayo, Zimbabwe. *Development Southern Africa*, *37*(1), 55–69. https://doi.org/10.1080/0376835X.2019.1584031

Nguyen, M.-H., Le, T.-T., & Vuong, Q.-H. (2023). Ecomindsponge: A novel perspective on human psychology and behavior in the ecosystem. *Urban Science*, *7*(1), 31. https://doi.org/10.3390/urbansci7010031

Nguyen, M.-H., La, V.-P., Le, T.-T., & Vuong, Q.-H. (2022). Introduction to Bayesian Mindsponge Framework analytics: an innovative method for social and psychological research. *MethodsX*, *9*, 101808. https://doi.org/10.1016/j.mex.2022.101808

North, N., & Pechmann, C. (Connie). (2024). Improving donation service design: expanding choice to increase perceived justice and satisfaction. *Journal of Services Marketing*, *38*(5), 564–577. https://doi.org/10.1108/JSM-01-2023-0001

Octawijaya IH, Kondo M, Hori A, Ichikawa M. (2023) Parent Willingness to Pay for School Feeding Programs in Junior High Schools in Malang Regency, Indonesia. Nutrients. 15(14):3212. https://doi.org/10.3390/nu15143212

Pastorino, S.; Hughes, D.; Schultz, L.; Owen, S.; Morris, K..; Backlund, U.; Bellanca, R.; Hunter, D.; Kaljonen, M.; Singh, S.; Eustachio Colombo, P.; Milani, P. (2023) School meals and food systems: Rethinking the consequences for climate, environment, biodiversity, and food sovereignty. London School of Hygiene & Tropical Medicine 166 p.

Perry, J., Horsey, B., Raneri, J., Hunter, D., O'Connor, S., Hyland-Wood, M., Casey, E., & Burkhart, S. (2024). Exploring school food provision programs and links to local foods in Pacific Island countries. Proceedings of the Nutrition Society, 83.

Piirsalu, E., Varov, I., Kaaret, K., Uiboleht, K., Kuldna, P. (2022). Mapping the school food system. D 2.2 joint report of mapping. SchoolFood4Change project.

Roothaert, R., Mpogole, H., Hunter, D., Ochieng, J., & Kejo, D. (2021). Policies, Multi-Stakeholder Approaches and Home-Grown School Feeding Programs for Improving Quality, Equity and Sustainability of School Meals in Northern Tanzania. *Frontiers in Sustainable Food Systems*, *5*. https://doi.org/10.3389/fsufs.2021.621608

Sahinyazan, F. G., Rancourt, M. È., & Verter, V. (2021). Food aid modality selection problem. *Production and Operations Management*, *30*(4), 965-983.

Salvatore, F. P., Fanelli, S., Lanza, G., & Milone, M. (2021). Public food procurement for Italian schools: results from analytical and content analyses. *British Food Journal*, *123*(8), 2936–2951. https://doi.org/10.1108/BFJ-09-2020-0807

Schwartz, A.E. and Rothbart, M.W. (2020), Let Them Eat Lunch: The Impact of Universal Free Meals on Student Performance. J. Pol. Anal. Manage., 39: 376-410. https://doi.org/10.1002/pam.22175

Sidaner, E., Balaban, D., & Burlandy, L. (2012). The Brazilian school feeding programme: an example of an integrated programme in support of food and nutrition security. Public Health Nutrition, 16, 989 - 994.

Sitao, V. J. R. (2018). *An assessment of school feeding programme - pilot phase and its relationship with enrolment, attendance, retention and the local agricultural production in Nampula province in Mozambique* [School of Health Systems and Public Health]. https://repository.up.ac.za/bitstream/handle/2263/67908/Sitao_Assessment_2018.pdf?sequence=1

Swensson, L. F. J. (2018). *Aligning policy and legal frameworks for supporting smallholder farming through public food procurement: The case of home-grown school feeding programmes* (177). https://hdl.handle.net/10419/200618

The Hashemite Kongdom of Jordan (2020) The National School Feeding Strategy, 2021-2025.

Tregear, A., Aničić, A., Biasini, F., Bituh, B., Bojovic, M., Brecic, R., Brennan, R., Baric, M., Del Rio, I., Donati, D., Filipovic, M., Giopp, J., Ilić, F., Lanza, A., Mattas, G., Quarrie, K., Rosi, S., Sayed, A., & Tsakiridou, E. (2022). Routes to sustainability in public food procurement: An investigation of different models in primary school catering. Journal of Cleaner Production. 338. 130604. 10.1016/j.jclepro.2022.130604.

Vehtari, A., & Gabry, J. (2019). *Bayesian Stacking and Pseudo-BMA weights using the loo package*. In (Version loo 2.2.0) https://mc-stan.org/loo/articles/loo2-weights.html

Vehtari, A., Gelman, A., & Gabry, J. (2017). Practical Bayesian model evaluation using leave-one-out cross-validation and WAIC. *Statistics and computing*, *27*(5), 1413-1432. https://doi.org/10.1007/s11222-016-9696-4

Verguet, S., Limasalle, P., Chakrabarti, A., Husain, A., Burbano, C., Drake, L. & Bundy, D. (2020) The Broader Economic Value of School Feeding Programs in Low- and Middle-Income Countries: Estimating the Multi-Sectoral Returns to Public Health, Human Capital, Social Protection, and the Local Economy. Front. Public Health 8:

Vuong, Q.-H., & Nguyen, M.-H. (2024a). *Better economics for the Earth: A lesson from quantum and information theories*. AISDL.

https://www.google.com/books/edition/Better_Economics_for_the_Earth_A_Lesson/I50TEQAAQBAJ

Vuong, Q.-H., & Nguyen, M.-H. (2024b). Further on informational quanta, interactions, and entropy under the granular view of value formation. https://philpapers.org/rec/VUOARN

Vuong, Q.-H. (2023). *Mindsponge theory*. Walter de Gruyter GmbH. https://www.google.com/books/edition/Mindsponge_Theory/OSiGEAAAQBAJ

Vuong, Q.-H., Le, T.-T., Jin, R., Khuc, Q. V., Nguyen, H.-S., Vuong, T.-T., & Nguyen, M.-H. (2023). Near-suicide phenomenon: An investigation into the psychology of patients with serious illnesses withdrawing from treatment. *International Journal of Environmental Research and Public Health*, *20*(6), 5173. https://doi.org/10.3390/ijerph20065173

Vuong, Q.-H. (2024). *Wild Wise Weird*. https://www.amazon.com/dp/B0BG2NNHY6

Vuong, Q.-H., Le, T.-T., Khuc, Q. V., Nguyen, Q.-L., & Nguyen, M.-H. (2022b). Escaping from Air Pollution: Exploring the Psychological Mechanism behind the Emergence of Internal Migration Intention among Urban Residents. International Journal of Environmental Research and Public Health, 19(19), 12233. https://doi.org/10.3390/ijerph191912233

Vuong, Q.-H., Le, T.-T., La, V.-P., Nguyen, H. T. T., Ho, M.-T., Van Khuc, Q., & Nguyen, M.-H. (2022c). Covid-19 vaccines production and societal immunization under the serendipity-mindsponge-3D knowledge management theory and conceptual framework. Humanities and Social Sciences Communications, 9(1). https://doi.org/10.1057/s41599-022-01034-6

Vuong, Q.-H., Nguyen, M.-H., & La, V.-P. (2022d). *The mindsponge and BMF analytics for innovative thinking in social sciences and humanities*. De Gruyter. https://books.google.com/books?id=EGeEEAAAQBAJ

Vuong, Q.-H., Nguyen, M.-H., & Le, T.-T. (2021a). *A mindsponge-based investigation into the psycho-religious mechanism behind suicide attacks*. De Gruyter. https://books.google.com/books?id=88I-EAAAQBAJ

Vuong, Q.-H. (2018). The (ir)rational consideration of the cost of science in transition economies. *Nature Human Behaviour*, *2*, 5. https://doi.org/10.1038/s41562-017-0281-4

Vuong, Q.-H., & Napier, N. K. (2015). Acculturation and global mindsponge: An emerging market perspective. *International Journal of Intercultural Relations*, *49*, 354-367. https://doi.org/10.1016/j.ijintrel.2015.06.003

Wagenmakers, E.-J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., . . . Epskamp, S. (2018). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic bulletin review*, *25*(1), 35-57. https://doi.org/10.3758/s13423- 017-1343-3

Wang, D., & Fawzi, W.W. (2020). Impacts of school feeding on educational and health outcomes of school-age children and adolescents in low- and middle-income countries: protocol for a systematic review and meta-analysis. Systematic Reviews, 9.

Watkins, K. (2024). School Meals International Donor Analysis Analysis of school feeding financing data systems: challenges and opportunities

Williams, K., Kimathi, M., Papa, F., Miller, M., & Beyler, N. (2021). *Study of School Food Authority (SFA) Procurement Practices*. https://files.eric.ed.gov/fulltext/ED616677.pdf

Wineman, A., Ekwueme, M. C., Bigayimpunzi, L., Martin-Daihirou, A., de Gois V. N. Rodrigues, E. L., Etuge, P, Warner, Y., Kessler, H., & Mitchell, A. (2022). School Meal Programs in Africa: Regional Results From the 2019 Global Survey of School Meal Programs. *Frontiers in Public Health*, *10*. https://doi.org/10.3389/fpubh.2022.871866

World Food Programme. (2022). State of School Feeding Worldwide 2022. Rome, World Food Programme.

World Food Programme. (2021) WFP Policy Engagement and Technical Assistance for the National Nutrition Programme for School Children in Indonesia (Progas): Learning, Conclusions and the Way Forward. 2021

World Food Programme. (2022). Home Grown School Feeding Resource Framework Synopsis – March 2017

World Health Organization. (2021). *Action framework for developing and implementing public food procurement and service policies for a healthy diet*. https://apps.who.int/iris/bitstream/handle/10665/338525/9789240018341-eng.pdf

Xie, J., & Brownell, K. (2020). *Nutritious food procurement in cities in low- and middle-income countries: Case studies on Addis Ababa Students Feeding Agency and Pune Sassoon General Hospital Meal Programme* (#7). https://doi.org/10.36072/wp.7