SYNERGY BETWEEN SCHOOL MEAL PROGRAMS AND FOOD BANKS TO COMBAT FOOD INSECURITY AMONG CHILDREN: THE SIGNIFICANCE OF EXPERTS INVOLVEMENT

Ni Putu Wulan Purnama Sari[1], Chenaimoyo Lufutuko Faith Katiyatiya[2], Adrino Mazenda[2*], Chido Chakanya[3], Minh-Hoang Nguyen[4], Quan-Hoang Vuong[4,5]

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

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

[3] Department of Animal Production and Technology, Chinhoyi University of Technology, Chinhoyi, Zimbabwe

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

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

[*]Corresponding author: adrino.mazenda@up.ac.za (Adrino Mazenda)

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Abstract

Background: Food insecurity condition challenges the availability of food, access to food, food supply stability, and food utilization. Food banks play a major role in the food aid sector by distributing donated and purchased groceries directly to food-insecure families, thus significantly impacting food insecurity. On the other hand, school meal programs are implemented in many countries to combat food insecurity among school-aged children. The synergy between school meal programs and food banks has a great potency to combat food insecurity among children effectively.

Aim: This study aims to examine the association between experts' involvement—such as nutritionists, farmers, and private sectors—and community engagement, including parents and others, with the linkage between food banks and school meal programs among implementing countries.

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 involvement of nutritionists and the private sector was positively associated with the linkage between food banks and school meal programs,

while farmers' involvement showed an ambiguous association. The engagement of parents and others also showed an ambiguous relationship with this linkage.

Conclusions: Findings underscore the strong need to formulate strategies for increasing the involvement of nutritionists and the private sector to successfully link the food banks with school meal programs in implementing countries, which is crucial for effectively combating food insecurity among school-aged children.

Keywords: school meals program; food bank; food insecurity; child nutrition; expert involvement.

"After some thinking, Kingfisher reckons that only by uniting the power of the entire village could they chase Snake away."

—In "The Virtue of Sacrifice"; *Wild Wise Weird* (Vuong, 2024).

1. Introduction

Food insecurity remains a critical issue that affects millions of individuals and households globally, with particularly devastating effects on children and low-income families (Shakeal & Shazli, 2020). According to Endale *et al*. (2014), food insecurity is characterized by the lack of consistent access to enough food for an active, healthy life. Food insecurity affects millions of children globally, limiting their access to sufficient, safe, and nutritious food (Mawela & Van den Berg, 2018). Studies have shown that marginalized populations are most affected, linking them to poverty, poor health outcomes, and limited educational achievement (Gundersen & Ziliak, 2015; Bruening, Dinour & Chavez, 2017; Rizvi *et al*., 2021; O'Hara & Toussaint, 2021).

Food insecurity is also prevalent among children. Literature reveals that the negative impacts of food insecurity in children include suffering from anxiety, behavioral and developmental problems, as well as poor academic performance (Gundersen & Ziliak, 2015; Bruening, Dinour & Chavez, 2017; Rizvi *et al*., 2021; O'Hara & Toussaint, 2021). These children also experience lower rates of school attendance and diminished concentration in class, which further compromises their long-term educational outcomes (Hunter *et al*., 2022).

Many strategies have been employed to combat food insecurity in both developed and developing countries. These strategies often rely on multiple complementary approaches, including government-led school meal programs, community-led food banks, and religious-based meal programs, as well as privately funded and organized food banks and pantries (Cheyne *et al*., 2020; Tan *et al*., 2020; Rizvi *et al*., 2021). These interventions, while serving distinct roles, are united by a common goal to alleviate hunger and ensure access to nutritious food.

Food banks play a crucial role in providing nutrition outside the classroom. These organizations are often non-government and community-based initiatives that collect surplus food from donors (such as farmers, retailers, and individuals) and distribute it to those in need (Bertmann *et al.*, 2017; Drake *et al.*, 2021; Rizvi *et al.*, 2021). The Global Child Nutrition Foundation reported that community-led non-government food banks are more popular in high-income countries than in low-income countries (GCNF, 2022a). This highlights greater potential synergies between school meal programs and food banks in high-income countries than in low-income countries. By working together, food banks and schools can create a comprehensive food security strategy that covers both school hours and out-of-school periods.

School meal programs are special feeding programs designed to offer free or subsidized meals to school-going children, most of whom come from low-income families (Mawele & Va den Berg, 2018, Tan *et al.*, 2020). They serve an essential role in improving child nutrition, enhancing academic performance, and promoting school attendance (Cohen *et al.*, 2021). Similarly, a food bank is defined as a place where stocks of food are supplied free of charge to people in need to address local food insecurity (GCNF, 2022a). Most of the food is donated by non-government sources, including supply chain actors from farm to retail (Roothaert *et al.*, 2021). There is a growing recognition of the potential for synergistic partnerships between food banks and school meal programs in combating food insecurity (Fernandes *et al.*, 2016; Roothaert *et al.*, 2021; Wineman *et al* 2022; GCNF, 2022a).

The implementation of school meal programs in many countries as a way to improve child nutrition and educational outcomes is well documented, and the effects are positive (Hansen & Corner, 2014; Bertmann *et al.*, 2017; Adelmam *et al.*, 2019; WFP, 2020; Cohen *et al.*, 2021; Rizvi *et al.*, 2021). Globally, the school meal programs serve over 388 million children (WFP, 2020). In high-income countries, school meal programs are usually government-funded and often include balanced, nutritious meals that adhere to national dietary guidelines (USDA, 2021; Cohen *et al.*, 2021). In low-income countries, these programs are often supported by international aid organizations, with a strong focus on combating malnutrition and increasing school attendance rates, particularly among vulnerable groups such as girls (GCNF, 2022a; Wineman *et al.*, 2022).

Despite the recognized crucial role of school meal programs in improving child nutrition and supporting educational outcomes (Fernandes *et al.*, 2016; GCNF, 2022), ensuring sustainability and adaptability to external challenges, such as economic crises or global pandemics, remains unclear. In particular, the global COVID-19 pandemic exposed the limitations of relying solely on school meal programs. School closures prevented millions of children worldwide from accessing daily meals during the pandemic (O'hara & Taussant, 2021; Abay *et al.*, 2021; Bertmann *et al.*, 2021; Graper *et al.*, 2024). This disruption highlighted the need for a more integrated approach, where school meal programs are linked with community-based initiatives, such as food banks, to provide consistent and reliable access to nutritious food, even during periods of crisis.

Food security programs such as school meal programs and food banks are critical in alleviating the negative outcomes of food insecurity. However, without proper expert involvement (nutritionists, farmers, and private sectors) and community engagement (parents and others), these initiatives may not become sustainable. Research has shown that expert involvement is essential for addressing the gaps that arise when traditional school meal systems are disrupted (Meier *et al.*, 2020; Drake *et al.*, 2020; Graper *et al.*, 2024). The importance of involving and engaging community stakeholders such as parents, farmers, nutritionists, and private businesses in food security programs has been highlighted through studies by Endale *et al.* (2014), Cheyne *et al*, (2020), Rizvi *et al.* (2021), GCNF (2022a), Hunter *et al.* (2022), Chaves *et al.* (2023) and Graper *et al.* (2024). Community stakeholders contribute vital resources such as farm produce, financial support, and labor. These can help sustain both food banks and school meal programs during times of stress, creating a more resilient food security network that ensures children are well-nourished both in and out of school.

Parental involvement-engagement in school-based nutrition programs enhances program success by fostering a sense of community ownership and accountability (Drake *et al.*, 2021; Roothaert *et al.*, 2021; Graper *et al.*, 2024). Parents can volunteer to assist with meal preparation and distribution, provide feedback on meal quality, and advocate for the expansion of these programs within their communities (Roothaert *et al.*, 2021). Moreover, engaging parents in food literacy programs (where they learn about nutrition, meal planning, and resource management) can have long-term benefits for combating food insecurity (Meier *et al.*, 2020).

The role of farmers in enhancing the synergy between school meal programs and food banks is also promising (Chaves *et al.*, 2023). Local farmers participate by donating surplus or imperfect produce to school meal programs as well as food banks for redistribution to people in need. This not only helps to reduce food waste but also ensures that food banks and schools have access to fresh and cheap, locally sourced foods. A systematic review by Chaves *et al.* (2023) revealed that lack of incentives and support for family farming, lack of access to markets, and fragile logistics operations are the main causes of the difficulties encountered in acquiring local foods for school feeding programs and food banks.

The role played by nutritionists, if maximized, has the potential to enable families and households to derive the most nutritional value from the foods they receive. Through sharing of knowledge and expertise on balanced diets, nutrition, and cooking techniques, nutritionists can ensure that those they serve will also receive the full benefits from the resources (Metclaffe *et al.*, 2020; Meier *et al.*, 2020; Roothaert *et al.*, 2021). This community-based nutritional guidance is especially valuable in low-income households, where families may not have access to or knowledge of healthier food options (Meier *et al.*, 2020).

The private sector, particularly businesses within the food industry, can play a pivotal role in strengthening the link between school meal programs and food banks. These entities

often have the capacity to donate surplus food or provide financial support to scale up school meal programs and food bank initiatives. Several studies suggest the importance of public-private partnerships in improving food security initiatives since businesses help both in operational support and running awareness campaigns to guarantee increased expert involvement (Endale *et al.*, 2014; Mawela & Van den Berg, 2018; Drake *et al.*, 2020; Rizvi *et al.*, 2021).

School meal programs and food banks can potentially ensure a more comprehensive food security solution for children by applying a holistic approach to resource use and mobilization, as well as knowledge and community support. The purpose of this study is to examine the association between experts' involvement—such as nutritionists, farmers, and private sectors—and community engagement, including parents and others, with the linkage between food banks and school meal programs among implementing countries. The focus of this study is the critical role of experts and communities in enhancing the linkage between food banks and school meal programs in combating food insecurity among children. Findings from this study may provide insights on how to better link the initiatives of food banks and school meal programs in implementing countries by increasing the involvement of nutritionists, farmers, and private sectors and improving the engagement of parents and the public, in general, to combat food insecurity among children effectively.

2. Method

2.1. Theoretical Foundation and Hypotheses

The mindsponge theory (MT), conceptualizing the mind as a mechanism for obtaining and analyzing information, serves as the foundational framework for this study (Vuong, 2023). MT offers a dynamic perspective on the cognitive functions of the human brain. The mindsponge mechanism, the essence of MT, utilizes the subjective evaluations of benefits and costs, which are designed to maximize perceived advantages while effectively mitigating perceived constraints (Vuong & Napier, 2015; Vuong et al., 2023; Vuong et al., 2021). The cognitive framework of MT encompasses entrenched beliefs that significantly influence the output of the brain and its mechanisms for processing information, aiming to pursue the system's fundamental goals while adhering to its primary interests/priorities. Currently, MT has been enhanced by integrating worldviews and principles drawn from quantum mechanics and Shannon's information theory to propose an entropy-based notion of value to increase its ability to explain the complex individual and collective information processes and behaviors (Vuong & Nguyen, 2024a, 2024b).

Information is regarded as the fundamental component of information processing. The information-processing mechanism outlined in MT suggests that diverse factors contribute to the accumulation of ideas/values/knowledge, subsequently influencing an individual's psychology and behavior (Vuong, Nguyen, & La, 2022). Notably, information

availability refers to the physical presence of information within the environment, while information accessibility relates to one's capability to recognize and recall this information when it is present. The optimization of information within this theoretical construct results in behavior that responds appropriately to the external stimuli (Nguyen, Le, & Vuong, 2023).

The mind is regarded as an information collection-cum-processor. While this definition is typically applied to the mental processes of the human mind, it can also extend to a wide range of biological and social systems (Vuong, 2023). MT shows a high credibility to be used in studies of the mind on a collective level, at the national level in particular (Duong et al., 2024; Vuong et al., 2022; Vuong et al., 2021). In this study, a nation is conceptualized as an information collection-cum-processor, or a collective mind. MT employs a granular worldview to elucidate the intricate interactions of information units within the mind, which are defined as the possible alternatives perceived by the mind. These information units, whether newly acquired or pre-existing, interact, cohabit, and connect within the mind to establish a mindset, a set of core values (i.e., information units that are deemed important for prolonging the existence of the system) (Vuong & Nguyen, 2024b).

The mindset, which comprises ingrained values, plays a crucial role in shaping the system's output, as well as its input processing and filtering systems. The evolution of one's mindset is primarily attributable to the system's capacity to encode and retain information. 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 the system's subjective representations of reality (Nguyen, Le, & Vuong, 2023).

Effective food management in the food banks and schools by actors of both food security initiatives is crucial in ensuring optimal food production and comprehensive nutrition strategies for school-aged children. The food bank's services out of the schools and the in-school meal programs tackle food insecurity among children from a two-sided approach. The synergy between actors involved in both food security initiatives determine the successful linkage between food banks and school meal programs.

In the current study, successful linkage between both initiatives can be deemed an outcome of the nation's information process. For this synergy to emerge and persist within the mind (i.e., implemented in the country as a program synergy), several conditions need to be met. First, the nation needs to have adequate access to information regarding food banks and school meal programs executed in the country, and second, the nation needs to justify this information as beneficial for the whole system. The multi-filtering system is mainly based on the mindset to determine whether the information is beneficial, neutral, or costly to the whole system. If the information is deemed beneficial after interacting with the nation's mindset, such as the regulations guiding both initiatives, it will be given a higher probability of being stored and used within the mind (i.e., upheld and implemented in the country). If it is deemed costly, the information will be discarded. If it is deemed neutral, the information will be kept within the mind's buffer

zone for later evaluation. Based on this rationale, we have outlined the following Hypotheses (H):

H1: Experts' involvement, i.e., nutritionists, farmers, and the private sectors, is associated with the linkage between food banks and school meal programs.

H2: Community engagement by parents and others is associated with the linkage between food banks and school meal programs.

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, 2022b). 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 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

To construct the model for this study, we employed one outcome variable and four predictor variables. The outcome variable *FoodBanksLink* is functioned as the indicator of the linkage between food banks and school meal programs. In order to thoroughly tackle the research goal, we incorporated four predictor variables capturing the role of experts involvement and community engagement in developing the linkage between food banks and school meal programs, such as: *NutritionistInvolvement*, *FarmerInvolvement*, *PrivateSectorInvolvement*, and *CommunityEngagement*. All variables provide valuable information regarding the impact of expert involvement and community engagement on building the linkage between both food security initiatives in countries with school meal programs. Table 1 below explains the variables' description in detail.

Table 1. Variable description

Variable's Name	Description	Data Type	Value
NutritionistInvolvement	The presence of any nutritionist involvement in school meal program in the most recently completed school year.	Binary	0 = No 1 = Yes
FarmerInvolvement	The presence of any farmer involvement in school meal program in the most recently completed school year.	Binary	
PrivateSectorInvolvement	The presence of any private sector involvement in school meal program in the most recently completed school year.	Binary	
CommunityEngagement	The presence of any community engagement (by parents and others) in school meal programs.	Binary	
FoodBanksLink	The presence of any link between food banks and the school meal programs.	Binary	

2.2.3. Statistical Model

In this study, we examined how expert involvement and community engagement are associated with the linkage between food banks and school meal programs among implementing countries. The parsimonious model is illustrated in Figure 1 below.

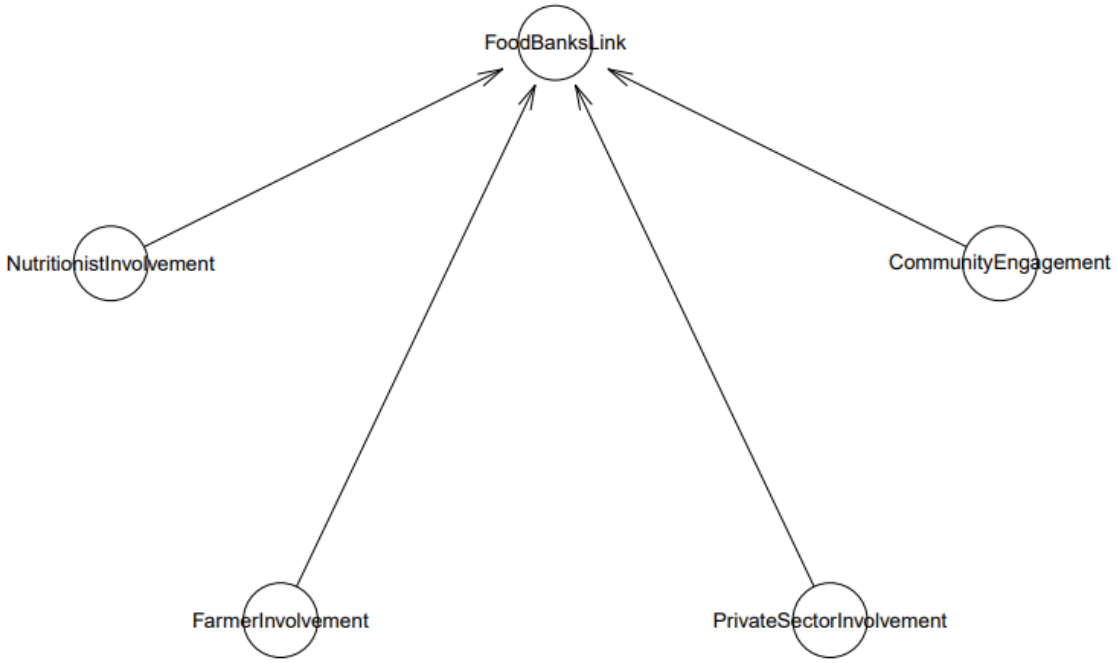

Figure 1. Analytical Model

The formula of this model is described below.

$$FoodBanksLink \sim normal\left(\log\left(\frac{\mu_i}{1-\mu_i}\right), \sigma\right) \quad (1.1)$$

$$\log\left(\frac{\mu_i}{1-\mu_i}\right) = \beta_0 + \beta_1 * NutritionistInvolvement_i + \beta_2 * FarmerInvolvement_i$$

$$+ \beta_3 * PrivateSectorInvolvement_i + \beta_4 * CommunityEngagement_i \quad (1.2)$$

$$\beta \sim normal\,(M, S) \quad (1.3)$$

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 of σ. μ_i indicates the probability that school meal programs will have linkage with food banks in country i. $NutritionistInvolvement_i$, $FarmerInvolvement_i$, $PrivateSectorInvolvement_i$, and $CommunityEngagement_i$ represent whether there are confirmations of government representative i on the presence of the nutritionists, farmers, private sectors, parents and others in school meal programs. The model has an intercept β_0 and four coefficients, β_1-β_4. The coefficients of the predictor and moderating variables are presented as a normal distribution around the mean denoted M with the standard deviation denoted S.

2.2.4. Data Analysis and Validation

Bayesian Mindsponge Framework (BMF) analytics was employed in the current study for several reasons (Nguyen et al., 2022; Vuong, Nguyen, & La, 2022). First, the analytical method integrates the logical reasoning capabilities of MT with the inferential advantages of Bayesian analysis, exhibiting a high degree of compatibility (Nguyen et al., 2022). Second, Bayesian inference is a statistical approach that treats all the properties (including the known and unknown ones) probabilistically (Csilléry et al., 2010; Gill, 2015), enabling reliable prediction of parsimonious models. Nevertheless, utilizing the Markov chain Monte Carlo (MCMC) technique still allows Bayesian analysis to deal effectively with various intricate models, such as multilevel and nonlinear regression frameworks (Dunson, 2001). Third, Bayesian inference has various advantages in comparison to the frequentist approach. One notable advantage is the ability to utilize credible intervals for result interpretation instead of relying solely on the dichotomous decision based on *p*-values (Halsey et al., 2015; Wagenmakers et al., 2018). The Bayesian analysis was performed on R using the **bayesvl** open-access package, which provides good visualization capabilities (La & Vuong, 2019).

In Bayesian analysis, selecting the appropriate prior is required during the model construction process. Due to the exploratory nature of this study, uninformative priors or a flat prior distribution were used to provide as little prior information as possible for model estimation (Diaconis & Ylvisaker, 1985). The Pareto-smoothed importance sampling leave-one-out (PSIS-LOO) diagnostics were employed to check the models' goodness of fit (Vehtari & Gabry, 2019; Vehtari, Gelman, & Gabry, 2017). LOO is computed as follows:

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

$p_{post(-i)}(\theta)$ is the posterior distribution calculated through the data minus data point i. The k-Pareto values are used in the PSIS method for computing the LOO cross-validation in the R **loo** package. Observations with k-Pareto values greater than 0.7 are often considered influential and problematic for accurately estimating LOO cross-validation. When a model's k values are less than 0.5, it is typically regarded as being fit.

If the model fits well with the data, we will proceed with the convergence diagnoses and results interpretation. In the current study, we validated the convergence of Markov chains using statistical values and visual illustrations. Statistically, the effective sample size (*n_eff*) and the Gelman–Rubin shrink factor (*Rhat*) can be used to assess the convergence. The *n_eff* value represents the number of iterative samples that are not auto-correlated during stochastic simulation, while the *Rhat* value is referred to as the potential scale reduction factor (Brooks & Gelman, 1998). If *n_eff* is larger than 1000, it is generally considered that the Markov chains are convergent, and the effective samples are sufficient for reliable inference (McElreath, 2018). As for the *Rhat* value, if the value exceeds 1.1, the model does not converge. The model is considered convergent if *Rhat* =

1. Visually, the Markov chains' convergence was also validated using trace plots, Gelman–Rubin–Brooks plots, and autocorrelation plots.

Data and code snippets of this statistical analysis were deposited at https://zenodo.org/records/13907906 for transparency and public evaluation.

3. Results

Before interpreting the results of BMF analytics, it is necessary to evaluate how well the model fits the data. As can be seen in Figure 2, we found only one value exceeding the 0.7 threshold; the recommended value is below the 0.7 threshold. It can be considered insignificant if compared to 125 other data. Therefore, there is still a good fit signal between the model and the data.

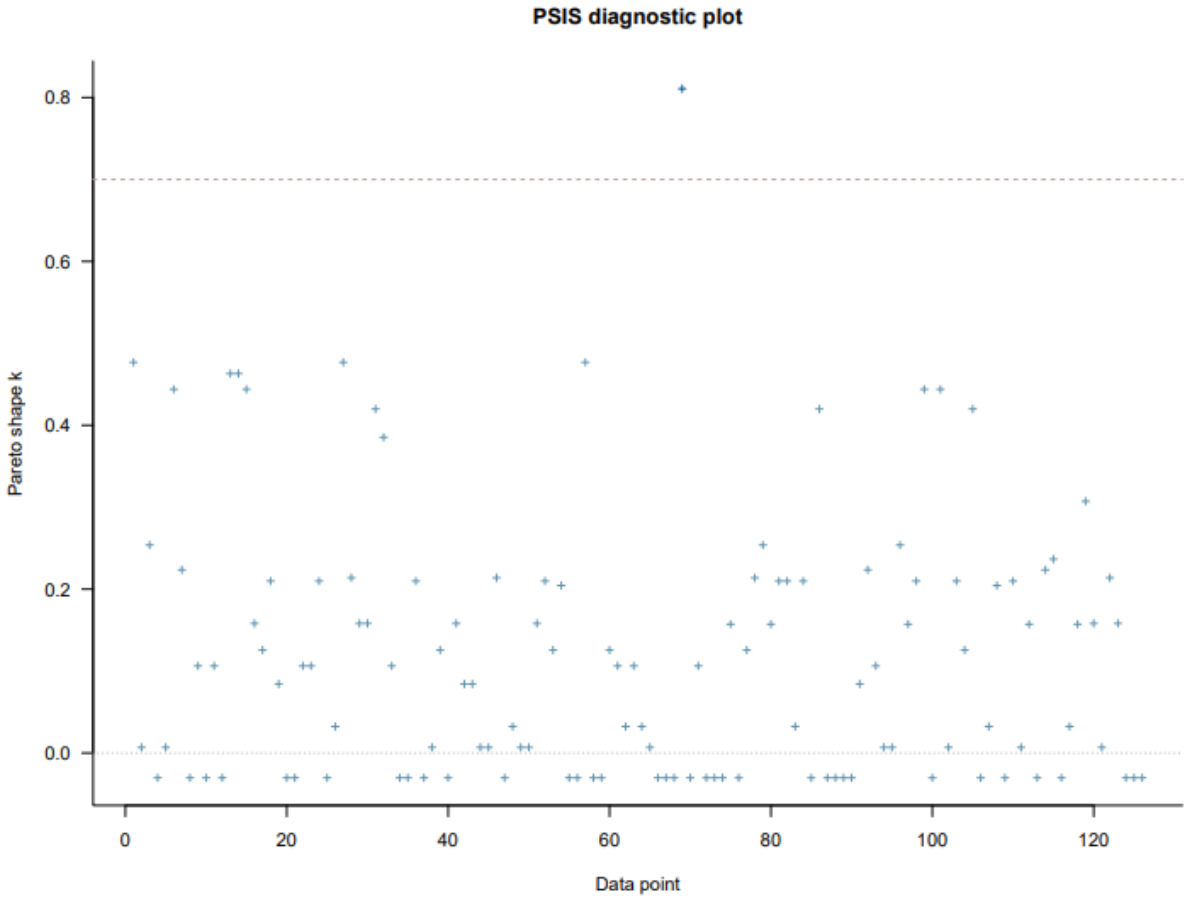

Figure 2. Model 1's PSIS-LOO diagnosis

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 the model's Markov chains are well-convergent. Table 2 below explains the model's posterior distribution statistics, as illustrated in Figure 1.

Table 2. Estimated results of Model 1

Parameters	Mean	SD	n_eff	Rhat
a_FoodBanksLink	-12.26	5.78	4446	1
b_NutritionistInvolvement_FoodBanksLink	9.04	5.65	11133	1
b_FarmerInvolvement_FoodBanksLink	-0.43	0.68	7775	1
b_PrivateSectorInvolvement_FoodBanksLink	2.22	1.33	10391	1
b_CommunityEngagement_FoodBanksLink	-0.70	0.75	2024	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.

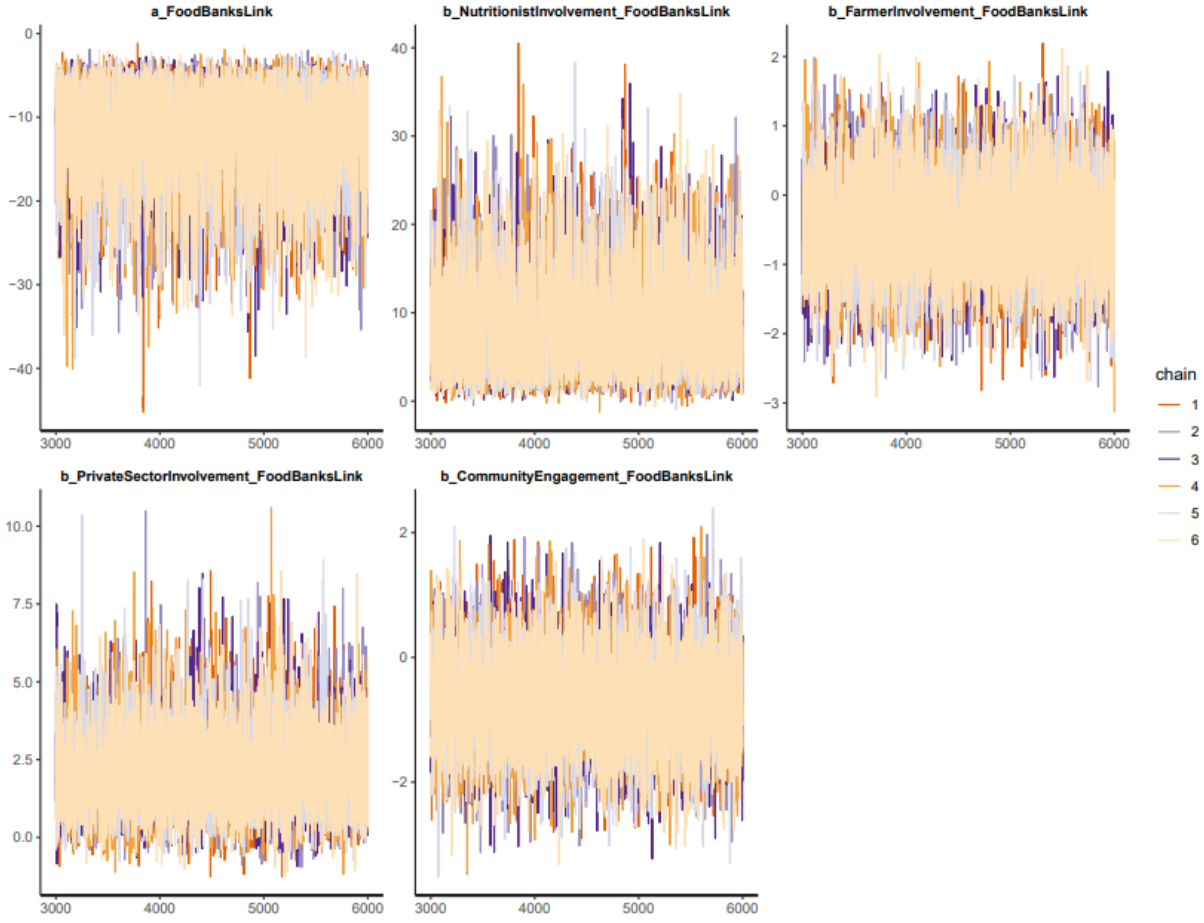

Figure 3. Model 1's trace plots

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.

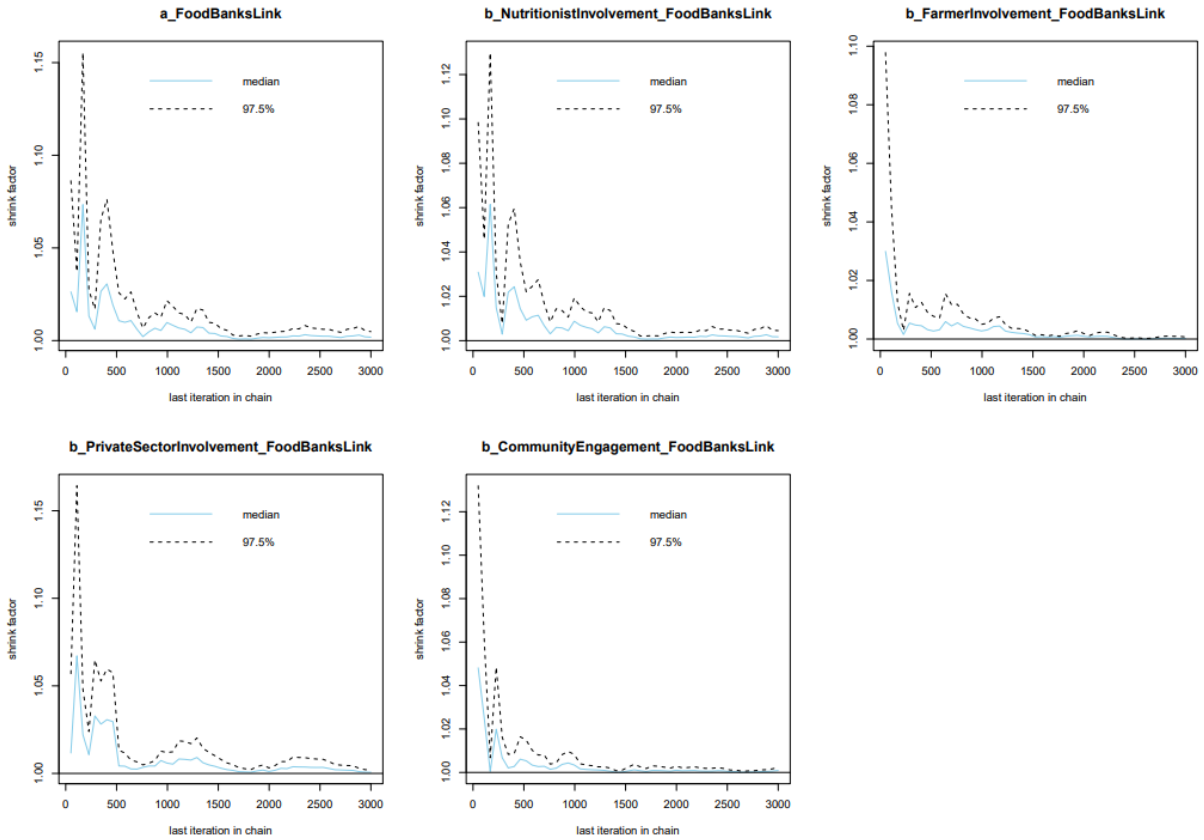

Figure 4. Model 1's Gelman-Rubin-Brooks plots

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.

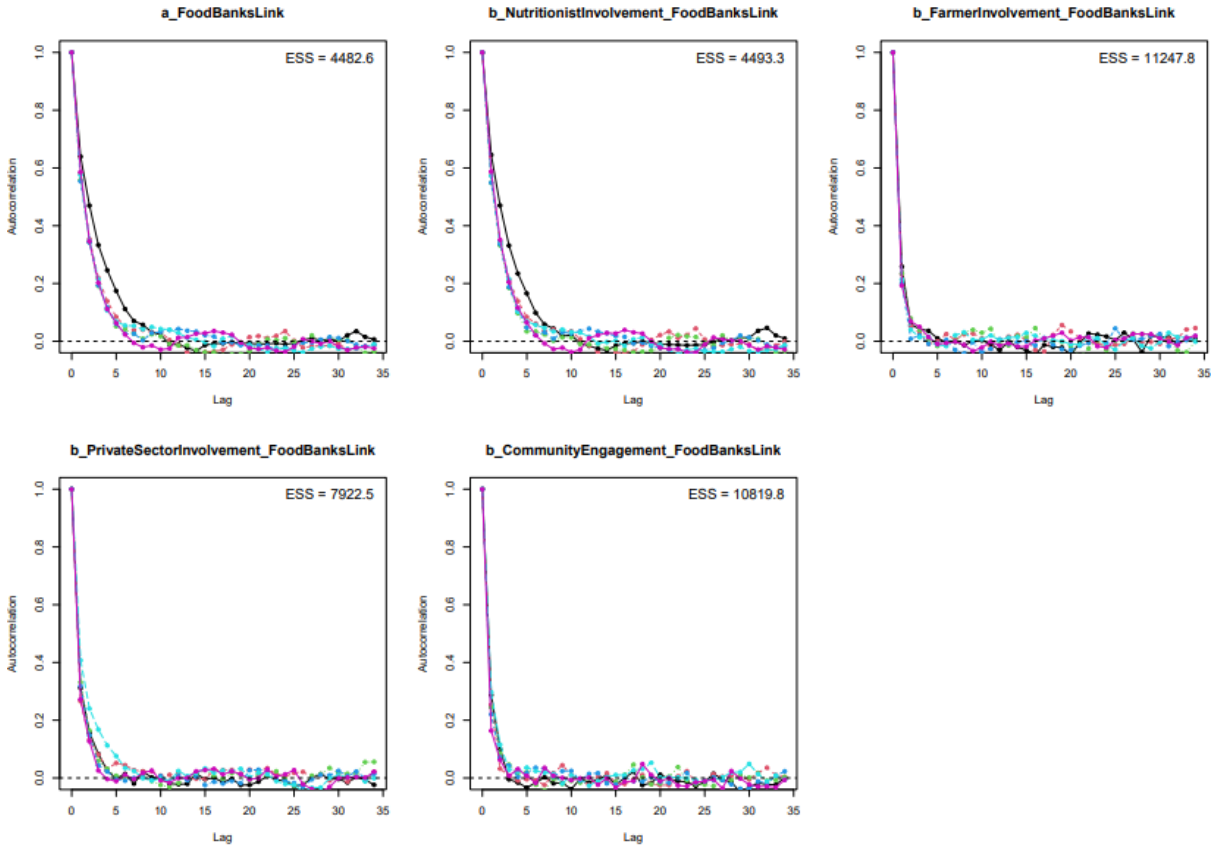

Figure 5. Model 1's autocorrelation plots

Since all the diagnostics confirm the convergence of Markov chains, the simulated results are eligible for interpretation. The estimated results of Model 1 show that the involvement of nutritionists and the private sector was positively associated with the linkage between food banks and school meal programs, while farmers' involvement showed an ambiguous association. The engagement of parents and others also showed an ambiguous relationship with this linkage.

To aid in the interpretation of results, Figure 6 illustrates the estimated coefficients with mean values having the highest probability of occurrence. The distribution of *b_NutritionistInvolvement_FoodBanksLink* and *b_PrivateSectorInvolvement_FoodBanksLink* are fully located on the positive side of the x-axis. This distribution signifies the reliable positive association between *NutritionistInvolvement* and *PrivateSectorInvolvement* with *FoodBanksLink*.

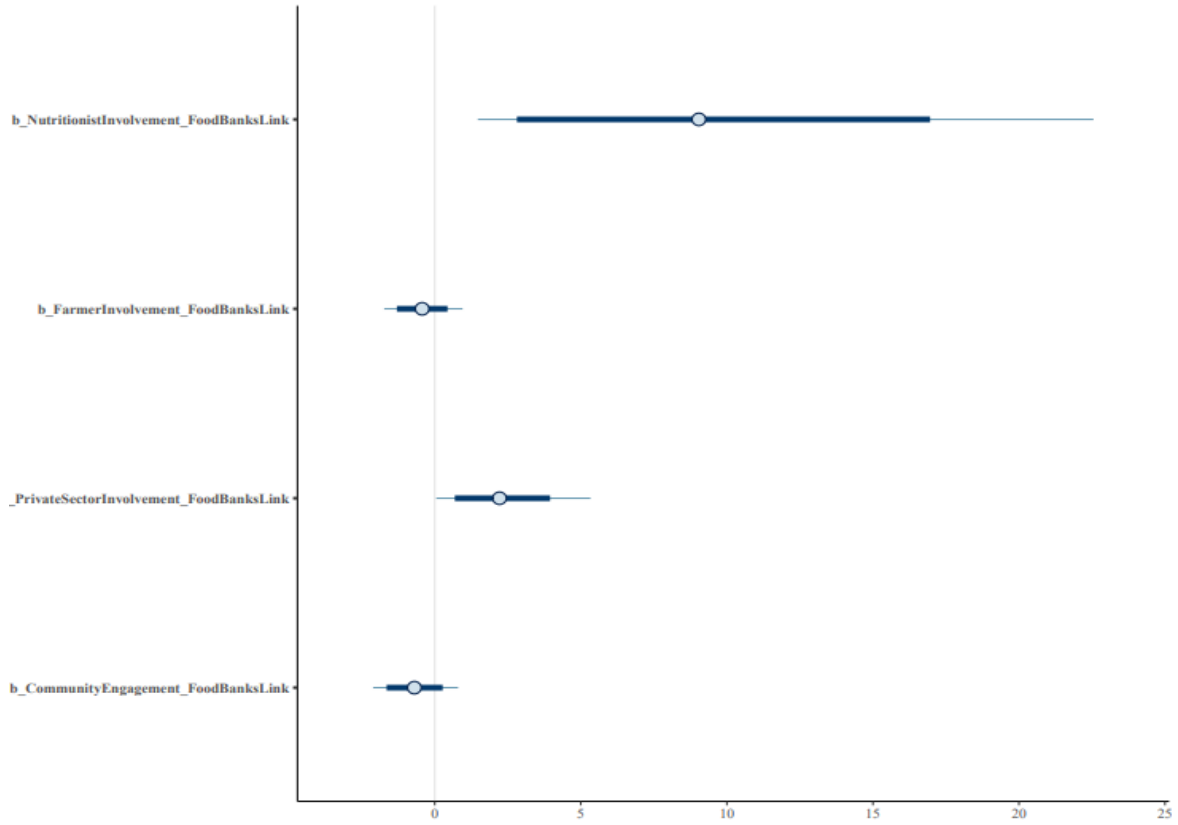

Figure 6. Estimated coefficients

Figure 7 shows the posterior distribution with Highest Posterior Density Intervals (HPDIs) at 89%. The found effects are clear, which suggests that the results are reliable.

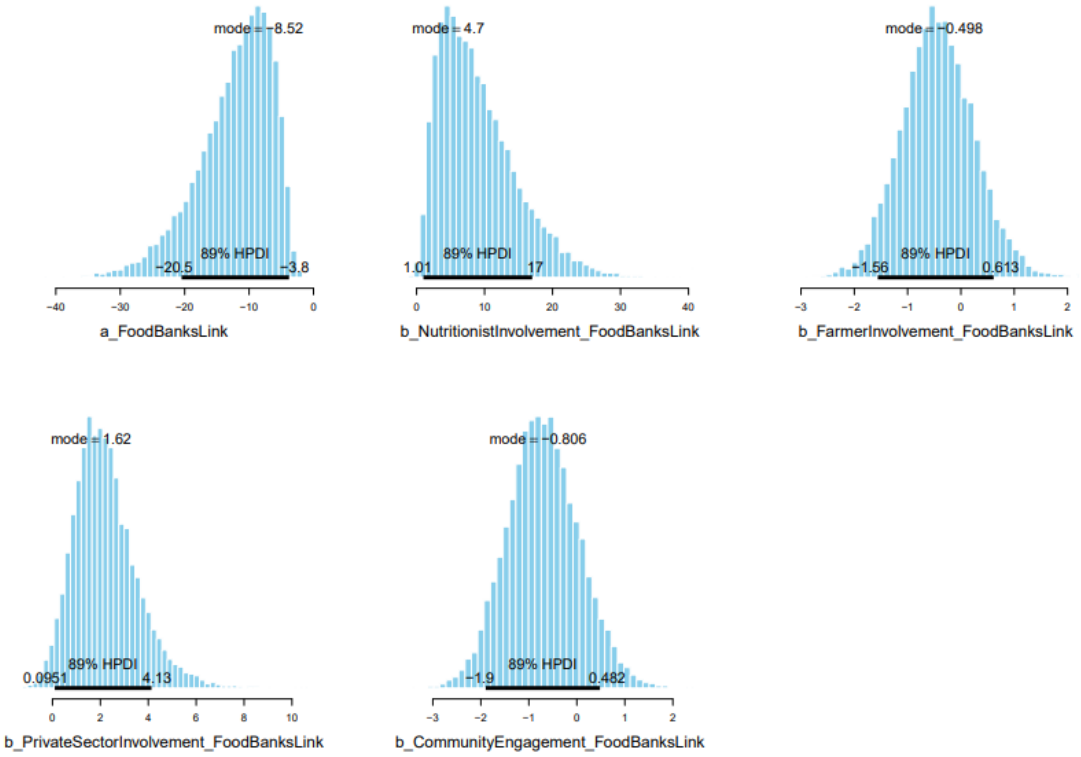

Figure 7. Distributions of posterior coefficients with HPDI at 89%

4. Discussion

The Bayesian Mindsponge Framework (BMF) was employed to examine the association between experts' involvement (nutritionists, farmers, and private sectors) and community engagement (parents and others) with the linkage between food banks and school meal programs in implementing countries.

The involvement of nutritionists and the private sector was positively associated with the linkage between food banks and school meal programs. This finding is in line with Masset & Gelli (2013), who highlighted that school children could benefit from involving nutritionists and the private sector in school feeding programs. These initiatives may improve nutrition, health, education, and food security (Masset & Gelli, 2013). Experts involvement is essential for addressing the gaps that arise when traditional school meal systems are disrupted (Meier *et al.*, 2020; Drake *et al.*, 2020; Graper *et al.*, 2024).

MT views this positive association as an outcome of the nation's information-processing system. The information regarding the involvement of nutritionists and the private sector in food banks and school meal programs execution is adequately available and accessible by the nation, enabling proper information and multi-filtering activities in the collective mind of the nation. In addition, this information is deemed beneficial for the country, enabling proper information benchmarking with the nation's mindset, such as the regulations guiding both food security initiatives, ensuring a positive benchmarking result. Therefore, this information is accepted, given a higher priority of being stored in the nation's mindset and used by the country for improving the food-related practices that emerged in food banks and schools. Consequently, the involvement of nutritionists and the private sector in both food security initiatives is upheld and implemented in the country to ensure the synergy between food banks and school meal programs.

Findings also revealed an ambiguous relationship between farmers' involvement and the linkage between food banks and school meal programs. This is not aligned with the argument made by Wineman et al. (2022), who stated that farmers' participation in school meal programs fosters local food purchases, particularly for school meal supplies. Across the entire food value chain, farmers' initiatives often create new markets for farm products and generate employment opportunities (Roothaert et al., 2021). Moreover, local sourcing is frequently employed to ensure that school menus include a variety of nutrient-dense foods, addressing both health and nutrition objectives (Oldroyd et al., 2022; Wineman et al., 2022). The World Bank and World Food Programme also emphasize the importance of long-term, sustainable solutions that leverage local resources and capacity (Kretschmer, Spinler, & Wassenhove, 2014). While many studies support possible positive associations between farmers' involvement and food security initiatives, the findings of this study open up a new perspective on the complexities of this relationship.

From the mindsponge perspective, MT considers this ambiguous association also as an outcome of the nation's information-processing system. Farmer's involvement indicates the existence of information and knowledge provided by farmers can contribute to the implementation of school meal programs in the country. However, the association

between farmer involvement and the linkage between food banks and school meal programs is ambiguous, suggesting that information and knowledge provided by farmers have either contributed to or negated food bank-related information. In terms of contribution, the information related to farmers' involvement may be buffered until a comprehensive evaluation is conducted by the nation, suggesting a need for comprehensive information from the farmer side to become available and accessible by the nation. Once this information undergoes thorough multi-layered filtering and evaluation, it is more likely to be recognized as beneficial for the nation, increasing the chances of its adoption and support by the government. In terms of negation, this information is considered unfavourable or deemed costly for the nation, indicating low support from the government for the farmers to be involved in both food security initiatives in the country.

The engagement of parents and others also showed an ambiguous association with the linkage between food banks and school meal programs. This is not aligned with the argument made by Flores (2023), who reported a positive association between school meal programs and parental involvement. Zuercher et al. (2024) postulated that parental perception of school meal programs influenced not only their participation or engagement but also their children's participation as students. There is a possibility that some parents may have a negative perception of school meal programs, thus needing further investigation. Communities require full and updated knowledge/information on how their engagement can foster food security among children. Formulating strategies to improve community engagement of parents and others in linking food banks and school meal programs is essential. In addition, policy actions centered around parental or community engagement, food banks, and school meal programs should be increased.

Similar to the ambiguous association of farmers' involvement, the information and knowledge provided by parents and the public in general do not affect the processing of food bank-related information. Thus, the association with the linkage between food banks and school meal programs is ambiguous. MT considers this phenomenon to be the need for a thorough assessment of parental-related information representing their involvement in both initiatives, requiring comprehensive information from the community side to be filtered by the nation by using its core values, i.e., regulations. After further information-processing activities, there is a possibility that this information may be accepted and become favourable for the country so that community engagement in both initiatives may be encouraged and supported by the government to improve the synergy between initiatives. Enhanced linkage between food banks and school meal programs will allow continual availability of nutritious food for children, thus combating food insecurity among them.

5. Study Limitations and Practical Implications

Limitations for this study range from its cross-sectional design, which makes it unable to measure how the variables under investigation changed over time. While a particular

scenario may be shown in this study to illustrate a trend of events, it might not depict the dynamic shifts in the situation on the ground. The survey that is being used is designed to be self-reporting. For measuring variables, it could be less objective. Understanding the impacts of community engagement and involvement in food banks and school meal programs to enhance food security among children requires a qualitative study using in-depth interviews with all school feeding program actors.

6. Conclusions

The involvement of nutritionists and the private sector is positively associated with the linkage between food banks and school meal programs in implementing countries. In contrast, the involvement of farmers, the engagement of parents, and others in both food security initiatives has ambiguous relationships with this linkage. Therefore, it is essential to formulate strategies to increase the effects of farmers' involvement and community engagement on the linkage between food banks and school meal programs. Further investigation is also needed to determine the parental perception of school meal programs and possible moderating variables on the association between farmers' involvement and the linkage between both initiatives to combat food insecurity among children successfully. Effective strategies for improving farmers' involvement and community engagement in both initiatives are also needed to clarify further their associations with the linkage between food banks and school meal programs in implementing countries.

7. Policy Recommendations

The successful linkage between food banks and school meal programs relies heavily on the involvement of experts, particularly nutritionists and private sector stakeholders. The national policies guiding, supporting, and protecting the involvement of nutritionists and the private sectors need to be strengthened and increased in terms of policy actions. Strengthening monitoring and evaluation efforts on their involvement is crucial for ensuring the success of food banks and school feeding initiatives. Implementing a universally recognized monitoring framework with standardized indicators across program areas can facilitate this process.

At the national level, measures should be taken to ensure that those responsible for executing school meal programs and food banks are familiar with relevant policies. Additionally, implementation support should be provided as needed. It is essential to equip schools with the resources to avoid reliance on external parties while fostering participation and commitment within the community for further reinforcement. Collaboration between external and internal stakeholders, along with efforts to strengthen cross-sectoral relationships, should be prioritized. Training tailored to the specific needs of stakeholders and their interactions will also enhance program effectiveness.

Sufficient funding for food banks and school meal programs is essential for the effective execution of relevant policies in and out of the classroom. To increase food availability

for these programs, community networks across the food supply chain—such as domestic in-kind donations as a manifestation of community engagement in both initiatives—should be developed. Ultimately, building strong connections between schools and their communities will enhance food security among children, supporting policies that promote their access to nutritious food through food banks and school meal programs.

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