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Transforming Child Nutrition Planning Through a Localized Data Driven Costing Model in Southern Bangladesh

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Abstract
Malnutrition remains a critical public health challenge in Bangladesh, specifically among children under 5 years of age in coastal and climate vulnerable regions. The study aims to explore and analyze the changes in children under 5 years of age nutrition status alongside the increased budget allocations for nutrition at the union level. The study was conducted in selected coastal upazilas of southern Bangladesh, guided by the UNICEF Conceptual Framework. A survey of 922 households was carried out using a semi-structured questionnaire, FGDs and KIIs were conducted. The study shows notable improvements in the nutritional status of under-five children from 2022 to 2023, with severe stunting dropping from 16.4% to 6.7% and severe underweight from 5.1% to 3.1%. A key finding is the strong positive correlation between increased nutrition and WASH budget allocations and reduced stunting and underweight. The study suggests that formalizing local budgets for nutrition and WASH can guide policy in South Asia to reduce child malnutrition. The Bangladesh National Nutrition Council (BNNC) endorsed Child Profile Estimates & Costing Model (CPE&CM) marks a critical step toward institutionalization, contributing to the Second National Plan of Action for Nutrition (NPAN2). This innovative tool guides local to central authorities in implementing need-based nutrition interventions with accurate cost estimates.

Keywords: Child malnutrition; child profile; costing model; coastal Bangladesh

1 Introduction

Child malnutrition remains one of the most pressing public health concerns in least developed countries, with long-term consequences for physical and cognitive development (Das et al., 2024; Sheikh et al., 2020). Malnutrition in earlier life affects children's both physical and mental growth as well as increases the probability of many diseases in afterwards life (Reinbott & Jordan, 2016; Zerga et al., 2022). Moreover, child malnutrition is a serious cause of mortality and morbidity worldwide (Caulfield et al., 2004; Hasan et al., 2013). In 2024, globally, 150.2 million children under age five were stunted, 42.8 million were wasted, and 35.5 million were overweight. Stunting has been declining steadily over the last decade, with 150.2 million, or 23.2 percent, of children under age 5 affected in 2024 worldwide 2000 (UNICEF et al., 2025).Nearly all stunted children lived in Asia and Africa (43 percent of the global share) (de Onis et al., 2013; UNICEF et al., 2025; Wolfle & Channon, 2023). In 2024, an estimated 6.6 percent of children under age 5 were affected by wasting, of which 12.2 million (1.9 percent) were suffering from severe wasting. More than three-quarters of all children with severe wasting lived in Asia and another 22 percent lived in Africa. Current levels of overweight have persisted for the last two decades in almost every region. There are now 35.5 million children under age 5 living with overweight globally, an increase of 2.4 million since 2000 (Global Nutrition Report, 2021; UNICEF, 2021; UNICEF et al., 2025)

Significant improvements have been made in improving maternity and child nutrition over the years, yet challenges persist, especially in coastal regions. (Das et al., 2024; Sheikh et al., 2020). Based on the BDHS, 31% of under 5 children are stunted where a child is short for their age, 8% are wasted, i.e., low weight for age, 22% are underweight, i.e., low weight for height and 2% are overweight (high weight-for-height) (BDHS, 2022; Daily Star, 2022). The percentage of stunting declined from 43% in 2007 to 31% in 2017-18 (BDHS, 2022). Similarly, the percentage of underweight fell from 41% in 2007 to 22% in 2017-18. After years at critically high levels (17% in 2011 & 14% in 2014), wasting decreased to 8% in 2017-18 (NIPORT, 2019).The MICS showed the stunting rate of under five children is 28%, as well as 9.8% are wasted, while 22.6% are underweight (MICS, 2019; NIPORT, 2019). The prevalence of stunting varies between rural and urban areas (MICS, 2019). According to the 2017–2018 Bangladesh Demographic Health Survey (BDHS), among the eight divisions, the prevalence of

stunting was the highest in Sylhet (43%), followed by Mymensingh (36%), Barishal (33%), Chattagram (33%), Rajshahi (31%), and Rangpur (30%). It was the lowest in Khulna and Dhaka (26%) (NIPORT, 2019).

Chronic malnutrition and disease infection remain the primary drivers of poor child health outcomes across Bangladesh and the broader South Asian sub-region, which experiences significantly higher levels of stunting and wasting compared to global averages (Rana et al., 2024; Sheikh et al., 2020; WHO, 2022). Poor nourishment during early childhood impairs physical and mental development, increases susceptibility to transmittable illnesses, and undermines long-term national economic productivity (Reinbott and Jordan 2016; NIPORT 2019; de Onis et al. 2013; Leroy et al. 2014). According to a recent report, 16 million people in Bangladesh face severe acute food insecurity, with 1.6 million children suffering from acute malnutrition, with those born in urban slums, tea estates, impoverished rural households, and Rohingya refugee camps at greatest risk (Dhaka Tribune, 2025; ReliefWeb, 2025). Bangladesh simultaneously confronts a dual burden of undernutrition and overnutrition, weakening broader development gains, while dietary diversification remains insufficient despite the country's cereal self-sufficiency (Daily Star, 2022; Das et al., 2024; Sultana et al., 2019; Sarma et al. 2017). Despite two decades of progress since the adoption of the first National Plan of Action for Nutrition in 1997, 22% of children under five remain underweight, underscoring that malnutrition continues to be a significant public health challenge (BDHS, 2022; Sheikh et al., 2020; Zerga et al., 2022). Investment in nutrition yields substantial returns: every $1 spent generates a $16 return, and a 10% increase in per capita income is associated with a 3.2% decrease in stunting and a 7.4% decrease in wasting prevalence (UNICEF, 2021). Government action has produced measurable results, reducing child underweight from 41% in 2007 to 22% in 2018 and stunting from 54.6% in 1997 to 28% in 2018, while targeted initiatives such as the Right2Grow project further demonstrate that focused funding can significantly improve nutrition outcomes (BNNC, 2020; Hamid, 2025).

This study was through under the project Right2Grow (R2G) initiative is a five-year advocacy program spanning multiple countries, including Bangladesh, with a dedicated focus on ensuring optimal nourishment and development for every child (Hamid, 2025; Right2Grow, 2021; Save the Children, 2025). In Bangladesh, the project aims to enable all children under five to be well-nourished (under project implementation areas) through strategic engagement with both the public and private sector, prioritizing child growth and maternal health (Right2Grow, 2021). The project is being implemented in selected areas of the coastal region in southern Bangladesh, this child profiling estimation will provide crucial insights into child undernutrition (Right2Grow, 2021). Nutrition planning in Bangladesh predominantly followed a top-down approach that often failed to reflect community-specific needs and local realities.

This study aims to generate strong, context-specific and evidence-based child profile estimates and costing model (CPE&CP) for children under 5 years of age. It creates reliable, localized data on the nutrition, WASH, and maternal and child health conditions of children under five, while enhancing the use of evidence in local governance and decision-making processes. The CPE&CM was developed to empower local stakeholders with reliable, actionable data for informed decision-making. It seeks to examine key health and nutrition indicators and explore the underlying socio-economic, environmental, and behavioral factors shaping these outcomes. Additionally, the study intends to enable Union Parishads, civil society organizations, and other local actors to apply evidence in planning, budgeting, and advocacy processes, as well as to estimate the financial needs and identify funding gaps for priority interventions. Ultimately, the research aspires to promote stronger local ownership, accountability, and community-driven approaches to sustainably reduce child malnutrition. By directly linking children's nutritional status with resource allocation, the CPE&CM ensures that interventions are better targeted, more equitable, efficient, and sustainable.

2 Materials and Method

2.1 Research Approach

The profile development in selected coastal upazilas was based on the UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition, measuring nutrition outcomes for under-five children alongside enabling, underlying, and immediate determinants. A survey of 922 households across five upazilas used a semi-

structured questionnaire with a comprehensive survey manual covering household identification, interviewer protocols, anthropometric techniques, and quality assurance.

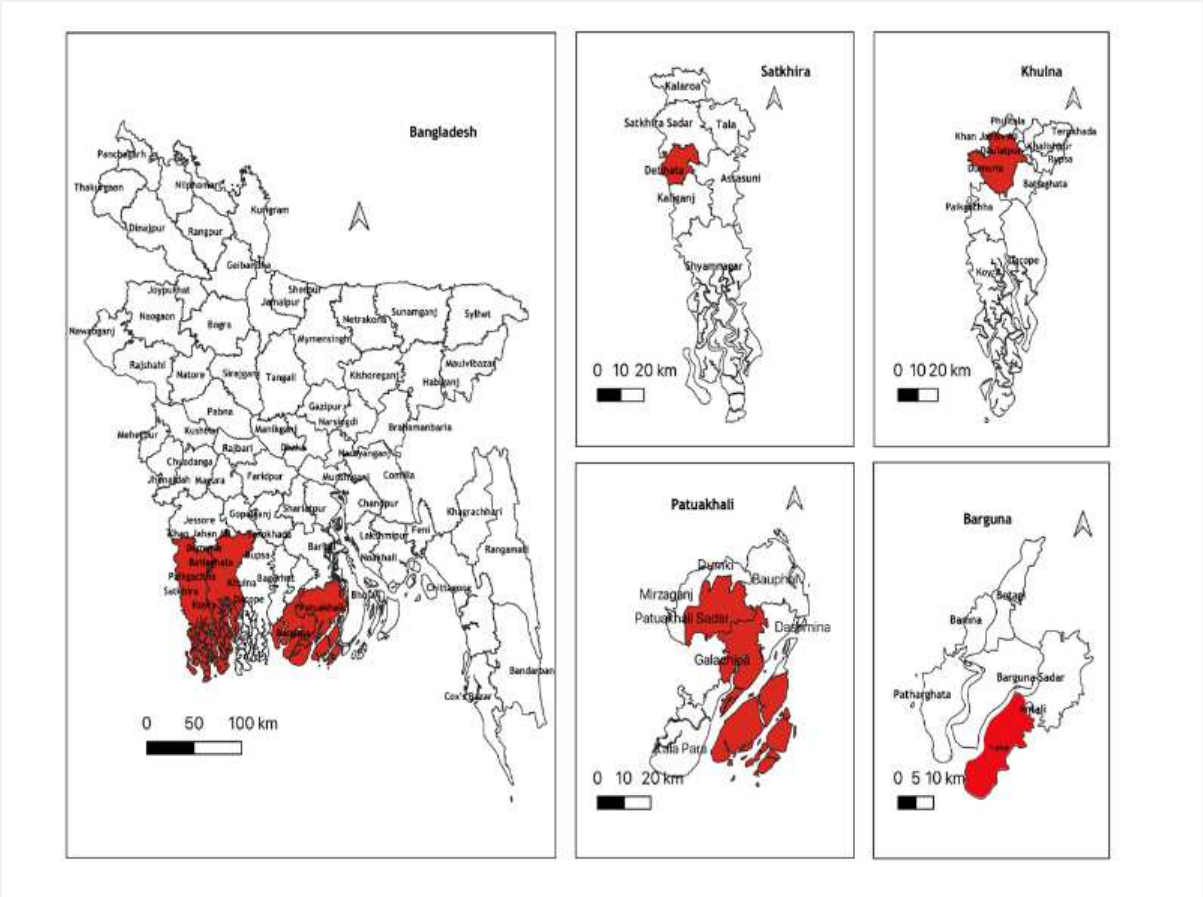

Figure 1 Geographical location of the study area

Two-thirds female field enumerators and expert supervisors conducted surveys using ODK digital platforms, with FAO's Food Insecurity Experience Scale (FIES) applied for household food insecurity estimation. Anthropometric measurements were conducted by trained Community Healthcare Providers at nearby Community Clinics, with technical error measurement methods applied to minimize bias and ensure data integrity. The study also included a rapid literature review on costing of nutrition-sensitive and nutrition-specific interventions for under-five children in Bangladesh, sourced from PubMed, MEDLINE, and WorldCat databases. Guided by the Bangladesh National Nutrition Council (BNNC), a Technical Working Group and Advisory Committee were established, convening four meetings to provide feedback and maintain study quality. The training module of National Nutrition Services (NNS), IPHN is used for capacity building of data enumerators for this study (BNNC, 2020). Further information can be found from **supplementary materials.**

2.2 Geographical Location of the Study

The study was carried out in specific coastal regions within the operational areas of R2G project. The data collection took place in Dumuria and Debhata Upazilas within the Khulna Division, as well as Patuakhali Sadar, Galachipa, and Taltoli Upazilas within the Barishal Division (Figure **1**).

2.3 *Household Survey with U5 Children and their HH Members*

For the first components of this assignment, i.e., the child profile estimate, households of the U5 children were the respondents. As the project was implemented in two administrative divisions in selected coastal areas the survey collected data from the selected districts of those administrative divisions. The sample size was calculated

based on one division and then multiplied by 2 to determine the total sample size for both divisions. We used the following formula:

$n = N*X / (X + N – 1)$,

where, $X = Z\alpha/22 *p*(1-p) / MOE2$,and $Z\alpha/2$ is the critical value of the Normal distribution at $\alpha/2$, MOE is the margin of error, p is the sample proportion, and N is the population size. Considering the confidence level of 95% and the MOE of 5%, the sample size in a given population comes to 385. To address any non-response issues, we considered a design factor of 20%, which increased the sample size to 461. Multiplying by 2, the total sample size for both divisions was 922 (Table **1**). The samples were taken using the following sample distribution.

Table 1 Sample size distribution

Division	District	Upazila	Sample size
Khulna	Khulna	Dumuria	188
	Satkhira	Debhata	187
Barishal	Barguna	Taltoli	187
	Patuakhali	Patuakhali Sadar	180
		Galachipa	180
Total			922

The study had taken the list containing households with at least one U5 child, taking support from the person responsible for registering for birth. From this list of households with at least one U5, the study took the required number of samples allocated for that union and paurasava randomly. Further information can be found from **supplementary materials.**

2.4 Ethical Approval

Ethical approval was obtained from the authorized institution. The study team upheld the highest standards of conduct toward children and adolescents, ensuring confidentiality and data protection to safeguard participant identities and prevent any associated risks. Data collection was conducted in comfortable, safe environments, and no personal contact information was recorded that could link respondents to their responses. Prior to each interview, study team members clearly explained the study's objectives, purpose, potential benefits, and risks to respondents. Informed verbal consent was obtained before proceeding with any tool administration, with participation remaining entirely voluntary. These ethical safeguards ensured the integrity and trustworthiness of the data collection process throughout all study sites, with further evidence available in the supplementary materials.

2.5 Limitations of the Study

The study was conducted in selected coastal upazilas within the project areas in Bangladesh; therefore, the findings cannot be generalized to the entire coastal region of the country. Additionally, the profile developed for under-five children is based solely on data from rural areas in these selected locations and does not represent urban children. Moreover, the study focused exclusively on children under the age of five, and other age groups were not included in the analysis.

2.6 Data Analysis

Descriptive statistics were calculated to assess the point prevalence of stunting among children under five years of age in the project areas over the period from 2012 to 2023. This longitudinal summary aimed to validate and complement the findings obtained from the cross-sectional study, providing insights into trends and variations in stunting prevalence over time. Measures such as mean, standard deviation, frequency distributions, and percentages were used to summarize the anthropometric outcomes across different years and study locations. Statistical significance for comparisons was determined using a p-value threshold of <0.05. All statistical analyses were conducted using Stata BE version 17, ensuring robust handling of data and duplicability of results. Microsoft Word was employed for data tabulation, descriptive summaries, and preparation of tables and figures for reporting.

3 Results

3.1 Demographic Characteristics; Demographic and Socio-economic Profile of the Surveyed Households

The average household size of the surveyed households in the selected coastal upazilas under R2G was 4.97 (Table **1**). This was higher than the national average household size for rural areas (4.1) in Bangladesh. The male-to-female household member ratio in the R2G working area was 98:100, which is similar to the national figure as stipulated in Census, 2022. The average number of members of the households in the selected coastal upazila under R2G working area was 1.43. Around 0.41 persons per household were found to be a person with disabilities or special needs.

Table 2 Demographic Data of the Surveyed Households in the Selected Coastal Upazilas

Upazila	Avg. HH Size	Avg. No of Male HH Members	Avg. No of Female HH Members	Avg. No of Earning Member (per HH)	Avg. No of Persons with Disability (per HH
Debhata	4.69	2.27	2.43	1.44	0.30
Dumuria	5.16	2.62	2.54	1.59	0.36
Galachipa	4.94	2.60	2.40	1.22	0.36
Patuakhali Sadar	4.96	2.38	2.57	1.43	0.36
Taltoli	5.12	2.49	2.60	1.47	0.60
All Upazila	4.97	2.47	2.50	1.43	0.41

The average monthly income in the households surveyed was BDT 19,159 (Table **2**). This is quite low in comparison to the average monthly household income of BDT 26,163 in rural areas as identified in the Household Income Expenditure Survey (HIES), 2022. Average expenditure was BDT 18,090/month/HH in these selected Upazilas which is also low in comparison of BDT 26,842 for rural areas (HIES, 2022).

Table 3 Monthly Income and Expenditure Scenario of the Surveyed Households in the Selected Coastal Upazilas

Upazila	Avg. Monthly Income (BDT)	Avg. Monthly Expenditure (BDT)	Avg. Monthly Expenditure on Food (BDT)	Avg. Monthly Expenditure Non-Food (BDT)
Debhata	16,672	15,471	10,111 (65.35%)	5,332 (34.46%)
Dumuria	20,676	20,885	11,181 (53.4%)	7,965 (38.13%)
Galachipa	18,196	17,767	12,132 (68.28%)	4,995 (28.11%)
Patuakhali_ Sadar	20,733	18,819	12,072 (64.15%)	6,921 (36.71%)
Taltoli	19,507	17,550	13,172 (75.05%)	5,729 (32.46%)
All Upazila	19,159	18,090	11,740 (65%)	6,186 (34.19%)

The study identified food-consumption expenditure to be BDT 11,740/month which was close to the expenditure of the same category in the HIES, 2022 (BDT 13,125) for rural areas (Table **3**). The non-food consumption was BDT 6,186/month, which was significantly lower than the expenditure of the same category (BDT 13,082) for rural areas.

3.2 Purposes of Child Profile Estimates and Costing Model for improved Nutrition and Wash

The Child Profile Estimates and Costing Model was developed by the study team under the guidance of the Bangladesh National Nutrition Council (BNNC), with intended beneficiaries including Upazila and District Nutrition Coordination Committees (UNCC & DNCC), local governments, CSOs, national policymakers, development partners, and researchers. As an outcome of the Right2Grow Program Bangladesh, the model offers a valid method for evaluating anthropometric results, nutritional status, food security, and WASH conditions of under-five children, while supporting bottom-up nutrition action planning and advocacy (Right2Grow, 2021). Addressing the critical gap in local-level child nutrition data, the tool serves dual purposes: assisting health service providers in assessing individual child nutritional status and associated underlying factors, and generating valid

local-level data at Union and Upazila levels to inform evidence-based costing, resource advocacy, and bottom-up planning. This empowers local stakeholders including DNCC, UNCC, Union Parishads, and CSOs to develop need-based interventions with accurate cost estimates across all governance levels.

3.3 Costing Model Development and Local Level Costing Tool

The Government of Bangladesh (GoB) has prioritized nutrition as a means to achieve greater progress towards its development goals (Save the Children, 2025). In 2012, Bangladesh committed to the six global nutrition targets set by the World Health Assembly (WHA) to be achieved by 2025 (Right2Grow, 2021; Save the Children, 2025). Additionally, it endorsed both the Rome Declaration and the Plan of Action at the Second International Conference on Nutrition (ICN2) in 2014, Nutrition for Growth (N4G) Summits (in 2013,2017 and 2021) reaffirming its dedication to addressing undernutrition. Nutrition has been integrated into key national development plans including the 8th Five Year Plan. To provide a robust policy framework, the GoB has developed the National Nutrition Policy (2015) and the Second National Plan of Action for Nutrition 2016-2025 (NPAN2) (BNNC, 2020). Calculating the financial cost to reduce child malnutrition (particularly stunting) is vital for effective national nutrition programing, involving the assessment of current investments, identification of gaps, and understanding of resource allocation from government budgets and donor contributions. The costing model provides tools for estimating resources needed for interventions at local level, supporting local level policymakers, citizens, and the private sector. The Right2Grow initiative strategically strengthens partnerships with the local government, Civil Society Organizations (CSOs) and the private sector to collaboratively combat malnutrition in children under five.

Figure 2 Increased local level budget for nutrition and WASH in 40 UPs

The study revealed a consistent increase in local budget allocations for nutrition and WASH-related interventions, rising from 2.56% in FY 2021-2022 to 18% in FY 2024-2025 across 40 unions in five sub-districts, reflecting growing prioritization of nutrition within Union Parishad development agendas (Figure 2). This shift was strongly influenced by the CPE&CM, which provided localized data and financial estimates that effectively guided planning, advocacy, and decision-making. Beyond local allocations, the Ministry of Health & Family Welfare has initiated a review of the existing national nutrition policy. By enabling practitioners and policymakers to visualize the real nutritional status of children under five at Union and Upazila levels, the model fills a critical void in disaggregated, community-level nutrition planning (Figure 3).

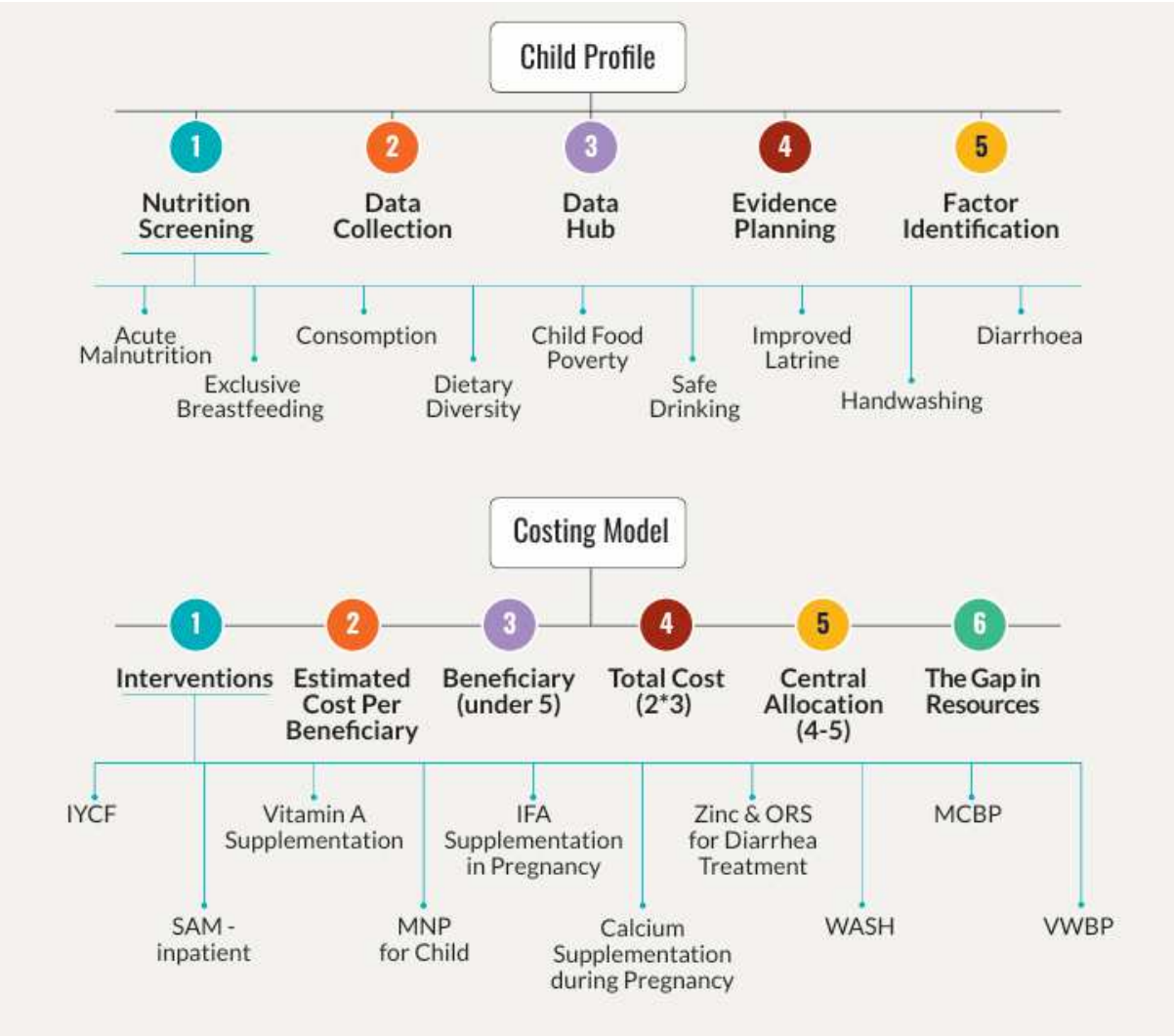

Figure 3. Advantages of child profiling and costing model development

The CPE&CM is a multi-dimensional, evidence-based model designed to strengthen local-level nutrition programming through community-led child profiling and structured costing. It generates comprehensive household-level data on child growth, feeding practices, WASH access, and health behaviors, while an Excel-based costing tool estimates per-child intervention costs to identify funding gaps and support efficient resource allocation (Save the Children, 2025). The tool development process began with designing a child profiling instrument to measure anthropometric status and related determinants such as household food security, health, and sanitation conditions (Figure 3). Scientifically validated and endorsed by the Bangladesh National Nutrition Council (BNNC), the model has been successfully piloted across 7,120 households in 40 unions within five coastal upazilas, demonstrating scalability and proof of concept. Its implementation follows five steps tool development, capacity building, data collection and analysis, costing, and consultation ensuring scientific rigor, local relevance, and stakeholder ownership while fostering collaboration among local governments, frontline workers, CSOs, and national policymakers. The costing component provides critical insights into financial needs, enabling local planners and CSOs to advocate effectively for additional resources aligned with national priorities such as NPAN-2 and SDG 2 (Save the Children, 2025; Sin et al., 2024). Priority nutrition budgeting at the national level requires approximately BDT 1,246.3 crore annually for NPAN2 implementation and USD 53.7 million for direct nutrition interventions as recommended by the World Bank (2018). Most notably, Union Parishad budget allocations for nutrition, WASH, and maternal and child health interventions rose dramatically from 1.45% to 23% between FY 2021-2022 and FY 2024-2025, demonstrating the model's effectiveness in translating local evidence into concrete resource mobilization (Save the Children, 2025).

4 Discussion

The Child Profile Estimates and Costing Model (CPE&CM), developed for selected coastal regions of Bangladesh, represents a transformative approach to improving child health and nutrition outcomes (Save the Children, 2025). Stunting prevalence in the study areas stood at 28.4%, peaking at 36.8% in Galachipa, consistent with national trends yet indicative of coastal regions lagging behind broader national gains that reduced stunting from 45% in 2000 to 24% by 2022 (BDHS, 2022; NIPORT, 2019). Wasting prevalence of 13.3%, with Patuakhali Sadar recording 16.3%, substantially exceeded both the national average of 8% and the global average of 6.6%, raising serious concern given wasting's direct association with child mortality and morbidity (BDHS, 2022; UNICEF et al., 2025; Hasan et al., 2013). Underweight prevalence of 19.3% remained close to the national figure of 22%, suggesting progress has plateaued among the most vulnerable populations (BDHS, 2022). These outcomes are compounded by severe socioeconomic disadvantage: average household income of BDT 19,159 fell well below national rural averages, average family size of 4.9 exceeded the national rural average of 4.1, and 37% of households experienced food insecurity, with nearly half adopting negative coping strategies such as reducing meal sizes (29%) or borrowing food (28%) well-documented predictors of child dietary inadequacy (Das et al., 2024; Reinbott & Jordan, 2016; Zerga et al., 2022). Suboptimal infant and young child feeding practices, including pre-lacteal feeding in 24% of children and poor dietary diversity among older infants, further contributed to stunting and micronutrient deficiency risks (Sheikh et al., 2020; Das et al., 2024).

The costing model, applying both program experience costing and ingredients-based costing drawn from the World Bank's NPAN2 framework, generated unit cost estimates ranging from BDT 41.00 for vitamin A supplementation to BDT 15,200 for SAM treatment, enabling evidence-based budget allocation at the local government level (BNNC, 2020; Save the Children, 2025). The integration of WASH costing at BDT 3,491 per beneficiary appropriately reflects the complementary relationship between sanitation and nutrition, given that poor WASH conditions impair nutrient absorption and contribute significantly to stunting (de Onis et al., 2013; Hamid, 2025). The model's endorsement by the Bangladesh National Nutrition Council (BNNC) and its alignment with the National Plan of Action for Nutrition (NPAN2) creates a clear pathway for embedding child nutrition profiling into routine planning and budgeting cycles, with BNNC recommending scale-up to ecologically diverse areas including haor, char, and hill regions (Save the Children, 2025). Given that every $1 invested in nutrition yields an estimated $16 return, and a 10% increase in per capita income is associated with a 3.2% decrease in stunting prevalence, this model provides a compelling tool for evidence-informed, bottom-up advocacy that can bridge the persistent gap between national commitments and local nutrition outcomes (UNICEF, 2021; Hamid, 2025). Longitudinal follow-up and gender-disaggregated analysis will nonetheless be essential to assess the model's sustained impact (Das et al., 2024; Wolfle & Channon, 2023).

5 Concluding Remarks

Child undernutrition remains a critical public health challenge in the coastal regions of Bangladesh, where stunting and wasting prevalence among children under five substantially exceeded national and divisional averages, although underweight rates were comparatively similar. Household-level poverty, food insecurity, suboptimal infant and young child feeding practices, and geographic isolation collectively sustain this disproportionate nutritional burden in coastal communities. The Child Profile Estimates and Costing Model, developed through the Right2Grow initiative, has demonstrated significant potential as a transformative planning instrument by translating localized nutrition evidence into actionable resource allocation and evidence-based advocacy. By empowering local governments, health providers, and civil society organizations to systematically assess nutritional needs and mobilize targeted funding, the model has strengthened grassroots governance and improved budget execution across participating Union Parishads. In Bangladesh and beyond, the study supports governments to deliver impactful, scalable solutions that accelerate progress toward the SDGs and a healthier future for all children.

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Author contributions
G.S.I: conceptualization, methodology, data curation, visualization, writing-original draft. M.T.I: project administration, supervision, resources, writing-review & editing, Z.U.K: supervision, writing-review & editing.

Consent to publish
All authors have read and agreed to the published version of the manuscript.

Data availability
The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Accordance statement
The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and approved by the Institutional Review Board (IRB) of the Institute of Health Economics (IHE), University of Dhaka (Ref. No. IHE/IRB/DU/62/2023/Final). Informed consent was obtained from all participants prior to data collection.

Consent to participate
Participation was restricted to adults aged 18 and older, and informed consent was obtained from each participant prior to data collection, ensuring they were fully aware of the study's objectives, intended data use, and their unconditional right to withdraw at any stage without consequence. Before fieldwork commenced, all team members completed a child safeguarding orientation facilitated by Save the Children, upholding the highest standards of conduct in interactions involving children and adolescents. The team also remained attentive to potential personal and professional biases throughout data collection and analysis, and all fieldwork was carried out in a manner that minimized disruption to facility operations, service providers, and participant households.

Declaration of competing interest
The authors declare that they have no competing interests.

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Declaration of AI-assisted technologies in the manuscript preparation process
The authors used AI tools, which include ChatGPT (version: GPT-4), Microsoft Copilot, and Grammarly (version: Grammarly Free), to improve the language and readability of the paper. After utilizing these tools, they reviewed and edited the content as necessary and took full responsibility for the final publication.

Supplementary material

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