The Nutrition Modeling Consortium: Improving Data Use for Nutrition Policy

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Key messages

> Mathematical modeling tools help policymakers maximize the efficiency of their nutrition investments.

> Three examples are provided that highlight how different tools were used to weigh policy trade-offs, identify savings and improve access to nutritious diets.

> More work is needed to improve end users' understanding of the tools' potential, and to smooth out between-tool interoperability.

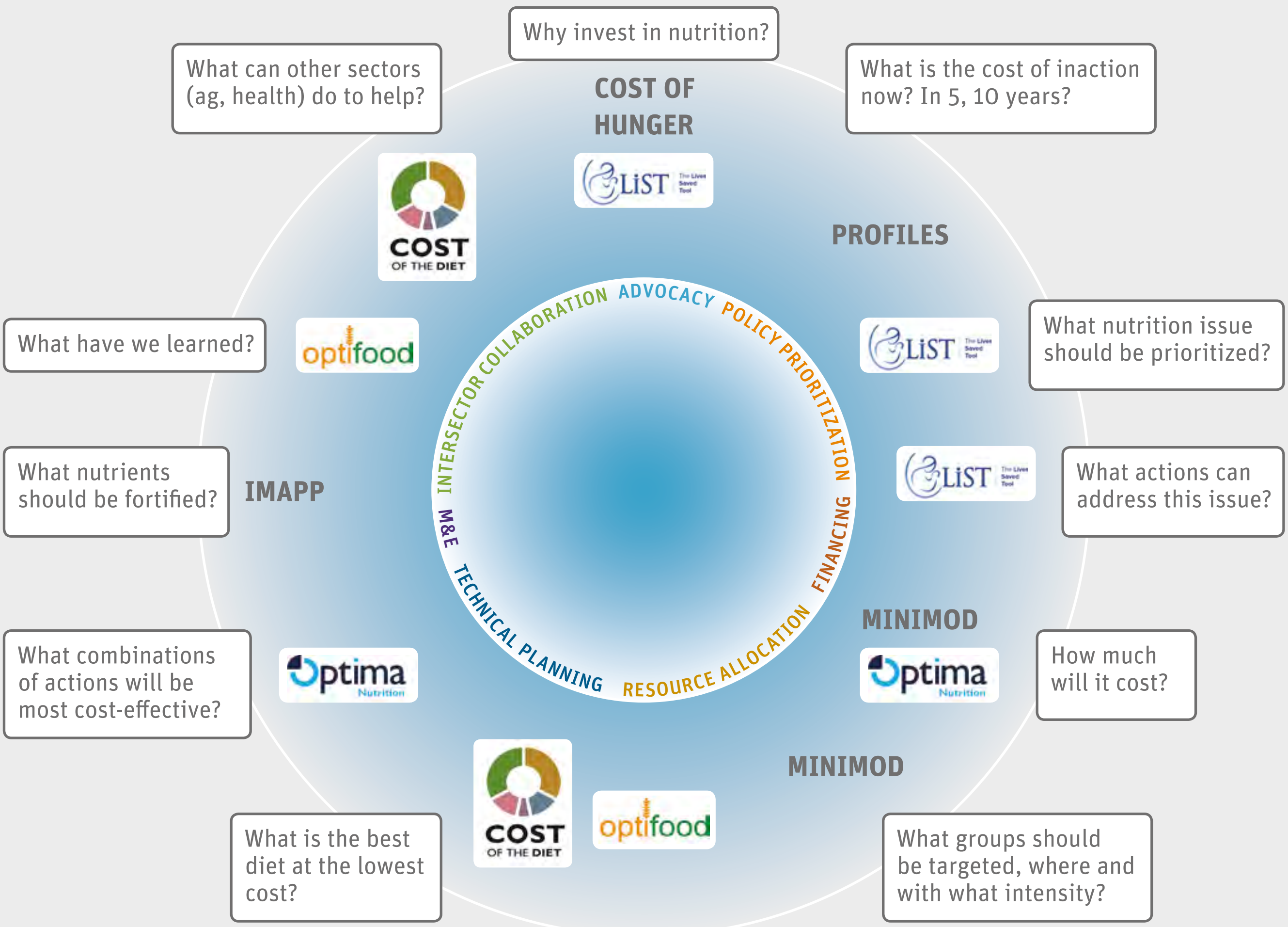
Introduction

Growing recognition of the centrality of nutrition to human and social development is prompting policymakers in low- and middle-income countries (LMIC) to invest in nutrition, yet their capacity to prioritize among interventions and to allocate resources efficiently remains a challenge. Indeed, the range of questions facing policymakers is overwhelming: What are the most urgent nutrition goals to address – child stunting, vitamin A deficiency or anemia? Which interventions will achieve those goals most cost-efficiently? And how can the benefits from this investment on social development over the next 10 years be compared with other interventions in the education, health or other sectors? Such questions, though difficult, need to be considered for informed policy decisions.

"The range of questions facing policymakers is overwhelming"

The core group of the Nutrition Modeling Consortium, photographed in February 2018. From left to right, **front row** (sitting): Rebecca Heidkamp, Lynnette Neufeld, Gilles Bergeron, Neff Walker, Florencia Vasta. **Middle row** (also sitting): Kavita Sethuraman, Saskia de Pee, Nick Scott, Monica Woldt, Homero Martinez, Elaine Ferguson, Patrizia Fracassi. **Back row** (standing): Saima Ahmed, Megan Bourassa, Saskia Osendarp, Steve Vosti, Frances Knight, Kara Greenblatt, Lindsay Allen, Banda Ndiaye, Nick Kassebaum, Jakub Katiekek, Carol Levin.

FIGURE 1: Cycle of policy decisions and corresponding tools



A tool like PROFILES will demonstrate the cost of inaction to the national economy and indicate what nutrition conditions (e.g., stunting, anemia or vitamin A deficiency) need most urgent attention. Having clarified national priority investments, PROFILES results can then be used by LiST to examine how many lives and DALYs (disease-adjusted life years) will be spared by alternative interventions on a given priority, comparing for instance the impact of exclusive breastfeeding (EBF) versus micronutrient powder supplementation (MNP) on the reduction of stunting.

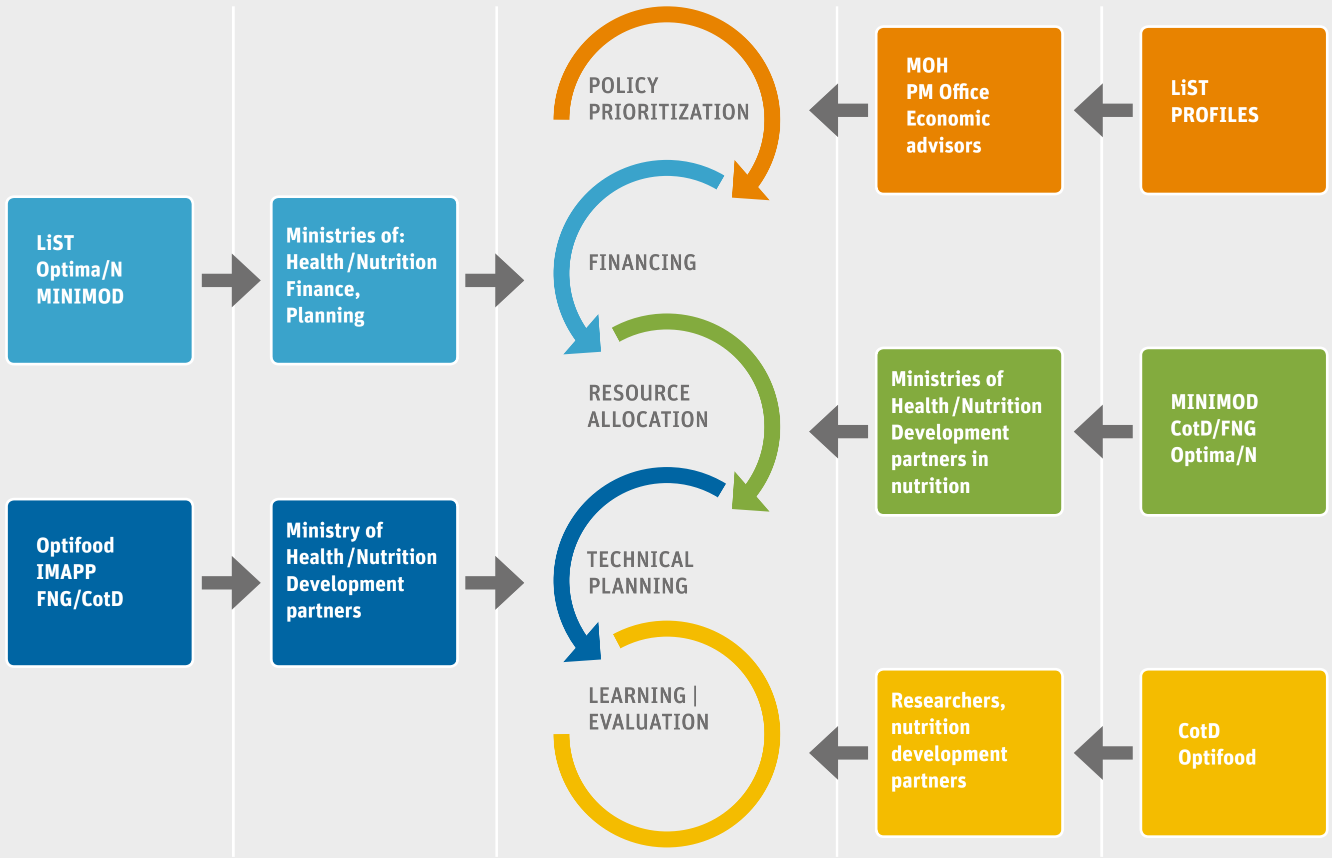
LiST does only one intervention at a time, however: what about the effects of multiple interventions on different outcomes? A tool like Optima Nutrition (Optima/N) will state what 'quantity' of each intervention is needed to obtain the optimal outcome on various conditions (e.g., stunting and child mortality). It will also permit statements about how much more could be achieved with greater budgets, and how those additional resources should be allocated across interventions. To refine this further, a tool like MINIMOD will allocate resources over space and time and among target groups, taking into account the regional severity of the problem, thus allowing policymakers to modulate interventions according to their most cost-effective combination in each region. Other sectors, such as agriculture and education, exert a powerful influence on the context in which malnutrition occurs. Tools like Cost of the Diet (CotD) and Optifood can guide multisectoral actions that are sensitive to nutrition programming needs.

Considerable work has already been done by computer modelers and nutritionists to guide such policy decisions. Tools have been developed to support nutrition actions, from advocacy to financing to resource allocation to learning (Figure 1). Those efforts, however, have been constrained by two key challenges. First, each tool was developed independently by different organizations to pursue different goals using different methods and data. This can generate inconsistent, even conflicting, recommendations. Second, end users are still largely unaware of those tools and their powerful capabilities. Consequently, uptake remains slow and is largely driven by tool modelers themselves rather than by endogenous programmatic demand or policy needs.

The Nutrition Modeling Consortium

To resolve the lack of connection between tools, and to increase uptake by end users, the New York Academy of Sciences, the Micronutrient Forum and the Bill & Melinda Gates Foundation convened a series of meetings between 2017 and 2019 that

FIGURE 2: Tag teaming between teams along the policy process



Adapted from personal communication from Purnima Menon, 2018

The dietary needs of adolescent girls and young children differ significantly resulted in the creation of the Nutrition Modeling Consortium (NMC). Membership in the NMC is open to all modeling efforts that use mathematical optimization to improve the allocation of nutrition resources. The NMC currently includes 14 tools (see **Table 1**), each addressing one or more steps along the 'policy cycle' illustrated in **Figure 1**.

A leading mandate of the NMC is to disseminate information to end users in LMIC about the purpose and capabilities of those tools and how they can be applied to address countries' specific needs, and also about how to obtain services through the Consortium. A second mandate is to discover and advance the tools' collective capacities, harmonize them and further their complementarity and interoperability. This includes, for instance, helping to normalize the evidence and assumptions they use to ensure that their results are not contradictory and that they coherently 'tag team' with one another when possible to support the entire nutrition portfolio development (**Figure 2**).

Achieving harmonization is a complex proposition, however. Aside from its aim and origin, each tool differs in its assumptions, objective functions and mathematical approaches. To bring them together, the NMC plans to pilot the simultaneous rollout of several tools in one location so that modelers can de-

TABLE 1: Tools currently in the Consortium and its parent organization

Tool name (acronym)	Parent organization	Brief description
Cost of the Diet | Fill the Nutrition Gap (COD)	Save the Children | World Food Programme	Models the lowest-cost, nutritionally adequate diet for model households and for individual groups, depending on the nutrient requirements of each member.
Cost of Hunger (COH)	Economic Commission for Latin America	Analyzes the cost of the double burden of under- and overnutrition on social and economic issues, and how much could be saved by addressing those nutritional problems.
EQUIST (EQU)	UNICEF	Identifies cost-effective interventions, prioritizes key bottlenecks, and targets the most effective and equity-focused strategies to remove bottlenecks to MNCH (maternal, newborn and child health) intervention coverage.
GHCC (GHC)	Washington University	Improves the availability of cost estimates and offers guidance to standardize costing in global health. Focus is on health (especially HIV and TB), not on nutrition.
IMAPP (IMP)	University of California, Davis	Supports the 2006 WHO / FAO Guidelines on Food Fortification using current consumption of potential fortification 'vehicles': what amount of nutrient to add for a targeted prevalence of inadequacy?
IHME (IHM)	Washington University	Provides rigorous and comparable measurement of the world's most important health problems, and evaluates the strategies used to address them.
LiST (LiS)	Johns Hopkins University	Models how changes in coverage of efficacious interventions affect mortality, stunting, wasting, breastfeeding practices, birth outcomes and maternal anemia.
MAPS (MAP)	London School of Hygiene & Tropical Medicine	Assesses how actions in food and agriculture systems can address micronutrient deficiencies, using economic optimization and subnational-level spatial environmental data to forecast food consumption.
MINIMOD (MNM)	University of California, Davis	Identifies cost-effective solutions to specific micronutrient-related problems. Includes an economic optimization tool to compute the cost of an intervention per child reached or effectively covered.
Nutrition & Child Development	Harvard University	Models nutrition interventions to human capital outcomes, child development, educational attainment, adult cognitive / socioemotional development and lifetime earnings.
OMNI (OMN)	Nutrition International	Integrates program coverage and intervention efficacy data to assess health and other impacts that result from nutrition programming, across multiple interventions.
Optifood (OPF)	London School of Hygiene & Tropical Medicine	Assesses the nutritional adequacy of local food environments and the affordability of a nutritious diet. Identifies problem nutrients and strategies to address gaps using food-based recommendations.
Optima Nutrition (OPM)	Barnett Institute | World Bank	Assesses how to allocate a specified amount of funding such that it maximizes nutrition outcomes in the most cost-effective way possible.
PROFILES (PRF)	FANTA | USAID	Raises awareness among policymakers of the impact of malnutrition on child mortality, morbidity and labor productivity by showing the consequences of status quo over a defined time period.

termine how their results can inform the use of other tools. The intuition behind such harmonization is illustrated in **Figure 2**: tools like LiST and PROFILES help top-level decision-makers prioritize the issues to be addressed. Once agreed, these are passed to tools like Optima/N to examine action(s) to be taken. Next, MINIMOD and CotD can allocate resources geographically and among target groups.

Preliminary results from such collaborations are expected later in 2019. In the meantime, and to illustrate the potential utility of those tools to country governments, we provide three examples below that illustrate how the use of individual tools in the past helped decision-makers reach better solutions.

1. Cost of the Diet (CotD) identifies ways to make a nutritious diet more affordable in Pakistan

The 2011 National Nutrition Survey in Pakistan found that 43.7% of children < 5 years were stunted, 31.5% underweight and 15.1% wasted. A CotD analysis was applied as part of the Fill the Nutrient Gap (FNG) process in 2016–17 to better understand the provincial malnutrition contexts, and to align actions at national and provincial levels. It sought to address the following questions:

1. What are the barriers to adequate nutrient intake?
2. What is the cost and content of the least expensive diet for specific members of modeled households (breastfed child, lactating woman, etc.), using locally available foods and appropriate portion sizes?
3. What proportion of the population could afford a nutritious diet?
4. What interventions could improve access to nutritious diets?

> **The Cost of the Diet (CotD)** software analyzes the amounts, combination and cost of local foods needed by households to have nutritious diets. CotD uses linear programming to find optimal combinations of available foods that meet energy, macronutrient and micronutrient needs for households and specifically targeted household members, e.g., adolescent girls. The tool allows users to model the impact of potential interventions on improving the quality and affordability of diets. Results can also be used for advocacy, to influence nutrition policies and programs and (if run regularly) as an early warning indicator.

CotD analysis of local foods in rural and urban areas showed: that food availability was not a barrier to a nutritious diet but that nutritionally adequate diets would be unaffordable for 68% of households; that the nutrient requirements of adolescent girls were the most expensive to meet; and that calcium, iron and vitamin B_{12} were the key problem nutrients based on local food availability and prices.

Among interventions identified for increasing the affordability of a nutritionally adequate diet, vouchers for animal-source foods and vegetables were most effective in meeting adolescent girls' nutrient needs, while fortified cereal and legume blends were best to meet the nutrient needs for children 6–23 months and pregnant and lactating women. However, no single intervention alone would significantly reduce the cost of a nutritious diet across households. Those two interventions were thus combined with cash transfers, producing the greatest impact on the affordability of nutritious household diets.

Details of these packages and accompanying stakeholder-developed recommendations can be found in the Pakistan Summary Report (at **www.wfp.org/fillthenutrientgap**).

> **The MINIMOD tool** is designed to improve the efficiency of micronutrient intervention programs. Starting from a 'business-as-usual' (BAU) scenario (retaining current micronutrient intervention programs), it asks what the impacts and costs would be of alternative programs over a 10-year planning time horizon, and what would be the most cost-effective program or combination of programs for achieving agreed-upon objectives.

2. MINIMOD identifies more cost-effective strategies for addressing vitamin A deficiencies among young children in Cameroon

Vitamin A (VA) deficiency is common in Cameroon, but shows large regional variations in terms of prevalence and severity (**Figure 3**). The cost of existing programs also varies – for example, the yearly cost of high-dose vitamin A supplementation (VAS) per child reached ranges from US$0.66 in the north to US$2.05 in the south (**Figure 4**), due to regional differences in population densities, infrastructure and so forth, all of which affect region-specific program coverage.

MINIMOD uses economic optimization routines to estimate the efficiency gains (vis-à-vis a Cameroon business-as-usual (BAU) scenario involving national VAS distribution and an underperforming VA-fortified edible oils program) that could result from regional VAS targeting and other investments, such as improving the VA-fortified edible oils program and developing a VA-fortified bouillon cube program.

Figure 5 identifies the most cost-effective interventions to achieve adequate VA intake in the south macro-region of Cameroon, where baseline levels of inadequate VA intake are relatively

FIGURE 3: Vitamin A deficiency among children < 5 years by region in Cameroon

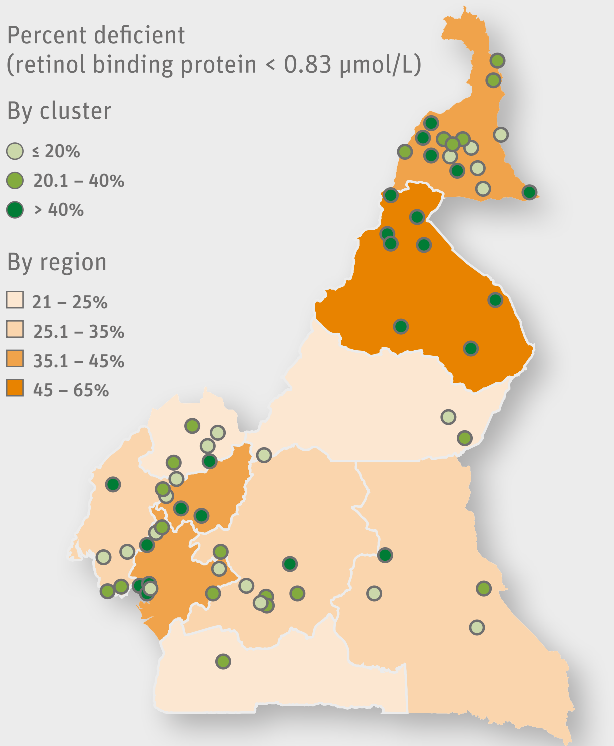
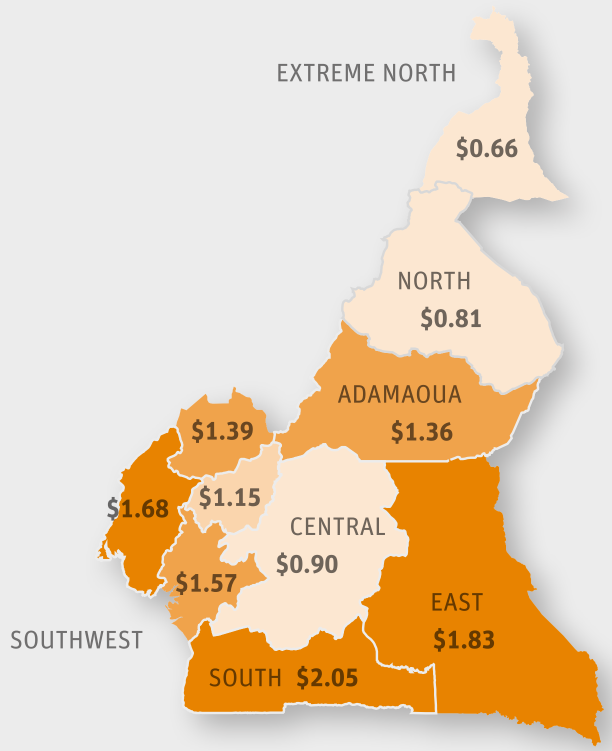
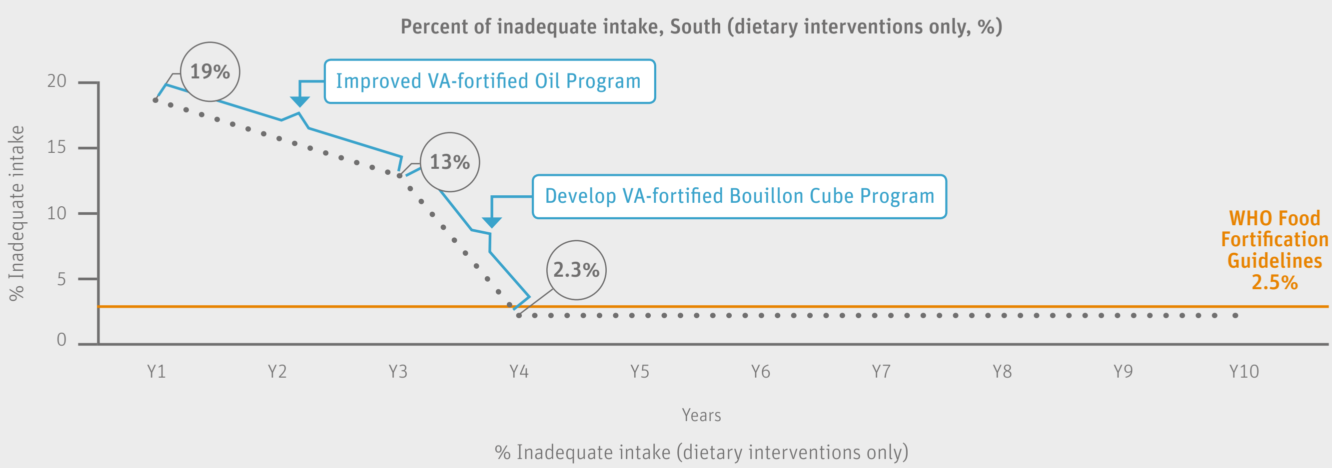


FIGURE 4: Yearly cost per child reached with vitamin A capsules in Cameroon



low (19%) and VAS costs are high (US$2.05 per child reached). For this macro-region, the tool suggests that improving the edible oils program and developing a fortified bouillon cube program could, jointly, within 4 years essentially eliminate inadequate VA intake (< 2.5%). Savings from doing so could be as high as US$5.4 million. Similar results emerge for the cities macro-region (not shown). However, in the north macro-region (not shown), where the prevalence of inadequate VA intake among children is very high (~60%), the fortification programs alone cannot eliminate this public health problem. Therefore, until new food-based delivery platforms can be implemented, VAS will need to continue in the north macro-region. The policy choices that emerged from these analyses are clear and important, and highlight the inefficiencies in this case of maintaining BAU.

FIGURE 5: Combination of cost-effective strategies for addressing vitamin A deficiencies in children – Cameroon, south macro-region



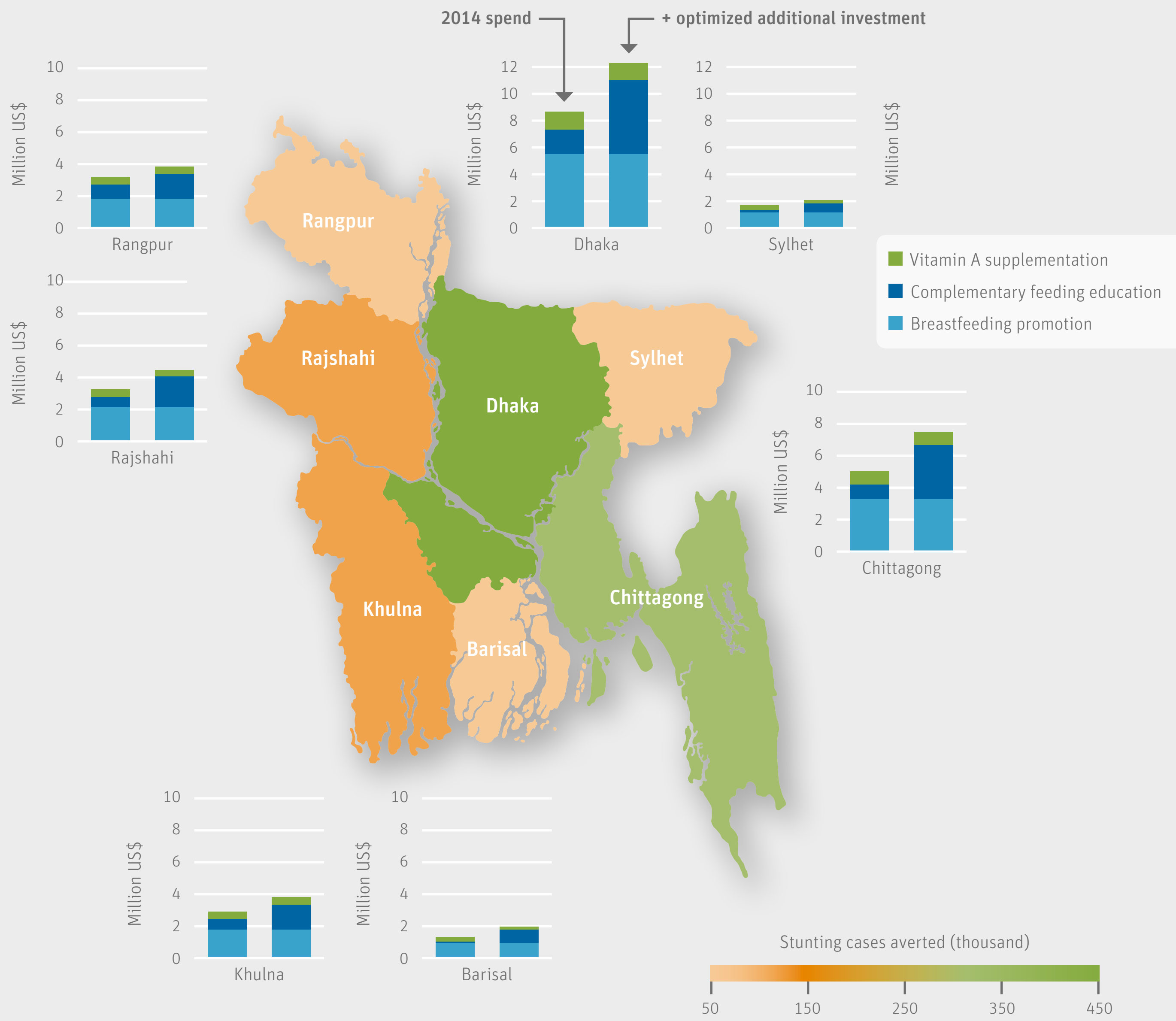
Optima Nutrition (Optima/N) aims to provide practical advice to governments on the allocation of current or projected budgets across programs to minimize stunting, wasting, anemia or under-five mortality at both the national and regional levels. Planners may choose from interventions that include vitamin supplementation programs, IYCF (infant and young child feeding) education, treatment of SAM (severe acute malnutrition), treatment and prevention of diarrhea, fortification of foods, WASH (water, sanitation and hygiene), family planning and malaria prevention interventions.

3. Optima Nutrition (Optima/N) helps to identify the best mix of interventions to reduce stunting in Bangladesh

Costing nutrition interventions, assessing their cost-effectiveness and doing cost–benefit analysis are well-refined analytical routines. Until Optima/N, however, one question eluded an answer: what is the optimal allocation of resources across interventions to obtain a given outcome (e.g., maximizing the number of non-stunted children < 5 years)? Optima/N answers such questions as:

- How can a fixed budget be allocated across interventions to minimize stunting, wasting, anemia and mortality in children < 5 years?

FIGURE 6: How can an additional US$10 million be optimally allocated across regions and programs in Bangladesh to minimize stunting?



- Which programs and regions should receive further funding, if funding were available?
- How might trends in undernutrition change under different funding scenarios?
- How close can the country get to its target under a BAU scenario versus the same funding level but reallocated optimally?
- What is the minimum funding required to meet the nutrition targets if allocated optimally?

An Optima/N application was conducted in Bangladesh to determine how an additional US$10 million could be allocated across regions – and to a selection of interventions within those regions – to minimize stunting (**Figure 6**).

The analysis suggested that the greatest number of stunting cases could be averted by focusing on Dhaka and Chittagong. Both regions would absorb the lion's share of funding, with complementary feeding education and VAS being the priority interventions for the additional funding. Other regions were also allocated a slight increase in funding but it contributed less to the total reduction in stunting, even after their package of interventions had been optimized. Such findings create context for the political choices that may drive policy decisions.

"Collectively, these tools provide extraordinary opportunities to effectively use data in nutrition planning"

Conclusions

The three analyses above offer a glimpse of the possibilities offered by modeling tools. Other aims not described here include advocacy (using PROFILES and Cost of Hunger), intersectoral planning (Optifood), food fortification program design (IMAPP) among others. Collectively, these tools provide extraordinary opportunities to effectively use data in nutrition planning. The fact that each tool was developed independently from the others and with distinct goals in mind inherently creates the possibility of seeing diverging recommendations but the creation of the Nutrition Modeling Consortium and the activation of its mandate will hopefully make it possible to preview and mitigate such challenges. More information on the Consortium and on each of the tools is available at **www.nyas.org/NMC**

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