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Cost analysis and nutritional adequacy of school meal programs and dormitory food expenses in Mongolia

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ABSTRACT

This study evaluates the adequacy of funding for Mongolia's school meal programs and dormitory food provisions, focusing on nutritional standards, current expenditure levels, and structural cost drivers. Using normative budget analysis, inflation-adjusted cost modeling, and empirical field data from selected schools, the study examines whether existing allocations meet national nutrition standards and assesses the economic implications of funding shortfalls. The findings reveal substantial gaps. Observed school lunches provided approximately 27% of students' daily energy requirements, below the national target of approximately 35%, while current dormitory meal allocations were estimated to cover approximately 55-77% of the cost required to meet full daily nutritional needs, depending on grade level. In addition to rising food prices, operational expenditures, particularly labor and associated social insurance contributions, significantly increase the effective per-student cost. Regional differences and seasonal constraints further influence procurement expenses and dietary diversity, especially in remote areas with transportation limitations. The ingredient-based funding gap is estimated at approximately Mongolian Tugriks (MNT) 60 billion annually; total financing requirements would be higher once operational costs are incorporated. Policy recommendations include revising funding norms to incorporate operational costs, indexing allocations to inflation, introducing regionally responsive adjustments, and strengthening meal management systems to sustainably meet nutritional targets.

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1. INTRODUCTION

School feeding programs can improve nutritional status and school participation [1]. Integrated models also address nutrition, education, and local agriculture [2], while program sustainability depends on costs and cost-outcomes [3]. Evidence from school feeding programs demonstrates benefits across several dimensions, although outcomes vary by context. In India, school meals substantially improved children's nutrient intake and reduced calorie, protein, and iron deficiencies [4], while also providing important nutritional protection during periods of household food insecurity [5]. Longer-term exposure to India's

Midday Meal Program was associated with significant improvements in reading and mathematics achievement [6]. Evidence from Lao People's Democratic Republic, however, indicates that effects on school participation and nutritional outcomes can be mixed [7], highlighting the importance of program design and implementation. Global survey evidence further demonstrates the widespread adoption and diverse objectives of school meal programs across countries [8]. These effects are most pronounced in contexts with high poverty and food insecurity, where children who might otherwise arrive at school hungry are better able to participate in lessons and remain engaged [1].

International evidence underscores these benefits. In India, school meal programs improved children's nutrient intake and nutritional protection [4], [6], while prolonged exposure to the midday meal program improved reading and mathematics achievement [5]. Among boarding students, inadequate dietary intake has been associated with reduced concentration and poorer academic performance, while school-based nutrition interventions more broadly have been linked to improvements in hunger, attendance, and behavior [9], [10]. In high-income contexts, school meal research has increasingly emphasized equity and broader educational and health outcomes. In Sweden, universal nutritious school lunches increased educational attainment and lifetime income, with particularly large gains among children from lower-income households [11]. In Norway, healthier dietary patterns and regular breakfast consumption among adolescents were associated with fewer behavioral problems at school [12]. Other work has emphasized the equity and inclusivity dimensions of school meal programs, particularly their potential to reduce barriers to participation and stigma associated with means-tested meals [13].

Malnutrition has important educational consequences, while school feeding interventions among disadvantaged children have been shown to improve attendance and selected educational outcomes, particularly mathematics achievement [14]. In Mongolia, 7.3% of children aged 6-11 years were stunted [15].

To address these risks, Mongolia introduced the school lunch program as part of a broader effort to improve the adequacy and equity of school food provision. National nutrition standards specify that school lunches should provide approximately 35% (±10%) of students' daily energy requirements, while food services for students residing in school dormitories are intended to meet 100% of their daily energy needs [16]. To support implementation of the program, the Government set the daily school lunch expenditure norm for students in grades 1-5 at Mongolian Tugriks (MNT) 1,500 per child in 2021 [17]. However, subsequent increases in food prices have reduced the purchasing power of this fixed allocation, creating growing pressure on the financial sustainability and effective implementation of the school meal program [18].

Comparable experiences internationally highlight similar vulnerabilities. In South Africa, school feeding was associated with improved school attendance, although implementation challenges such as late food delivery and irregular food supply persisted [19]. Brazil's long-standing national school feeding program illustrates how strong policy and regulatory frameworks and intersectoral coordination can support an integrated school feeding system [20]. However, even well-established school feeding programs may face challenges in fully meeting national menu and nutrition standards, underscoring the importance of strong regulatory frameworks and effective implementation [20]. In the United States, a high-income context, recent policy reforms emphasize the need for strict nutrition standards to safeguard the quality and impact of school meals [21].

Given this global and national context, assessing Mongolia's school meal programs is critical. This study evaluates whether current funding aligns with nutritional standards, examines the actual nutrition delivered, and identifies gaps in implementation—providing an evidence-based foundation for improving program sustainability and impact.

2. METHOD

We used a comprehensive approach to analyze meal costs and nutritional value, combining policy review, cost modeling, and direct field measurement.

2.1. Policy and normative analysis

We reviewed policy documents, including government resolutions that set budget norms and nutrition standards for school and dormitory meals. Nutritional requirements for different age groups were based on official guidelines, which specify that dormitory meals should meet 100% of daily needs, while a school lunch should provide 30-35% of daily calories.

2.2. Cost modeling scenarios

We conducted a cost modeling analysis under three scenarios:

2.2.1. Inflation-adjusted normative scenario

The 2021 per-child meal budget norms were adjusted to 2024 prices using food inflation data. According to the National Statistics Office, food ingredient prices increased by roughly 36% nationwide

between 2021 and 2024 (authors' calculation) [22]. This scenario estimated the updated cost required to purchase the same basket of foods.

2.2.2. Sample menu costing

We developed a nutritionally adequate sample menu with 100 alternatives that complied with recommended calorie and nutrient norms for school meals. Table 1 presents an illustrative example of menu items and ingredients. Full menu alternatives were designed to collectively meet recommended calorie and nutrient norms across approved weekly rotations. The menu consisted of typical Mongolian school dishes (e.g., porridge, meat stew, soup, and bread) with over 200 ingredients considered. Market prices for 2024 were obtained from the National Statistics Office and local retail outlets. Costs per child per day were calculated based on these prices [23]. In addition to ingredient cost modeling, operational expenditure data (labor, insurance, equipment replacement, sanitation, and training) were collected from sampled schools to estimate non-ingredient per-student meal costs.

Table 1. Sample menu for school lunch and dormitory meal

Kit	Ingredients	Unit of measurement	Gross weight	Net weight
Cabbage dumplings	Cabbage	g	45	40
	Mutton tail	g	10	8
	Carrots	g	8	5
	Round onion	g	10	6
	Garlic	g	0.5	0.5
	Salt	g	0.2	0.2
	Butter	g	3	3
	Fennel	g	0.1	0.1
	Water	ml	8	8
	Flour	g	15	15
Vegetable soup with tofu	Tofu	g	50	50
	Bok choy	g	30	25
	Tomatoes	g	40	40
	Garlic	g	0.3	0.3
	Vegetable oil	ml	5	5
	Meat or bone broth	ml	250	250
	Salt	g	0.3	0.3
Beetroot salad	Potatoes	g	22	18
	Brown turnips	g	42	35
	Cucumber/fresh/	g	17	15
	Round onion	g	12	10
	Vegetable oil	ml	6	6
	Salt	g	0.3	0.3
Total	Calories: 394.4 kcal, protein: 12.8 g, fat: 25.8 g, carbohydrates: 27.3 g			

2.2.3. Field survey of schools

We conducted a field survey to capture actual meal provision and costs. A stratified purposive sampling strategy was used to ensure representation of diverse contexts [24]. The final sample comprised 19 schools, including day schools and schools with dormitories, across five geographic contexts: western, central, eastern, forest/taiga, and the capital city, as in Table 2. Consistent with a maximum-variation purposive sampling approach, the selection sought to capture contrasting implementation contexts, including rural schools facing procurement constraints and urban schools operating larger meal programs [25]. Data collection was conducted between March 30 and May 20, 2024, across the selected schools and dormitories. In each selected school, we recorded the actual meals served to students, measured portion sizes and caloric content, and documented ingredient expenditures. For each school, the average caloric content of the lunch and the average cost per child per day were determined.

To ensure the accuracy and reliability of the nutritional content measurements, a team comprising a school nutritionist and two researchers was assembled. The reported caloric values of the school meals reflect the consensus findings of this team. Duplicate measurements and data validation procedures were implemented, and caloric estimates were reviewed by a licensed school nutritionist. These steps strengthen confidence in the validity and reliability of the findings. However, slight variations in actual caloric content may have occurred due to differences in food quality, ingredient composition, and preparation methods across sites. The nutritional analysis followed procedures recommended by the Food and Agriculture Organization of the United Nations/International Network of Food Data Systems (FAO/INFOODS) [26]. These field measurements enabled us to evaluate the real-world implementation of the program and identify any deviations from the established norms.

Table 2. Selected schools

	Region	N of schools
1	Western	4
2	Forest/Taiga	5
3	Eastern	2
4	Central	4
5	Capital City	4
	Total	19

2.3. Data analysis

Descriptive statistics were used to summarize caloric intake and per-child costs. We compared outcomes across the three approaches (normative adjustment, sample menu costing, and field survey) to identify funding gaps. Budget shortfalls were calculated in MNT. Qualitative notes from school staff provided context on the operational difficulties of meeting nutrition standards under current allocations. Annual additional funding requirements were estimated by multiplying the per-student daily funding gap by the number of eligible students and annual feeding days. Percentage budget increases were calculated relative to current program allocations.

3. RESULTS AND DISCUSSION

3.1. Funding levels vs. required costs

Our analysis reveals a substantial gap between current funding and the cost of providing nutritionally adequate meals. The erosion of purchasing power following recent food price increases has amplified pre-existing structural financing gaps (1,500 MNT for lunch; 4,000-4,300 MNT for dormitories). For school lunches, policy requires provision of ~35% of daily nutritional needs. However, the field survey found lunches currently deliver only ~27% on average. Meeting the 35% target under 2024 prices requires ~2,500 MNT per child per day, nearly 1,000 MNT more than current allocations. For dormitories, funding shortfalls are more pronounced. Current allocations cover only ~77% of primary students' daily needs and ~55% for secondary students. To achieve full nutritional adequacy, per-student daily costs should be ~7,100 MNT (primary) and 8,700-8,800 MNT (secondary). The summary of the results is presented in Figure 1.

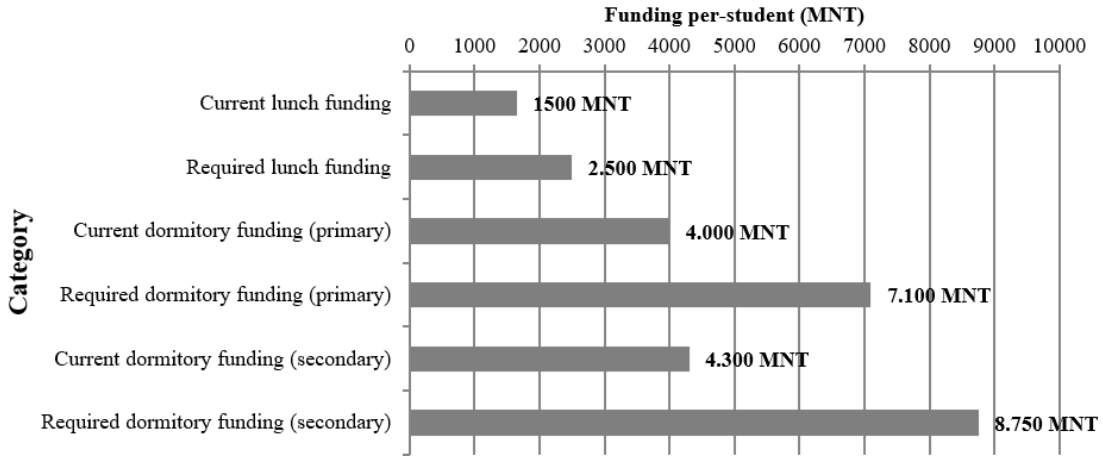

Figure 1. Current vs required funding for school meals (2024)

3.2. Nutritional value and meal composition

Field data confirmed that caloric provision varied widely across schools. Some lunches provided as little as 232 kcal (1,232 MNT cost), while others delivered ~688 kcal (2,266 MNT cost). Average provision in rural schools ranged 500 kcal—below the ~700 kcal benchmark—while urban schools averaged slightly higher (575 kcal) but at higher costs as displayed in Figure 2.

Menus generally relied on staples (rice, flour-based foods, potatoes) with limited portions of meat and minimal fresh produce. As a result, protein intake in some schools was as low as 7-9 g per lunch. Statistical analysis indicated a moderate positive correlation between caloric content and cost (r=0.35,

p<0.05). Dormitory meals, while more substantial, also emphasized low-cost staples. Older students were especially underserved, consistent with the ~55% coverage level observed, as in Figure 3.

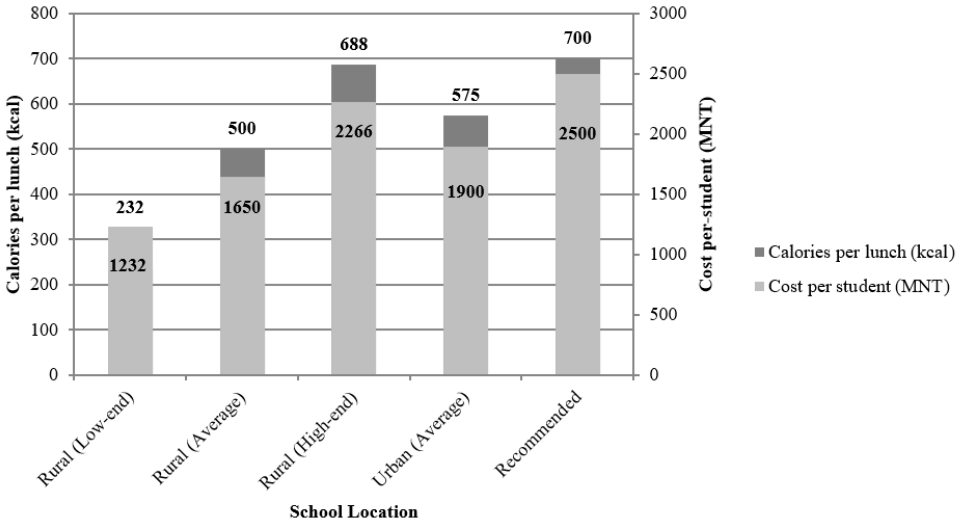

Figure 2. Calorie content and cost of school lunches

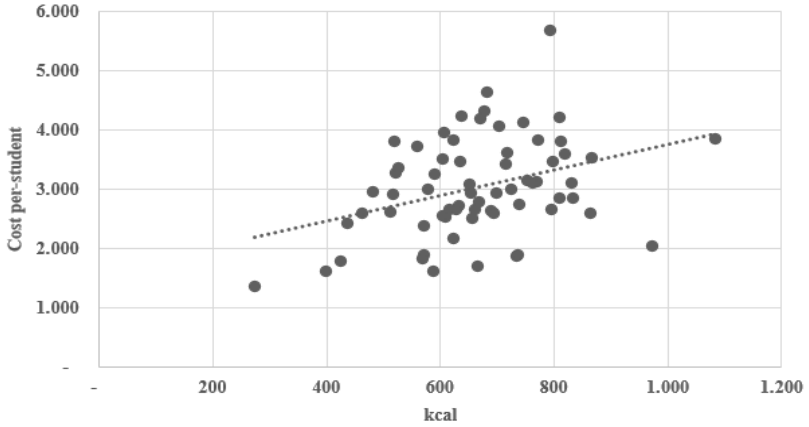

Figure 3. Correlation between caloric content and cost

3.3. Economic impact of increasing meal funding

Closing the funding gaps identified in this study would require approximately 42.9 billion MNT annually for school lunches and 17.1 billion MNT for dormitory meals, translating into a 53% and 25-30% increase in their respective budgets as presented in Figure 4. While these figures represent a considerable fiscal challenge, they underscore the trade-off between short-term budgetary pressures and long-term human capital investment. The field data show that current meal allocations fall short of national nutrition standards, leaving students undernourished relative to policy goals. This is not a trivial gap: students receiving inadequate meals face elevated risks of poor health, irregular attendance, and weaker academic performance. Global evidence further demonstrates that childhood undernutrition is associated with poorer cognitive and educational performance and can have lasting consequences for educational attainment, productivity, and adult income [27], [28]. In contrast, our sample schools that approached caloric and nutrient standards showed higher attendance and fewer teacher reports of fatigue and inattention, suggesting a positive association between improved nutritional adequacy and learning-related outcomes.

In addition to food ingredient expenditures, the analysis incorporated kitchen-related operational costs that are directly associated with meal preparation and service delivery. Field data indicate that these operational costs increase the daily per-student meal cost for primary school students by approximately MNT

1,601. This estimate excludes utilities and minor maintenance costs (e.g., water, electricity, and routine repairs), which are currently financed separately through local government budgets.

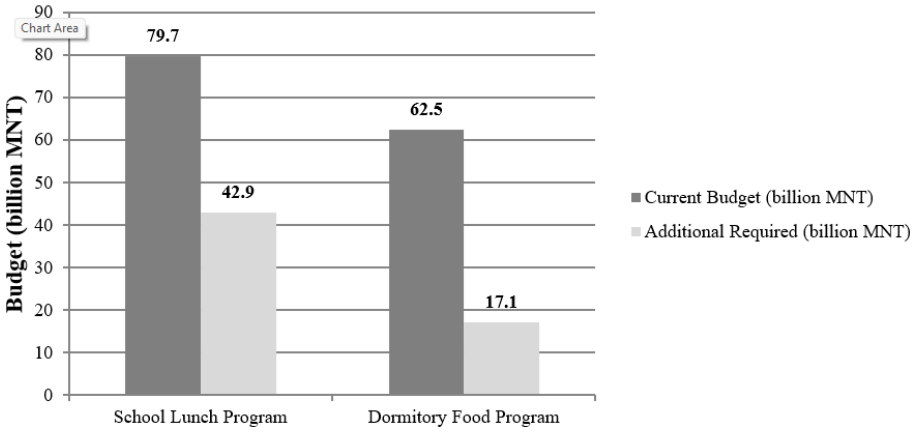

Figure 4. Fiscal impact of increased school meal funding

The cost composition reveals that labor-related expenditures constitute the largest share of non-ingredient costs. Specifically, 56.9% of the additional operational cost is attributable to kitchen staff base salaries and mandatory social and health insurance contributions. A further 24.4% corresponds to staff allowances, overtime payments, and associated insurance contributions. Operational and support services account for smaller proportions, including sanitation, safety, and service-related expenditures (3.1%), staff training (1.3%), and occupational health and safety services (0.5%). Additionally, 13.8% of total operational costs reflect replacement and replenishment expenses for kitchen equipment and utensils.

When operational costs are added to ingredient-based expenditures, the effective cost of providing nutritionally adequate meals exceeds current per-student allocations by an even wider margin. This finding suggests that funding gaps identified in the ingredient-based cost modeling represent conservative estimates. A comprehensive budgeting framework should therefore integrate both ingredient and operational cost components to ensure sustainable program implementation.

The results reveal clear regional differences in daily school meal costs for primary school students. Per-student costs amount to MNT 2,453 in the Forest region, 2,474 in the Central region, 2,516 in the Western region, 2,497 in Ulaanbaatar, and 2,574 in the Eastern region. While these differences may appear modest in nominal terms, they reflect structurally distinct food supply environments across regions.

Importantly, these variations cannot be explained solely by general price levels. Instead, they are closely associated with regional agricultural structures, food supply conditions, and seasonal characteristics. Regions where crop production and livestock farming are relatively well integrated tend to benefit from more stable and locally sourced food supplies. Such integration reduces dependence on external markets and mitigates seasonal price volatility.

In contrast, more remote and sparsely populated regions face greater reliance on long-distance transportation, extended storage periods, and season-related logistical constraints. These factors increase procurement costs and limit dietary diversity. Seasonal dynamics are particularly influential during winter months, when harsh weather conditions disrupt transportation networks and reduce access to fresh produce. During these periods, schools rely more heavily on stored, preserved, or processed food items, which may meet caloric requirements but reduce micronutrient diversity.

These findings indicate that uniform national per-student budget allocations may insufficiently account for regional and seasonal cost heterogeneity. Static funding norms therefore risk disproportionately disadvantaging remote schools, where procurement constraints are structurally higher. Incorporating seasonal and regional adjustment mechanisms into budgeting frameworks could enhance both equity and nutritional adequacy.

The broader implications extend beyond education. Childhood undernutrition can have lasting consequences for adult health and human capital, while malnutrition more broadly imposes substantial economic costs through increased healthcare expenditure and reduced workforce productivity [28], [29]. Conversely, investment in school meals can generate benefits extending from childhood into adulthood. Evidence indicates that school feeding can improve school attendance and selected educational outcomes,

including mathematics performance [14]. Longer-term evidence from Sweden further shows that sustained access to nutritious school lunches increased educational attainment and lifetime income, with particularly large gains among children from lower-income households [11]. Our findings also suggest that improving per-student meal budgets could stimulate local food markets and agriculture, as schools and dormitories increase demand for diverse and higher-quality ingredients [29].

Mongolia's situation aligns with global challenges. In the United States, fewer than one-quarter of school nutrition directors reported that the federal school lunch reimbursement rate was sufficient to cover the cost of producing a reimbursable meal [30]. Similarly, fixed school meal allocations are vulnerable to inflation, as rising food prices reduce their real purchasing power over time [17], [18]. Without timely budget adjustments, these programs fail to deliver their intended nutritional and educational benefits.

Our findings suggest that Mongolia faces a structurally similar risk, compounded by additional operational and regional cost pressures. Beyond food ingredient expenditures, essential operational costs substantially increase the effective per-student cost of meal provision. Because these expenditures are required for preparation, staffing, and service delivery, ingredient-based allocations alone underestimate the true financial requirements of nutritionally adequate provision. The funding gap presented in this study should therefore be interpreted as a conservative estimate of the total resource shortfall.

Moreover, regional cost disparities reflect structurally different agricultural integration, transportation dependency, and supply chain conditions across Mongolia's diverse geographic contexts. Seasonal constraints, particularly during winter months, intensify these disparities, as limited access to fresh produce and increased logistics costs reduce dietary diversity while raising procurement expenses. Static national funding norms therefore risk disproportionately disadvantaging remote and sparsely populated regions.

Unless funding mechanisms are recalibrated to reflect inflation, operational cost structures, and regional heterogeneity, the gap between policy commitments and school-level realities will continue to widen, reinforcing inequities in both education and health outcomes. To address these gaps, five interrelated policy actions are recommended: i) revised funding norms: increase per-student budgets (~2,500 MNT for lunches; 7,000-9,000 MNT for dormitories) to reflect current ingredient and operational costs; ii) comprehensive cost integration: incorporate operational expenditures (labor, insurance, equipment replacement, sanitation, and safety services) into official budgeting formulas to ensure realistic cost estimation; iii) inflation indexation: link allocations to food price indices to prevent recurring shortfalls and preserve purchasing power; iv) regional and seasonal adjustment mechanisms: introduce differentiated funding or seasonal supplements for remote areas to account for transportation and supply chain constraints; v) efficiency improvements: enhance menu planning, procurement coordination, and resource use, including bulk purchasing and strengthened local sourcing where feasible [31].

In addition, partnerships with international organizations could provide technical assistance and transitional financial support during reform implementation [32]. Strengthening linkages between school feeding programs and local agricultural production may support local farmers and rural economies [31], [32]. Finally, robust monitoring and evaluation systems are essential to ensure that revised funding structures translate into measurable improvements in nutritional adequacy and educational outcomes.

4. CONCLUSION

This study assessed the cost and nutritional adequacy of Mongolia's school meal and dormitory food programs using normative cost modeling and empirical field data. The findings indicate that school lunches currently provide only approximately 27% of daily caloric requirements, compared to the 35% policy target, while dormitory meals cover only 55-77% of daily needs depending on grade level. While food price inflation since 2021 has substantially eroded the purchasing power of existing allocations, the funding gap is not attributable to inflation alone. The analysis further indicates that essential operational expenditures significantly raise the effective cost of meal provision, reinforcing that ingredient-based funding norms underestimate total program requirements. When these operational costs are considered alongside ingredient expenditures, the current shortfall appears even more pronounced than previously estimated.

The findings further demonstrate that regional and seasonal heterogeneity complicates uniform national budgeting. Static per-student allocations may therefore inadequately reflect structural cost differences across regions, potentially reinforcing geographic inequities in nutritional provision. Meeting established nutrition standards would require a substantial increase in per-student allocations, implying an additional annual investment of approximately 60 billion MNT. However, sustainable reform requires more than nominal budget increases. Funding frameworks should integrate operational cost components, incorporate inflation indexation mechanisms, and consider regionally differentiated adjustments to account for structural cost disparities.

Sustainable school meal programs represent a strategic investment in Mongolia's human capital. Adequate school nutrition contributes not only to improved health outcomes but also to stronger educational participation, learning performance, and long-term economic productivity. Ensuring that funding mechanisms reflect real delivery costs is therefore both a social protection priority and an education policy imperative.

Future research should examine the longitudinal effects of improved funding on academic performance, attendance, and student health outcomes. Further studies are also needed to model food price volatility under different inflation scenarios and to evaluate regionally differentiated financing approaches. Expanding the sample to include a broader range of geographic and socio-economic contexts would enhance generalizability. Additionally, deeper investigation into procurement systems, community-based agricultural linkages, and alternative financing mechanisms could provide practical guidance for strengthening the efficiency, equity, and resilience of Mongolia's school meal and dormitory food services.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Bayarbaatar	✓	✓		✓		✓	✓		✓	✓		✓	✓	
Adiyasuren														
Khajidmaa	✓	✓		✓	✓	✓			✓	✓				
Otgonbaatar														
Battsengel			✓		✓			✓	✓		✓		✓	
Bayarsaikhan														
Batkhurel Gombodorj					✓	✓				✓				

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [KO], upon reasonable request.

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