SCALING UP NUTRITION IN GUINEA-BISSAU: WHAT WILL IT COST?

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Scaling Up Nutrition in Guinea-Bissau: *What Will It Cost?*

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Abstract: This paper builds on global experience and Guinea-Bissau's specific context to identify an effective nutrition approach along with costs and benefits of key nutrition interventions. It is intended to help guide the selection of the most cost-effective interventions as well as strategies for scaling these up. We estimate that the costs and benefits of implementing 10 nutrition-specific interventions in all regions of Guinea-Bissau would require a public investment of USD 17 million over five years (with about USD 3 million needed to maintain the current coverage of the interventions and USD 14 million needed to expand the coverage to reach 90 percent of the population). The two key conclusions of this paper are, first, that investing in nutrition in Guinea-Bissau is cost-effective based on international standards and, second, that investments in nutrition can generate very substantial health and economic benefits, with one dollar spent on nutrition interventions resulting in about 10 dollars of returns over the productive lives of children covered by high-impact nutrition interventions. Economic productivity could potentially increase by USD 120 million (discounted at 3 percent) over the productive lives of the beneficiaries, with an impressive internal rate of return of 9 percent annually. These findings point to a powerful set of nutrition-specific interventions that represent a highly cost-effective approach to reducing child malnutrition and stunting in Guinea-Bissau.

Keywords: nutrition-specific interventions, cost-effectiveness, benefit-cost analysis, nutrition financing, Guinea-Bissau.

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The authors are grateful to the World Bank for publishing this report as an HNP Discussion Paper.

ABBREVIATIONS AND ACRONYMS

ANFA	Associação Nacional para Fortificação Alimentar
CoD	Cause of Death
CRENAG	Centro de Recuperação e Educação Nuntricional Ambulatória para Desnutrição Aguda Grave
CRENAM	Centro de Recuperação e Educação Nuntricional Ambulatória para Desnutrição Aguda Moderada
CRENI	Centro de Recuperação e Educação Nutricional em Regime de Internamento
CSB	Corn-Soya-Blend
DALYs	Disability Adjusted Life Years
DHS	Demographic and Health Survey
EU	European Union
FAO	Food and Agriculture Organization (UN)
GAIN	Global Alliance for Improved Nutrition
GDP	Gross Domestic Product
GIDA	Gestão Integrada da Desnutrição Aguda
GNI	Gross National Income
HAZ	Height-for-age Z-score
HDI	Human Development Index
HNP	Health, Nutrition and Population
IHME	Institute for Health Metrics and Evaluation
IGME	Inter-agency Group for Child Mortality Estimation
IU	International Units
LiST	Lives Saved Tool
MAM	Moderate Acute Malnutrition
MPI	Multidimensional Poverty Index
M&E	Monitoring and Evaluation
MICS	Multiple Indicator Cluster Survey
MoPH	Ministry of Public Health
n.a.	Not Applicable
PAF	Population Attributable Fraction
PEN	Plano Estratégico de Nutrição
PPP	Purchasing Power Parity
SAB	Bissau capital area
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SMART	Standard Monitoring and Assessment of Relief and Transition
SUN	Scaling Up Nutrition
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WAZ	Weight-for-age Z-score
WDI	World Development Indicators
WHO	World Health Organization
WHO-CHOICE	Choosing Interventions that are Cost-Effective
WHZ	Weight-for-height Z-score
WFP	World Food Programme (UN)
YLD	Years of Life spent with Disability (from a disease)
YLL	Years of Life Lost (from a disease)

All dollar amounts are U.S. dollars unless noted otherwise.

GLOSSARY OF TECHNICAL TERMS

A **benefit-cost ratio** summarizes the overall value of a project or proposal. It is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. The benefit-cost ratio takes into account the amount of monetary gain realized by implementing a project versus the amount it costs to execute the project. The higher the ratio, the better the investment. A general rule is that if the benefit from a project is greater than its cost, the project is a good investment.

Capacity development for program delivery is a process that involves increasing in-country human capacity and systems to design, deliver, manage, and evaluate large-scale interventions (Horton et al. 2010). This includes developing skills by training public health personnel and community volunteers to improve the delivery of services. These efforts typically accompany program implementation or, when possible, precede program implementation. In this analysis 9 percent of total programmatic costs is allocated to capacity development for program delivery.

Cost-benefit analysis is an approach to economic analysis that weighs the cost of an intervention against its benefits. The approach involves assigning a monetary value to the benefits of an intervention and estimating the expected present value of the net benefits, known as the *net present value*. Net benefits are the difference between the cost and monetary value of benefits of the intervention. The net present value is defined mathematically as:

$$Net\ present\ value = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

where C_t is net cash inflows, C_0 is the initial investment, the index t is the time period, and r is the discount rate. A positive net present value, when discounted at appropriate rates, indicates that the present value of cash inflows (benefits) exceeds the present value of cash outflows (cost of financing). Interventions with net present values that are at least as high as alternative interventions provide greater benefits than interventions with net present values equal to or lower than alternatives. The results of cost-benefit analysis can also be expressed in terms of the benefit-cost ratio.

Cost-effectiveness analysis is an approach to economic analysis that is intended to identify interventions that produce the desired results at the lowest cost. Cost-effectiveness analysis requires two components: the total cost of the intervention and an estimate of the intervention's impact, such as the number of lives saved. The cost-effectiveness ratio can be defined as:

$$Cost\text{-}effectiveness\ ratio = \frac{total\ cost\ of\ implementing\ the\ intervention}{impact\ of\ the\ intervention\ on\ a\ specific\ outcome}$$

The analysis involves comparing the cost-effectiveness ratios among alternative interventions with the same outcomes. The intervention with the lowest cost per benefit is considered to be the most cost-effective intervention among the alternatives.

A **DALY** is a **disability-adjusted life year**, which is equivalent to a year of healthy life lost due to a health condition. The DALY, developed in 1993 by the World Bank, combines the years of life lost from a disease (YLL) and the years of life spent with disability from the disease (YLD). DALYs count the gains from both mortality (how many more years of life lost due to premature death are prevented) and morbidity (how many years or parts of years of life lost due to disability are prevented). An advantage of the DALY is that it is a metric that is recognized and understood by external audiences such as the World Health Organization (WHO) and the National Institutes of Health (NIH). It helps to gauge the contribution of individual diseases relative to the overall burden of disease by geographic region or health area. Combined with cost data, DALYs allow for estimating and comparing the cost-effectiveness of scaling up nutrition interventions in different countries.

A **discount rate** refers to a rate of interest used to determine the current value of future cash flows. The concept of the time value of money suggests that income earned in the present is worth more than the same amount of income earned in the future because of its earning potential. A higher discount rate reflects higher losses to potential benefits from alternative investments in capital. A higher discount rate may also reflect a greater risk premium of the intervention.

The **internal rate of return** is the discount rate that produces a net present value of cash flows equal to zero. An intervention has a non-negative net present value when the internal rate of return equals or exceeds the appropriate discount rate. Interventions yielding higher internal rates of return than alternatives tend to be considered more desirable than the alternatives.

The **Lives Saved Tool (LiST)** is an estimation tool that translates measured coverage changes into estimates of mortality reduction and cases of childhood stunting averted. LiST is used to project how increasing intervention coverage would impact child and maternal survival. It is part of an integrated set of tools that comprise the Spectrum policy modeling system.

Nutrition-sensitive interventions "address the underlying and basic determinants of maternal, fetal, and child nutrition and development, including food security; adequate caregiving resources at the maternal, household and community levels; and access to health services and a safe and hygienic environment, and incorporate specific nutrition goals and actions. Nutrition-sensitive programs can serve as delivery platforms for nutrition-specific interventions, potentially increasing their scale, coverage, and effectiveness. Examples include programs for agriculture and food security; SSNs [social safety nets]; early childhood development; maternal mental health; women's empowerment; child protection; schooling; WASH [water, sanitation and hygiene]; and health and family planning services" (Bhutta et al. 2013).

Nutrition-specific interventions "have an immediate and direct impact on maternal, fetal, and child nutrition and development, including adequate food and nutrient intake, feeding, caregiving and parenting practices, and low burden of infectious diseases. Examples include adolescent, preconception, and maternal health and nutrition; maternal dietary or micronutrient supplementation; promotion of optimum breastfeeding; complementary feeding and responsive feeding practices and stimulation; dietary supplementation; diversification and micronutrient supplementation or fortification for children; treatment of SAM [severe acute malnutrition]; disease prevention and management; and nutrition in emergencies" (Bhutta et al. 2013).

Sensitivity analysis is a technique that evaluates the robustness of findings when key variables change. It helps to identify the variables with the greatest and least influence on the outcomes of the intervention, and it may involve adjusting the values of a variable to observe the impact of the variable on the outcome.

Stunting (chronic malnutrition) is low height-for-age, defined as more than 2 standard deviations below the mean of the sex-specific reference data. Stunting is the cumulative effect of long-term deficits in food intake, poor caring practices, and illness.

Unit Cost is the cost of all inputs divided per unit of output (person treated, group sensitized, report produced, and so on) in one given intervention.

Wasting (acute malnutrition) is low weight-for-height, defined as more than 2 standard deviations below the mean of the sex-specific reference data. Wasting is usually the result of a recent shock, such as lack of calories and nutrients or illness, and is strongly linked to mortality.

A **Z-score** is a metric describing deviations from a reference value (usually the mean of a distribution). It is calculated with the following formula:

$$Z\text{-}score = \frac{(observed\ value) - (median\ reference\ value)}{standard\ deviation\ of\ reference\ population}$$

EXECUTIVE SUMMARY

The overall objective of this report is to support the Government of Guinea-Bissau in developing a costed scale-up plan for nutrition. It builds on the existing interventions outlined in the National Nutrition Policy (Política Nacional de Nutrição) and the national Nutrition Strategic Plan (Plano Estratégico de Nutrição, or PEN) to provide a costing analysis for implementing high-impact interventions over five years and to serve as an input into a national roadmap for improving maternal and child nutrition and health outcomes. This executive summary is written for policy makers; it highlights the study's main findings and discusses their implications for the Government of Guinea-Bissau and its partners. The paper itself is more technical in nature and is written for planners and programmers. The analyses presented below are intended to bring evidence of potential impact and allocative efficiency into nutrition programming in Guinea-Bissau.

Guinea-Bissau has faced years of political instability coupled with extreme poverty and a rising disease burden. As a result, the country is ranked 178th out of 188 countries in the 2015 UNDP Human Development Index. Although the country's stunting prevalence (chronic malnutrition) has dropped progressively over the past several years (from 40.9 percent in 2006 to 27.6 percent in 2014), more than a quarter of all children in Guinea-Bissau remain stunted. Furthermore, striking regional variations in stunting rates warrant a consideration of the need to scale up high-impact interventions. Stunting rates are highest in the Bafatá and Oio regions. Bolama, Bijagós, and Bissau experience the lowest stunting rates, likely as a result of less severe food insecurity in these areas (WFP 2016). Even in the wealthiest quintile, almost one fifth (18.8 percent) of children are stunted, indicating a need to drastically improve nutrition status for all populations.

Malnutrition, particularly in very young children, leads to increased mortality rates, increased risk illness, and negative long-term effects on cognitive abilities. These result in irreversible losses to human capital and contribute to losses in economic productivity. Undernutrition is an underlying cause of about one-half of under-five child mortality and one-fifth of maternal mortality in developing countries. Children who have been malnourished early in life are more likely to experience cognitive deficiencies and poor schooling outcomes. In the longer term, stunting results in a loss of as much as 20 percent of wages earned over a lifetime. Furthermore, because chronic malnutrition increases the risk of child illnesses, in the short term it increases households' expenditure on health.

At the same time, interventions aimed at improving nutrition in pregnant women and children under the age of five are consistently identified as being among the most cost-effective development actions, with a significant potential to reduce poverty and boost shared prosperity. It is estimated that investing in nutrition can increase a country's gross domestic product (GDP) by 4 to 11 percent annually in Africa and Asia. Investments in early nutrition lock in human capital for life and help drive future productivity and growth. Evidence shows that these early investments in nutrition have the potential to boost wages, supercharge the demographic dividend, make children 33 percent more likely to escape poverty in the future, and help reduce gender inequities.

The report uses the costing framework developed and presented in *Scaling Up Nutrition: What Will It Cost?* (Horton et al. 2010) as a starting point, and applies this framework to the country-specific context of Guinea-Bissau. This report estimates the cost of scaling up 10 high-impact interventions in Guinea-Bissau: (1) iron and folic acid supplementation during pregnancy, (2) vitamin A supplementation for children, (3) deworming for children, (4) breastfeeding counseling and (5) complementary feeding education, (6) treatment of severe acute malnutrition with complications, (7) treatment of severe acute malnutrition without complications, (8) management of moderate acute malnutrition, (9) therapeutic zinc supplementation for the treatment of diarrhea; and (10) salt iodization. These interventions were selected because they have been shown to have high impact on the nutrition and health status of children under five (Bhutta et al. 2013) and because they are included in the country's key national strategic documents, namely PEN.

Cost-effectiveness analyses were limited to the following interventions: breastfeeding counseling, complementary feeding education, treatment of severe acute malnutrition (both complicated and uncomplicated), and management of moderate acute malnutrition; and therapeutic zinc supplementation for the treatment of diarrhea. Vitamin A supplementation and deworming were excluded from the cost-effectiveness analyses because coverage is already at 90 percent for both interventions, so no scale-up was projected. Additionally, the Lives Saved Tool (LiST) does not include the impact of salt iodization (because iodization affects cognitive development rather than morbidity or mortality) or iron and folic acid supplementation in pregnancy (because these interventions affect maternal morbidity, but not child morbidity or mortality).

The total cost of implementing these high-impact nutrition interventions over the next five years, the timeline envisioned in the draft PEN, is **USD 17 million.** The cost includes about USD 3 million to maintain the interventions at the current coverage level and an additional **USD 14 million** to scale them up to 90 percent. This scale-up of the interventions would **prevent over 2,400 child deaths and 4,300 cases of stunting**. Those investments are further estimated to translate into economic benefits of about **USD 120 million** over the productive lives of children who receive the interventions. The resulting benefit-cost ratio of 9.8 suggests that every dollar invested would result in about 10 dollars in economic returns.

The two key conclusions of this report are, first, that investing in nutrition in Guinea-Bissau is cost-effective based on international standards and, second, that investments in nutrition can generate very substantial health and economic benefits, with one dollar spent on nutrition interventions resulting in about 10 dollars of returns over the productive lives of children covered by high-impact nutrition interventions.

The analyses show that the total costs over five years of implementing 10 high-impact nutrition-specific interventions in Guinea-Bissau are estimated to be about USD 17 million. About USD 3 million is needed to continue the current coverage of the interventions and a further USD 14 million is required to finance the scale-up of interventions. Estimates show very large benefits from investing in this scale-up: over 2,400 child deaths and 4,300 cases of stunting would be averted. Investing in life-saving measures would give each child in Guinea-Bissau more years of good health and productivity and contribution to the country's growth and prosperity. Indeed, the estimates suggest increases in economic productivity of about USD 120 million over the productive lives of the children who benefit from the interventions.

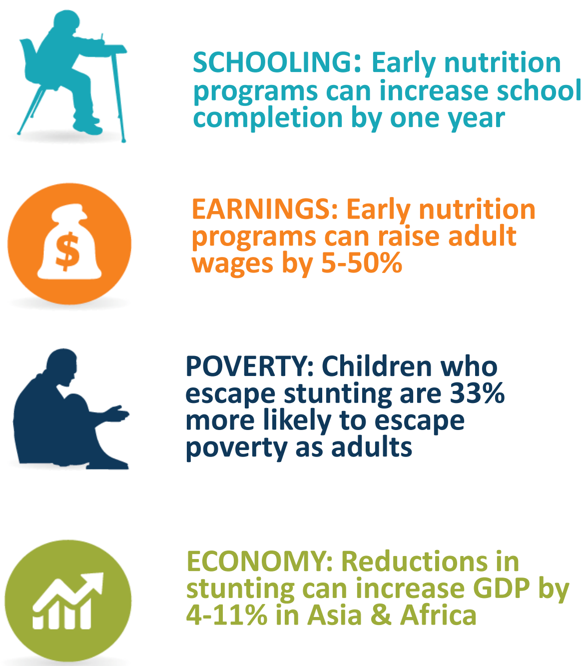
The treatments of severe and moderate acute malnutrition and breastfeeding counseling are the most cost-effective interventions in terms of disability-adjusted life years (DALYs), even though they have relatively high unit costs. Complementary feeding education—part of the infant and young child feeding package—

on the other hand, offers the lowest cost per cast of stunting prevented. This also points to an important policy tradeoff. The analyses show that different packages of interventions and different geographic prioritization may be needed depending on whether the key focus of the policy is to reduce stunting prevalence or to reduce mortality and acute morbidity resulting from malnutrition. If preventing premature death and morbidity is considered to be the key policy priority, it would be important to begin to prioritize a rapid expansion of the coverage of the treatment of severe and acute malnutrition and breastfeeding counseling in Bissau, which has the lowest cost per DALY and death averted. If, on the other hand, preventing stunting is prioritized, it would be important to focus on scaling up education on correct complementary feeding practices (part of the infant and young child feeding package) in Bafata and Oio, where the cost per case of stunting prevented is the lowest.

The scale-up of key interventions is estimated to contribute substantially to reducing stunting among children in Guinea-Bissau, thereby improving health and later productivity. Guinea-Bissau's rising health expenditures, which result from its disease burden, must be slowed, especially because most families are currently paying for health care out of pocket. Not only can preventing stunting and treating wasting significantly reduce health spending because fewer children would need to be treated for illnesses, but—more importantly—it provides a foundation of human capital that yields a lifetime of benefits and contributes toward a more productive society (see Box 1).

Box 1: The Importance of Investing in Nutrition

Every year, malnutrition claims the lives of 3 million children under age five and costs the global economy billions of dollars in lost productivity and health care costs. Yet these losses are almost entirely preventable. A large body of scientific evidence shows that investments in early childhood nutrition programs have the potential to save lives, help millions of children develop fully and thrive, and deliver greater economic prosperity.



Because the detrimental effects of malnutrition that occur in the 1,000 day window from a woman's pregnancy to her child's second birthday are essentially irreversible, it is critical to focus nutrition interventions on pregnant mothers and children under two (Black et al. 2008, 2013; World Bank 2006). The rates of return from nutrition investments are highest for programs targeting the earliest years of life (Heckman and Masterov 2004).

Sources: Martorell et al. 2010 for schooling; Hoddinott et al. 2011 for earnings; Hoddinott et al. 2008 for poverty; and Horton and Seckel 2013 for economy.

PART I – BACKGROUND

OBJECTIVES AND STUDY RATIONALE

In 2015 the Government of Guinea-Bissau requested technical assistance from the World Bank in estimating the cost of implementing the national Strategic Nutrition Plan (Plano Estratégico de Nutrição, or PEN) 2015–2019. PEN was defined and validated using a participatory and inclusive approach involving various stakeholders working in nutrition in the country. It provides a policy framework for the implementation of multisectoral nutrition actions in the country. The ultimate objective of PEN 2015–2019 is to ensure the implementation, extension, and synergy of the nutrition interventions and sectors sensitive to nutrition in order to improve population's nutrition status. PEN targets for 2019 are:

- Reduce the prevalence of malnutrition in the population by 15 percent.
- Reduce the prevalence of over-nutrition in the population by 15 percent.
- Increase the level of household food security by 30 percent.
- Improve the intersectoral coordination of nutrition actions.
- Reduce the prevalence of stunting, acute malnutrition, and underweight in children 6–59 months of age by 15 percent.
- Reduce the prevalence of anemia in children 0–23 months of age by 15 percent.
- Reduce the prevalence of malnutrition among mothers by 15 percent.
- Reduce the prevalence of overweight and obesity among mothers by 15 percent.
- Reduce the prevalence of anemia in mothers by 15 percent.
- Improve the surveillance system to collect and monitor nutrition actions regularly.

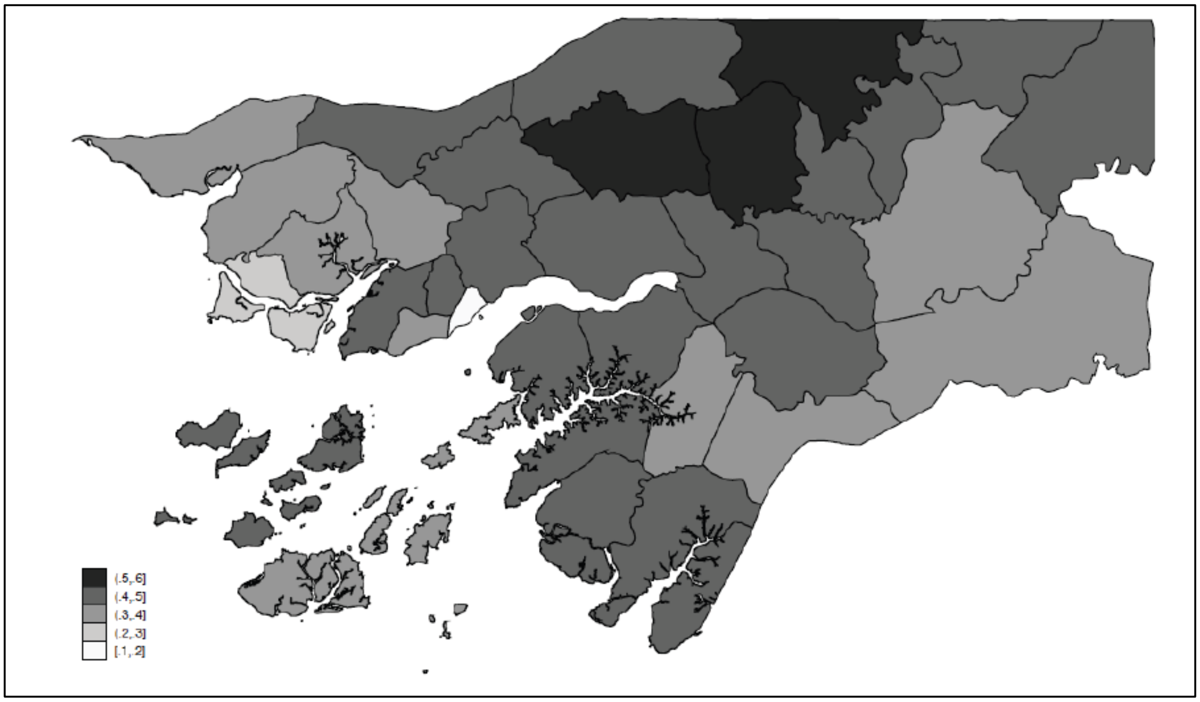
This report presents analyses conducted as part of the technical assistance provided by the World Bank. It focuses on a package of high-impact, evidence-based, nutrition-specific interventions. It consists of four parts. The first part presents background and an overview of nutritional status of the population of Guinea-Bissau, with a focus on pregnant women and children under age five. The second part describes the methodology used, including details about the assumptions used to develop unit cost (cost per beneficiary) that will be used by the Government of Guinea-Bissau as the basis for estimating the cost of PEN's implementation. The third part presents an analysis of the costs, benefits, and cost-effectiveness of a set of key nutrition-specific interventions included in PEN. The last part of the report summarizes the main conclusions and policy implications. The goal of the analyses is to contribute to the building of an investment case for nutrition in Guinea-Bissau and to inform the prioritization within PEN by identifying which interventions are the most cost-effective (that is, which interventions offer the lowest cost per death or case of stunting averted) and in which geographic regions investments in nutrition-specific action have the potential to have the greatest impacts.

COUNTRY CONTEXT

One of the poorest and most fragile countries in the world, Guinea-Bissau has faced continuous political instability and a lack of stable social and economic institutions for more than two decades. There are an estimated 1.7 million inhabitants, with approximately 50 percent of the population under 18 years of age and 16 percent under age five. In 2014, Guinea-Bissau had a gross national income (GNI) per capita of USD 550 with 70 percent of the population living in poverty (USD PPP 2 per day); with about 33 percent in extreme poverty (USD PPP 1 per day), marking a significant increase from 21 percent in 2002 (World Bank 2015). Guinea-Bissau ranked 178 out of 188 countries in the 2015 UNDP Human Development Index (HDI), falling below the average for countries in the low ranks of the HDI and below the average for countries in Sub-Saharan Africa. Between 2005 and 2014, Guinea-Bissau's HDI value increased by 6.8 percent—an average annual increase of about 0.73 percent. The 2006 Multidimensional Poverty Index (MPI) estimates that health accounts for close to 30 percent of overall poverty deprivation in the country (UNDP 2015).

All regions of Guinea-Bissau have high rates of poverty, with extreme poverty concentrated in the north (see Figure 1). The poverty index, shown in the legend of Figure 1, as a range from the darkest shaded area with a poverty rate of 0.5 to 0.6, or 50 to 60 percent of the population, to the lightest shaded box at a poverty rate of 0.1 to 0.2, or 10 to 20 percent of the population. The poverty index is somewhat lower in the capital, Bissau (0.1 to 0.2) than in the other eight regions of the country, with about 50 percent of residents getting by on less than USD 1 per day. Fifty-six percent of the population lives in rural areas, largely concentrated in the north of the country (World Bank 2015).

Figure 1: Poverty Headcount Ratios at USD PPP 1/day



Source: World Bank 2015.
Note: The poverty indexes range from 0.5 to 0.6 in the darkest box (indicating 50 to 60% of the population living on less than USD 1/day) to 0.1 to 0.2 in the lightest box (indicating 10 to 20% of the population living on less than USD 1/day).

Although total health expenditure in Guinea-Bissau continues to grow, the government health expenditure as a percentage of general government expenditure remains relatively low at 7.8 percent (WHO 2016) and per capita health expenditure remains below USD 35, which is estimated by the World Health Organization (WHO) as the minimum amount needed to cover essential health services (UNICEF 2015). Nearly 80 percent of health care is financed from private sources. Out-of-pocket expenditures are among the highest in the West Africa region and account for over 60 percent of total private health expenditure. This leads to increased household burden on accessing health care and increased risk of impoverishing or catastrophic health expenditure.

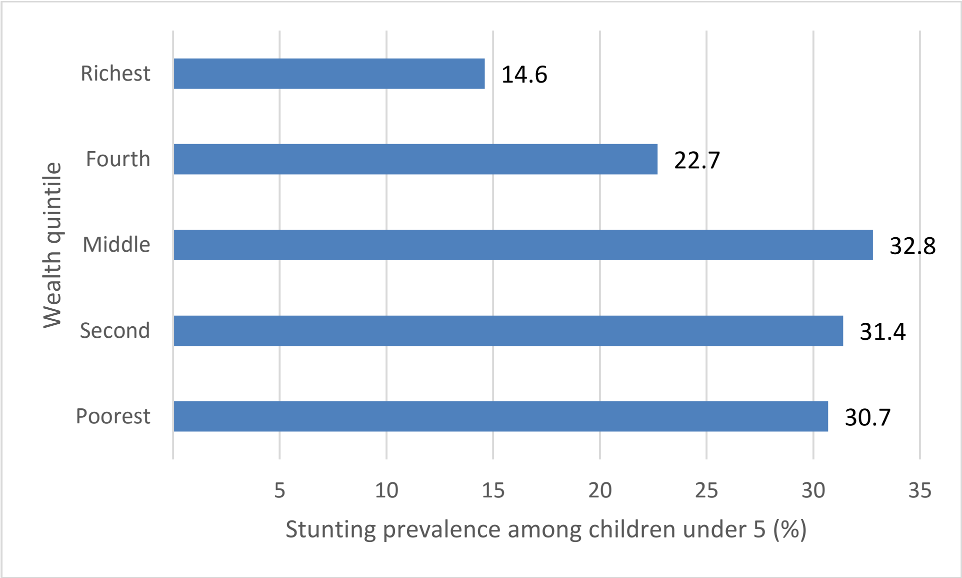
Maternal and child mortality rates are falling, but many health challenges persist. The infant mortality rate reported in the 2010 and 2014 Multiple Indicator Cluster Surveys (MICS) has decreased from 63 to 55 per 1,000 live births and the under-five mortality rate from 116 to 89 per 1,000 live births (MICS 2010, 2014). Despite this progress, Guinea-Bissau has one of the highest under-five mortality rates in the world (UNICEF 2013). The main causes of childhood deaths in Guinea-Bissau are diseases that are easily preventable, including malaria, acute respiratory infections, and diarrhea. Similarly, maternal mortality rates have declined on average 2.5 percent per year since 1990 (Maternal Mortality Estimation Inter-Agency Group no date), but still ranks 13th among the 15 countries in the world with the worst maternal mortality rate (all these countries are in Sub-Saharan Africa) (World Bank 2013) and among the 11 bottom-ranked countries for the health and well-being of mothers and children (Save the Children 2015).

POVERTY, HEALTH AND NUTRITIONAL STATUS IN GUINEA-BISSAU

Poverty and malnutrition in Guinea-Bissau are compounded by chronic food insecurity. Rice is the main staple food, and many Guinea-Bissau families struggle to complement their diet with other more nutritious foods. Food security is further impacted by irregular rainfall, volatile prices of imported rice, and an economy based on an undiversified local cashew nut production; in 2012 and 2013 donors intervened with food aid because many families could not muster the resources to buy rice (World Bank 2015). The Guinea-Bissau Food Security and Nutrition Monitoring System data showed that, overall, 11 percent of the households were food insecure in 2015. However, this figure varies across regions: in some areas, up to 51 percent of families are affected (WFP 2016).

Inequalities in child undernutrition across wealth quintiles are pronounced in Guinea-Bissau. The high levels of poverty translate into poor nutrition. Stunting rates in the poorest households (40.6 percent) are more than twice those in the richest households (17.8 percent) (Figure 2). However, although stunting rates are nearly uniformly high across the three lowest wealth quintiles, even in the wealthiest households nearly one-fifth of the children are stunted. This indicates that, while stunting is associated with poverty, other factors also put children at risk of chronic malnutrition. These include the high prevalence and incidence of disease, in particular diarrhea, as well as inappropriate feeding and caregiving practices. This suggests a need to design different strategies to address undernutrition among the poorest from the strategies used among the non-poor.

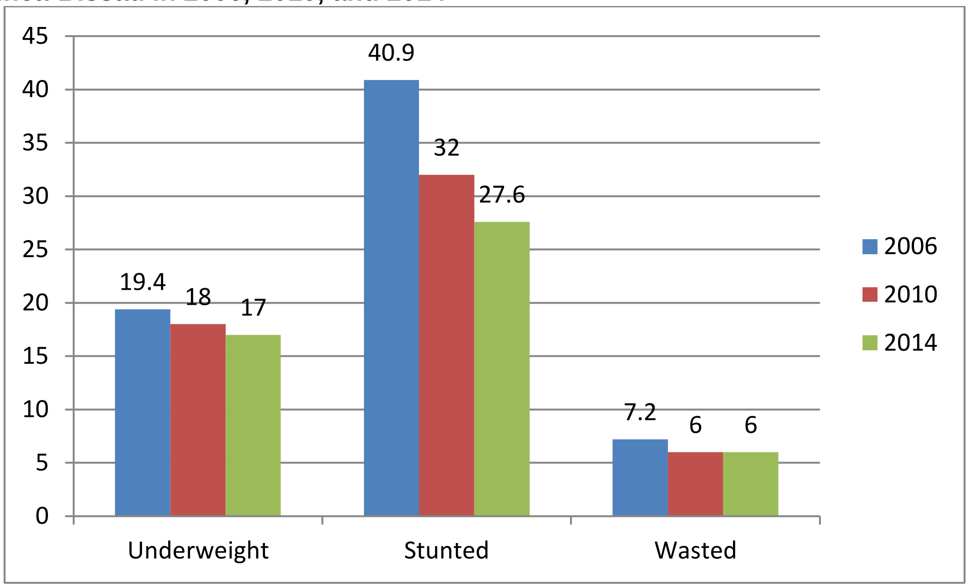
Figure 2: Wealth Inequalities in Child Stunting



Source: MICS 2014.
Note: The percentage of children stunted describes how many children under age five have a height-for-age below −2 standard deviations of the WHO reference median.

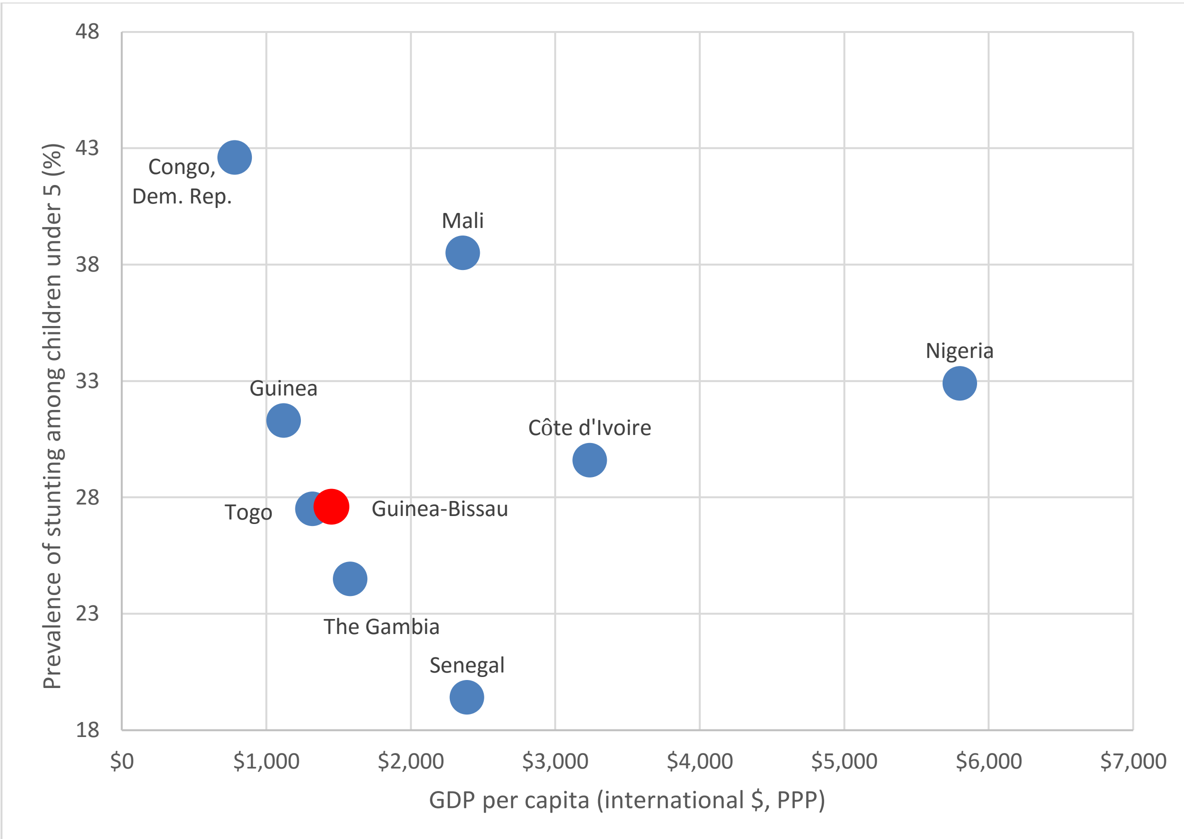
Stunting prevalence in Guinea-Bissau has seen steady improvements over the past decade. The percentage of children who are stunted (< −2 standard deviations in height-for-age) was estimated at 27.6 percent in 2014, which is a drop from the estimates of 2010 and 2006 (see Figure 3) (MICS 2006, 2010, 2014). The prevalence of stunting in Guinea-Bissau is well below the average for Sub-Saharan Africa (40 percent) and below the average among many of its income peers (UNData 2013) in West and Central Africa. Nevertheless, some countries with lower per capita incomes, such as The Gambia, exhibit similar rates of child stunting, which shows that it is possible to achieve better nutrition outcomes despite low income (see Figure 4).

Figure 3: Prevalence of Underweight, Stunting, and Wasting in Children under Five in Guinea-Bissau in 2006, 2010, and 2014



Source: MICS 2014.
Note: The percentage of children underweight, stunted, and wasted describes how many children under age five have a weight-for-age, height-for-age, and weight-for-height, respectively, below −2 standard deviations of the WHO reference median.

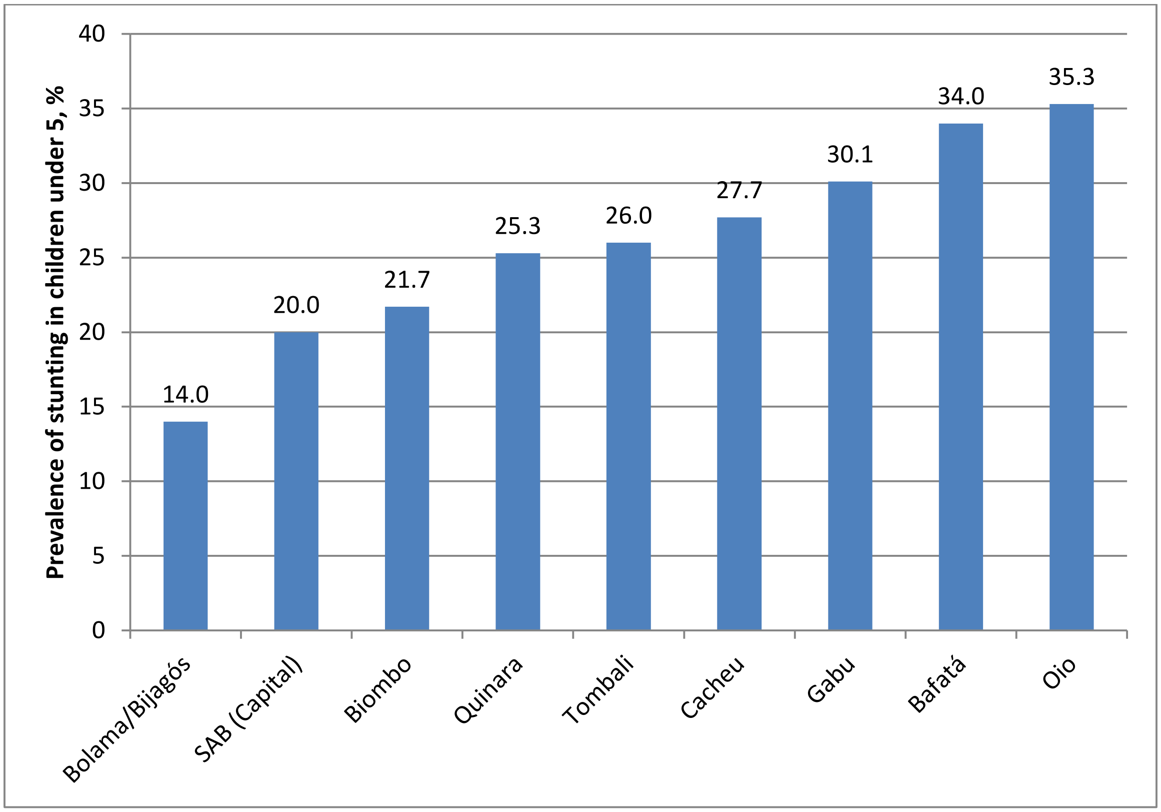
Figure 4: Prevalence of Stunting and GDP per Capita in Guinea-Bissau and Selected Income Peer Countries



Sources: Stunting rates were obtained from UNICEF, WHO, and World Bank 2016; GNI data were obtained from the World Bank 2016.
Note: The percentage of children stunted describes how many children under age five have a height-for-age below −2 standard deviations of the WHO reference median.

The national prevalence of stunting at 27.6 percent masks dramatic geographical disparities within the country (MICS 2014). Figure 5 shows disparities across regions. The Oio region, for example, has a stunting prevalence above 35 percent, whereas in the Bijagós region the stunting prevalence is much lower—14 percent (MICS 2014). On average, the regions in the south have fewer cases of stunting than the northern and eastern regions.

Figure 5: Prevalence of Childhood Stunting by Administrative Region

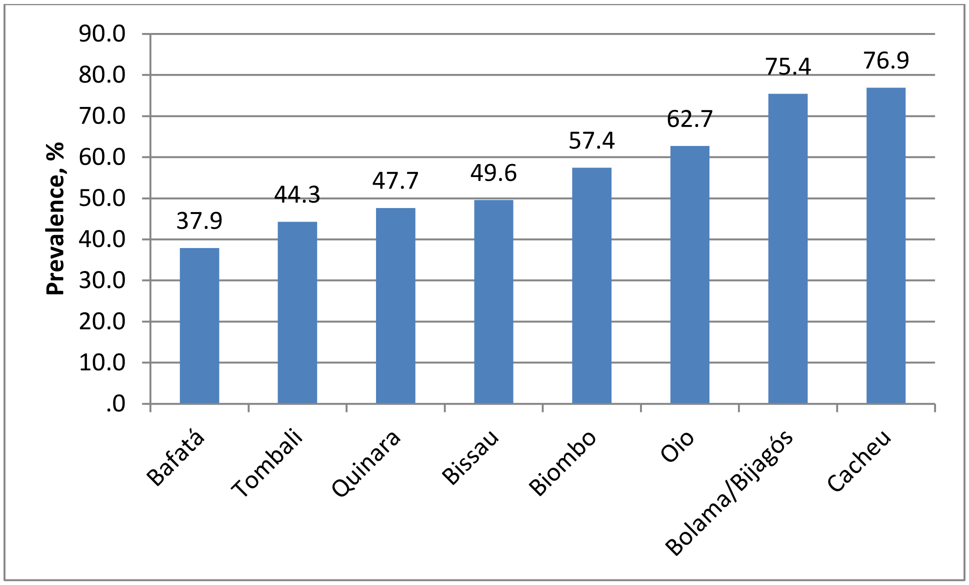


Source: Data from MICS 2014.
Note: The percentage of children stunted describes how many children under age five have a height-for-age below −2 standard deviations of the WHO reference median.

In Guinea-Bissau, approximately half of all children are exclusively breastfed until six months of age (MICS 2014). However, regional percentages of exclusive breastfeeding vary greatly as well. Bafatá and Tombali show lower than national average rates of exclusive breastfeeding, while Oio, Bolama/Bijagós, and Cacheu show markedly higher rates (see Figure 6). Given the data on regional variations, it may be pertinent to target breastfeeding counseling interventions to areas with the lowest rates, as well as learn from areas with higher rates on successful approaches.

Following the six month period of exclusive breastfeeding, it is recommended that infants gradually begin taking nutritious complementary foods in semi-solid form, followed by solid foods. Between 6 and 24 months, it is critical that children receive a diverse range of foods from four or more food groups, three to five times per day, in adequate age-appropriate amounts (UNICEF 2011). Achieving this minimum acceptable diet is difficult for many families in Guinea-Bissau, where food insecurity impacts as much as half of the population in some regions. Overall, only 8 percent of all children in Guinea-Bissau receive a minimum acceptable diet, but with wide ranges across regions. For example, 28 percent of children in Bolama/Bijagós receive a minimum acceptable diet, but only 3 and 3.7 percent of children in Gabu and Cacheu, respectively, receive a minimum acceptable diet.

Figure 6: Prevalence of Exclusive Breastfeeding for Children Age 0–5 Months by Administrative Region
Percent



Source: MICS 2014.
Note: Exclusive breastfeeding is defined as an infant receiving only mother's breastmilk and no other foods, liquids, or even water. Global recommendations are for mothers to exclusively breastfeed for the first six months of life for best infant outcomes.

Guinea-Bissau has made great strides in reducing vitamin A deficiency over the past decade. Severe and prolonged vitamin A deficiency increases child mortality, increases vulnerability to infectious diseases such as measles, and leads to blindness among children under five. It is estimated that nearly all children under five in Guinea-Bissau received two high-potency doses of vitamin A supplements in 2014 (UNICEF 2016). Current coverage rates are a strong improvement from the WHO's 1995–2005 estimates that found nearly 55 percent of preschool-age children and 18 percent of pregnant women in Guinea-Bissau had vitamin A deficiency—prevalence rates that were higher than the regional averages (WHO 2009). This is a significant public health achievement: twice-annual doses of vitamin A supplementation have shown to reduce the risk of death in children age 6–59 months by about 23–30 percent (Beaton et al. 1993; Fawzi et al. 1993; Glasziou and Mackerras 1993).

Micronutrient deficiencies (hidden hunger) are pervasive in Guinea-Bissau. Collectively, micronutrient deficiencies alone add up to an estimated loss of over USD 6 million in GDP every year (Horton et al. 2010). The most recent data available reveal that the prevalence of anemia among preschool-age children and pregnant women is a severe public health concern. The WHO estimates that 71 percent of preschool-age children and 49 percent of pregnant women in Guinea-Bissau are anemic, with approximately half of all anemia caused by inadequate dietary intake of iron, and the rest due to infections and parasites (WHO 2015). The national averages in Guinea-Bissau are comparable to the regional estimates for Central and West Africa: 71 percent prevalence among preschool-age children and 56 percent prevalence among pregnant women (Stevens et al. 2013). Micronutrient deficiencies are further compounded because fewer than one in twelve households consume adequately iodized salt, leaving children in the vast majority of households unprotected from iodine deficiency disorders (MICS 2014). Adequate intake of iodine is critical for cognitive development and successful pregnancy outcomes. Significant effort is needed to meet the Universal Salt Iodization goal of 90% of households consuming appropriately iodized salt.

Approximately 15 percent of post-neonatal deaths and 1 percent of neonatal deaths in Guinea-Bissau in 2013 were attributed to diarrheal disease (WHO no date). Nearly 90 percent of these deaths are directly attributed to poor water, sanitation and hygiene (Prüss-Üstün et al. 2008). Although all undernourished children are at higher risk of death, a child who is severely stunted is 4.6 times more likely to die of diarrhea than a child who is not stunted (Black et al. 2008). An estimated 55 percent of children under five who experience diarrheal diseases receive oral rehydration treatment with continued feeding in Guinea-Bissau (MICS 2014). This coverage is higher than the regional average of 30 percent (UNICEF 2012). Despite this, diarrheal diseases were estimated to be the fourth leading cause of premature death in Guinea-Bissau (IHME 2013). Diarrheal episodes also impact morbidity. The disease exacerbates the relationship between malnutrition and infection: as children with diarrheal diseases tend to eat less, absorb fewer nutrients, and exhibit reduced resistance to infections. Prolonged diarrheal episodes lead to impaired growth and development (Ejemot et al. 2008). At the same time, undernutrition is also a consequence of repeated bouts of illness, diarrhea in particular. Poor sanitation is also a contributing factor—through its impact on malnutrition rates—to other leading causes of child mortality, including malaria, acute respiratory infections, and measles. In addition to oral rehydration solution, it is currently recommended to treat cases of diarrhea with a 10 to 14 day course of therapeutic zinc. Therapeutic zinc supplements have been shown to reduce the duration and severity of diarrheal illness, as well as the likelihood of subsequent infections for two to three months (Khan and Sellen 2011).

National and Partner Efforts to Address Malnutrition in Guinea-Bissau

Following a movement in 2013 to coordinate partners working in food security and nutrition, the Government of Guinea-Bissau became the 49th member of the Scale-Up Nutrition (SUN) movement in March 2014 (Scaling Up Nutrition 2015). During this time, Guinea-Bissau also adopted a National Nutrition Policy (MoPH No date), which outlines priority strategies for improving nutrition status. The policy identifies key targets to be reached by 2025, including a reduction in stunting, acute malnutrition, anemia in children and women of reproductive age, vitamin A deficiencies, and iodine deficiencies. The National Nutrition Policy also calls for greater integration and partnership efforts to improve nutrition programs. The Ministry of Health has forged many partnerships with stakeholders, including UN agencies (UNICEF, the International Fund for Agricultural Development, the UN Population Fund, the Food and Agriculture Organization, and the World Food Program), civil society organizations (CARITAS, Catholic Relief Services, and others), and other development partners (the European Union and the World Bank). The government and partners are currently working on developing a national Nutrition Strategic Plan (Plano Estrategico de Nutrição, or PEN*)* to operationalize the national policy and propose a prioritized intervention package and a set of supportive actions to achieve the targets outlined in the national policy.

PART II – METHODOLOGY

EVIDENCE-BASED INTERVENTIONS

The analysis includes 10 interventions that comprise a modified package of the interventions included in the 2013 *Lancet* series on Maternal and Child Undernutrition, tailored to the Guinea-Bissau context. These interventions are based on current scientific evidence, and there is general consensus from the global community about their impact. The interventions are also included in the current draft of the national Strategic Nutrition Plan (Plano Estratégico de Nutrição, or PEN*)*. The interventions and the associated target population are specified in Table 1. The following section provides further details on the mechanisms for delivery and costing methods for each intervention.

Table 1: Nutrition-Specific Interventions

Intervention	Description	Target population	Costed delivery platform
1. Iron and folic acid supplementation	Iron and folic acid supplementation during pregnancy	Pregnant women	Primary health care and community nutrition programs
2. Vitamin A supplementation	Semi-annual doses given through mass immunization campaigns	Children 6–59 months of age	Community campaigns (mass immunization campaigns)
3. Deworming	Two rounds of treatment per year given through mass immunization campaigns	Children 12–59 months of age	Community campaigns (mass immunization campaigns)
4. Breastfeeding counseling	Behavior change communication focusing on the promotion breastfeeding	Children 0–23 months of age	Antenatal/postnatal care and community nutrition programs
5. Complementary feeding education	Promotion of complementary feeding; and promotion of safe water, hygiene and sanitation, and growth promotion	Children 6–23 months of age	Antenatal/post-natal care and community nutrition programs
6. Treatment of severe acute malnutrition without complications	For children without complications, outpatient treatment with ready-to-use therapeutic food	Children 6–59 months of age suffering from severe acute malnutrition (weight-for-height Z-score < −3 or MUAC < 115 mm). Intervention targets all incident cases; incidence is calculated as 1.6 times the prevalence, based on the most recent UNICEF programmatic guidance	Outpatient primary health care
7. Treatment of severe acute malnutrition with complications	For children who meet the clinical criteria, treatment with amoxicillin, albendazole, F-100 (in stabilization phase only),	Children 6–59 months of age suffering from severe acute malnutrition (weight-for-height Z-score < −3 or	Inpatient primary health care

Intervention	Description	Target population	Costed delivery platform
	vitamin A supplementation, and ready-to-use therapeutic food	MUAC < 115 mm). Intervention targets all incident cases; incidence is calculated as 1.6 times the prevalence, based on the most recent UNICEF programmatic guidance; it is assumed that 10% of all severe acute malnutrition cases will have complications	
8. Salt iodization	Iodization of centrally processed salt	General population	Market-based delivery system
9. Therapeutic zinc supplementation for the treatment of diarrhea	For each episode of diarrhea, 10–14 day course of oral zinc (20g per day) with oral rehydration solution	Children 6–59 months of age	Primary health care and community nutrition program
10. Management of moderate acute malnutrition	For children who meet the clinical criteria (weight-for-height Z-score between −3 and −2 SD or MUAC < 125 mm), provision of a small amount of nutrient-dense complementary food	Incidence (estimated as twice the prevalence) of moderate acute wasting (between weight-for-height Z-score < −2 and weight-for-height z-score < −3) among children 6–59 months of age	Outpatient primary health care

Note: MUAC = mid-upper arm circumference; SD = standard deviation.

ESTIMATING UNIT COSTS

The *program experience costing approach* employed in the *Scaling Up Nutrition* report (Horton et al. 2010) is used for calculating the cost of scaling up in Guinea-Bissau.[1] This approach generates unit cost data (cost per person covered) that capture all aspects of service delivery—including the costs of commodities, transportation and storage, personnel, training, supervision, monitoring and evaluation (M&E), relevant overhead, wastage, and so on—for each intervention from actual programs that are already in operation in Guinea-Bissau, and considers the context in which they are delivered.

Another commonly used method is the *ingredients approach*, in which selected activities are bundled into appropriate delivery packages (such as the number of visits to a health center; see Bhutta et al. 2013, for example). Although the program experience approach tends to yield cost estimates that are higher than those of the ingredients approach, the estimates more accurately reflect real programmatic experience, including inefficiencies in service delivery. It should be noted, however, that the calculated costs are reported in financial or budgetary terms. They do not capture the full social resource requirements, which account for the opportunity costs of the time committed by beneficiaries accessing the services. In this report, the program experience approach was used for programs where budgets for specific interventions were available and the cost for specific interventions could be isolated from the overall budget. For interventions for which budgets were not available or which were part of larger integrated programs (for example, iron and folic acid supplementation in pregnancy), an indirect (that is, ingredient-based) costing approach was used.

The unit cost estimates represent the total cost for the health system. This includes the government organizations, as well as other organizations (nongovernmental organizations, UN family organizations) involved in in the provision of nutrition services. It is assumed that there is no household expenditure on these interventions. The costs of managing the national program (for example, the costs of developing national policies and guidelines and protocols, developing pre-service and in-service training for providers, and establishing and managing data collection and reporting systems) are included separately within PEN and are not included in these estimates.

Complete budgets were obtained from some interventions, such as vitamin A supplementation and deworming, to calculate unit costs. Field discussions suggested that some budgets may have underestimated the full economic scope of implementation (for example, by not taking into account unpaid working days).

When possible, and based on available data, intervention costs were disaggregated into key cost categories including (1) human resources (for example, salaries and other payments to personnel providing services);[2] (2) consumables (medicines and other therapeutic products, such as ready-to-use therapeutic foods, and all other equipment with a lifespan shorter than three years—for example, job aids, scales); (3) transportation (the cost of moving goods and people needed to provide services, including the cost of renting vehicles and of fuel); (4) program cost (cost of managing service delivery—for example, the cost of supervision and the cost of monitoring and evaluating the specific intervention) and promotion activities (such as radio spots informing a local population that a vitamin A supplementation campaign will take place in a given place at a given time).

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[1] The *program experience costing approach* describes a specific costing method (collecting expenditure data from specific programs within a specific timeframe and calculating unit cost based on the number of beneficiaries reach during that timeframe). The *program costs* refer to the cost of managing specific interventions (sometimes referred to as *overhead*) such as the cost of supervision, the cost of M&E, and the cost of headquarter staff.

[2] WHO, Guinea-Bissau office, official per-diem and stipend rates.

Table 2 provides a summary of the high-impact interventions and their current status of implementation in Guinea-Bissau. The table also displays the costing method, and whether the actual budget or indirect (ingredient-based) methods were used for estimation.

Table 2: High-Impact Interventions

High-impact intervention	Current practice	Costing method [a]
1. Iron and folic acid supplementation during pregnancy	In place	Indirect (ingredient-based)
2. Vitamin A supplementation for children	In place[b]	Program experience
3. Deworming for children	In place[b]	Program experience
4. Breastfeeding counseling	In place[c]	Program experience
5. Complementary feeding education	In place[c]	Program experience
6. Treatment of severe acute malnutrition without complications	In place	Indirect (ingredient based)
7. Treatment of severe acute malnutrition with complications	In place	Indirect (ingredient based)
8. Salt iodization	In place	Indirect (ingredient based)
9. Therapeutic zinc for the treatment of diarrhea	In place	Indirect (ingredient based)
10. Management of moderate acute malnutrition	In place	Indirect (ingredient based)

Note: a *Program experience* refers to actual costs obtained from a budget; *Indirect (ingredient based)* refers to costs obtained using indirect methods of estimating the unit costs.
b Vitamin A supplementation (children) and deworming campaigns are run together.
c Breastfeeding counseling and Complementary feeding education actions are provided together as part of the infant and young child feeding package.

Iron and Folic Acid Supplementation

Iron and folic acid, given in combination, are essential nutrients for pregnant women for optimal fetal growth and development. Guinea-Bissau's PEN recommends that pregnant women receive iron and folic acid supplements at each prenatal appointment, with a recommended dosage of two tablets per day for the duration of the pregnancy. The tablet supplements (60 milligrams of ferrous salt + 0.4 milligrams of folic acid) are procured by UNICEF. The four prenatal appointments are held with nurses who distribute the tablets, educate mothers on how to use them, and record the sales and appointments. These appointments are said to last about 30 minutes, of which iron and folic acid supplementation takes no more than 20 percent of the time.

UNICEF estimates the total number of pregnant women to be 4.5 percent of population.[3] Based on the population estimates for 2015, this came to 68,879 pregnant women. However, the statistics center of the Ministry of Public Health (MoPH) recorded 74,517 first antenatal appointments in the same year[4]. Because

[3] UNICEF (United Nations Children's Fund), 2015, Projeção da População 2016 and 2017.

[4] Data from the National Institute of Public Health (INASA), 2016, "Dados do Ano 2015."

of this small, and seemingly inexplicable, difference in data, it was deemed preferable to work with the MoPH figure.

In the absence of information about numbers of iron and folic acid supplement tablets acquired, this figure was estimated using data on attendance of prenatal appointments by pregnant women in 2015 as a proxy for consumption of iron and folic acid. Of all the estimated 75,000 pregnant women attending their first prenatal appointment, only one-third reach their fourth prenatal appointment. This often occurs because mothers attend their first prenatal appointment late in their pregnancy. On average, pregnant women attend only 2.4 appointments. Assuming that the average interval between these prenatal appointments is eight weeks (that is, starting at week 6 of pregnancy and ending at week 38), the effective consumption of tablets per pregnant women is 2.4 appointments × 8 weeks × 2 tablets per diem. This results in 269 tablets per pregnant woman. If all pregnancies went ahead and all prenatal appointments were attended by expectant mothers, per head consumption would be 448 tablets.

In order to estimate the total cost, the costs of MoPH staff and community health workers were included. The costing of the human resources was made with the assumptions mentioned above. No information about the transport costs for the tablets for any of the 117 health centers was available, so segments that united these centers along the Guinean road network (using Google Maps) were created, and the distance and time required for the tablets' transport to each health center were calculated in order to estimate transportation costs. Given that there are many centers and that distances in Guinea-Bissau tend to be short, it seemed more expedient to use values contracted for the internal distances by the UN agencies (UN 2003). These data provided a cost for distances between Bissau and the 11 capitals of the health districts. Then the distance and the duration of traveling between the capital and the health districts was calculated.

Vitamin A Supplementation and Deworming

Vitamin A supplementation and deworming are interventions delivered through the same mechanisms and at the same time, therefore they are explained jointly in this section in terms of the intervention process and costing methods. However, for further analyses, the two interventions are treated separately.

PEN recommends that children 6–59 months of age be given vitamin A supplements to prevent the debilitating effects of vitamin A deficiency such as night blindness. PEN also recommends that children 12–59 months of age be dewormed twice every year to prevent nutrient deficiencies caused by parasites and worms.

Twice yearly, UNICEF organizes mass immunization campaigns, which include vitamin A supplementation and deworming aimed at children 6–59 months of age. Supplies for both vitamin A supplementation and deworming are procured by UNICEF, which also manages these campaigns through most of the country; the exceptions are the regions of Bafatá and Gabu, where campaigns are organized by Plan International. Although these campaigns are coordinated by UNICEF, there is heavy reliance on public health personnel at regional and local levels to run a successful campaign. Other inputs to the campaigns include supervision, training, and demand creation interventions.

At each campaign, children 6–11 months of age are given 100,000 international units (IU) of vitamin A and children 12–59 months are given 200,000 IU of vitamin A in capsule form. Children 12–59 months are also given one dose of mebendazole chewable tablets for deworming. In 2015, 270,790 children received these supplements, including 39,924 children age 6–11 months and 230,866 children 12–59 months, representing 97% of the country's children age 6–59 months.

The cost values listed below are taken from the budget for the second campaign of 2015 (MoPH 2015a). These documents contain coordination costs as well as the operational costs for 9 of the 11 regions in the country. Data on the remaining regions (Bafatá and Gabu) were provided by summary reports produced by the regional health directorates (Direção Geral da Saúde de Bafatá 2015; Direção Regional da Saúde de

Gabú 2015).[5] Using these data requires some specific assumptions and thus these two regions were costed separately. In order to estimate the overall cost, we also included the regular wages paid by the MoPH (Direção Geral do Orçamento 2012).[6]

As Table 3 indicates, the sparsely settled archipelagos of Bolama and Bijagós weigh heavily on the overall efficiency of service provision. Accounting for only 2% of the population, these two regions require nearly 15% of the country's resources. Although landlocked, Farim also contains difficult crossings and poor communications. In contrast, the input per output cost ratio is much lower in the densely populated and well accessible capital of Bissau. Core costs cover medical supplies, essential staff, and transport of goods and staff involved in delivering vitamin A capsules and deworming tablets. Additional costs cover supplies, human resources, and transport expenses involved in training, coordination, and demand creation.

Table 3: Annual Regional Costs, Input, and Output for Vitamin A Supplementation and Deworming

	Cost (USD)			Vitamin A		Deworming	
Region	Staff	Transport	Evaluation	Number of beneficiaries	Cost per beneficiary (USD)	Number of beneficiaries	Cost per beneficiary (USD)
Bafatá	5,585,000	1,342,800	321,500	39,357	184	34,682	209
Bijagós	3,901,500	1 865,000	650,500	4,335	1,480	3,816	1,682
Biombo	3,420,000	10,000	182,500	16,164	223	14,601	247
Bolama	1,012,567	231,000	156,500	1,507	929	1,403	998
Cacheu	7,667,500	605,500	538,500	34,451	256	30,463	289
Farim	2,722,500	26,000	238,500	9,631	310	8,810	339
Gabu	9,596,300			39,140	245	33,571	286
Oio	5,355,000	12,000	232,500	30,240	185	27,413	204
Quinara	2,585,000	81,000	160,500	12,460	227	10,623	266
Bissau	7,725,000	30,000	290,500	66,318	121	61,170	132
Tombali	3,165,000	314,000	196,500	17,181	214	15,219	242
Total	52,735,367	4,517,300	2,968,000	270,784	222	241,771	249

Sources: Ministério da Saúde Pública 2015a; Direção Geral da Saúde de Bafatá 2015; Direção Regional da Saúde de Gabú 2015.

[5] Direção Geral da Saúde de Bafatá, 2015, Campanha de Suplmentação de Vitamina A; Direção Regional da Saúde de Gabú, 2015, Apresentação da Campanha de Suplementação da Vitamina A.

[6] Direção Geral do Orçamento, 2012, Tabela de Passagem [standard wage rates in the public health sector].

Breastfeeding Counseling and Complementary Feeding Education

PEN recommends that pregnant and breastfeeding women should be counseled on optimal breastfeeding practices, including early initiation of breastfeeding, exclusive breastfeeding for six months, and continued breastfeeding after the introduction of solid foods. PEN also recommends that mothers of young children be educated on the importance of balanced and diversified diets and appropriate frequency of feeding. Families should also be educated on general nutrition practices and personal hygiene to prevent illnesses that can lead to poor nutrition outcomes, as well as feeding and care practices during and after illness. Currently, breastfeeding counseling takes place through several agents. These include antenatal care appointments, skilled birth attendants, and integrated community-based promotion of breastfeeding, along with other health interventions, all of which currently have low coverage. Breastfeeding counseling also takes place though small mothers' groups, known as Mães Amigas das Crianças. In 2015, 1,530 mothers participated across six regions where they were educated about optimal breastfeeding practices and techniques. These mothers' groups are supported by the MoPH as well as UNICEF and CARITAS.

In the absence of information from the implementing nongovernmental organization, CARITAS, the costs were estimated as cost per beneficiary of the mothers' groups run by the Direção de Serviço de Alimentação, Nutrição e de Sobrevivência das Crianças (DSANSC), for which there is an abridged budget (DSANSC 2015). Core costs relate to the staff and materials directly involved in running the Mães Amigas das Crianças. Additional costs cover supplies, human resources, and transport expenses involved in training, coordination, and sensitization.

Breastfeeding counseling and complementary feeding education are two interventions generally delivered together, and so descriptions and cost structures are combined. However, in the LiST tool, which was used for impact modeling, breastfeeding promotion and complementary feeding education are treated as separate interventions. Therefore, in the sections on impact and cost-effectiveness, those interventions are presented separately and also as part of the infant and young child feeding package.

Treatment of Severe Acute Malnutrition without Complications

PEN recommends using the national protocol on integrated management of acute malnutrition (GIDA, Gestão Integrada da Desnutrição Aguda) when discussing interventions for the treatment of moderate and severe acute malnutrition (with and without complications).[7] Currently, inpatient and outpatient treatment of severe acute malnutrition is conducted in 56 centers, known as CRENAGs (Centro de Recuperação e Educação Nuntricional Ambulatória para Desnutrição Grave) across Guinea-Bissau.[8]. These centers are overseen by 11 regional nutrition coordinators (Responsável da Nutrição Regional) and managed by the MoPH with support from UNICEF and its partners for materials, supplies, and training. After being screened and diagnosed by the staff from one of the 146 local Centro de Recuperação e Educação Nuntricional Ambulatória para Desnutrição Moderada (CRENAM) centers, severely malnourished patients are referred to CRENAG centers. These centers each have two nurses and one cook. As prescribed by GIDA protocol, children with severe acute malnutrition are treated as outpatients and receive the adequate doses of ready-to-use therapeutic food (Plumpy'Nut) as well as appropriate medications. The average treatment lasts seven weeks. The dosage of ready-to-use therapeutic food provided to children varies by bodyweight. For this analysis, an average of 15 kilograms of ready-to-use therapeutic food per child is assumed.

Transport costs of the patient to the center are borne by the households or, occasionally, by the nongovernmental organizations. UNICEF provided data on unit costs of materials. Per head doses are indicated on the GIDA protocol. Equipment with low durability (calculators, scales, and metric instruments) was included given its high turnover.

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[7] UNICEF (United Nations Children's Fund), 2013, Budget for Training Formação GIDA (four regions).

[8] UNICEF (United Nations Children's Fund), 2015, List of CRENI and CRENAG centers.

The MoPH indicated that nurses and health technicians at CRENAG centers dedicate about 40 percent of their working time to treating outpatient children with severe acute malnutrition. Itineraries for passing through all CRENAG centers starting from Bissau were used to estimate the transport costs of materials and supplies in terms of fuel and services (borne by UNICEF). According to UNICEF staff, there are three annual rounds for distributing the supplements and medications to the Centro de Recuperação e Educação Nutricional em Regime de Internamento (CRENI) and CRENAG centers. Because the treatment is outpatient and the costs are estimated from the health system perspective, the transport of the children with complicated severe acute malnutrition to the CRENAG is not included in the analysis.

The Treatment of Severe Acute Malnutrition with Complications

Children with severe acute malnutrition with complications, which either developed during outpatient treatment in CRENAG centers or were present when the child was screened in the community, are referred for in-patient treatment in CRENI centers where they are treated for about five days. These patients are to be transported to the closest of 25 CRENI units, unless transport is unavailable, in which case treatment must be conducted at the CRENAG facility. Children with complicated severe acute malnutrition require specifically formulated therapeutic nutritional formula (F-100) and prescription medication for treatment of underlying infections and other complications, as indicated in the GIDA protocol.

Between 40 and 70 percent of staff time at CRENI centers is dedicated to the treatment of severe acute malnutrition with complications. Prices of materials and supplies were provided by UNICEF. The GIDA protocol provides information on the doses of medical inputs and other procedures. The transport of supplies was calculated using the same methods as the calculation of outpatient treatment of severe acute malnutrition, reflecting current practice. Activities pertaining to the educational and psychological recovery of children were also included; a brief indication of the costs of these activities in the CRENI center of the Hospital Simão Mendes was made available by AIDA,[9] a nongovernmental organization.

Salt Iodization

The *PEN* recommends that all salt consumed in Guinea-Bissau be iodized. This implies two distinct operations: ensuring that all imported salt is iodized and iodizing domestic salt originating from producers' associations. To this end, there is also a generic recommendation to "provide a framework for iodization with the salt-producing associations." PEN also advocates quality control of the iodate content in the salt on sale in order to enforce the law. Sensitization of families and school children on the benefits of iodized salt and other supplemented foodstuffs is also recommended.

The iodization of salt has been mandated by law since 2004, with the precise iodine level set in a 2012 law (Locatelli-Rossi 2015). Guinean salt producers are organized in seven regional associations, which are nongovernmental organizations rather than corporations, of varying size (see Table 4). Since 2014, a government body called ANFA (Associação Nacional para Fortificação Alimentar) controls the quality of the salt on sale and provides technical assistance to the country's salt producers. Since 2015, the associations all have adequate equipment for iodization.

The salt consumed in Guinea-Bissau largely comes either from domestic producers or from inland imports from Senegal. The latter are predominant in the eastern regions—namely Bafatá and landlocked Gabú—where little or no salt is produced. Total salt consumption in Guinea-Bissau is roughly estimated at 6,000 tons (Locatelli-Rossi 2015) annually, of which the seven existing local producers' associations provided approximately 60 percent in 2014 (see Table 4). This means 40 percent is divided between imports and the hypothetical output of non-associated producers. Given the lack of import figures, this output cannot be known with any degree of certainty. Fewer than 30 percent of the households sampled in the 2012 Standard Monitoring and Assessment of Relief and Transition (SMART) survey used iodized salt, with the salt-producing regions faring much worse than the importing regions.[10]

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[9] AIDA 2015, some costs of recovery from severe acute malnutrition, personal communication.

[10] SMART budget for 2012.

There is some evidence that the salt imported from Senegal is iodized (Locatelli-Rossi 2015; MICS 2014), so salt iodization efforts are directed toward domestic producers. The ANFA distributes materials required for iodization to these associations. Both consumables and durables are supplied by UNICEF, which also organizes training. Salt iodization takes place in the associations' facilities using nonspecialized workers hired on a daily basis.

Table 4: Producers of Salt

Producer – location	Output (tons)
Aprosal	1,001
Ambrosal	146
Wluty	2,300
Apis	104
Ade - S. Domingos	65
Ade – Cabêdo	18
Teningena	1
Total	3,635

Source: Locatelli-Rossi 2015.

The cost estimates are based on the cost of iodization per ton of iodized salt. Core costs relate to the staff, supplies, and supplements required for the process. Information on salt production was taken from a recent report on salt iodization (Locatelli-Rossi 2015). The costs here do not include the costs of demand creation or promotion of iodized salt.

Information on the costs of the fortification process was obtained from ANFA. Iodization implies the application of 80 grams of potassium-iodate per ton of salt. This requires manual work, consumables, and fixed equipment. With the adequate equipment, a team of 10 workers can fortify 7 tons of salt every hour. Given that the associations are based in different regions and operate independently, it seemed more realistic to calculate the labor costs separately for each association instead of aggregating the salt production (Table 5). With the latter option, iodization would appear slightly more efficient than with the former, more realistic setting.

Table 5: Labor Required for Salt Iodization

Producer (location)	Tons of salt	Fortification hours needed	Four-hour slots needed	Total labor hours
Aprosal	1,001	143	35.75	358
Ambrosal (Buba)	146	21	5.25	53
Wluty (Biombo)	2,300	329	82.25	823
Apis (Canchungo)	104	15	3.75	38
Ade (Ingore)	65	10	2.50	25
Ade (Cabêdo)	18	3	0.75	8
Teningena (Formosa)	1	1	0.25	3
Total	3,635	522	131	1305

The lifetime of the durable goods was estimated by UNICEF. The cost of distributing the drums of potassium-iodate and other durables was calculated assuming three land routes from Bissau and back plus sea transport to Formosa island (see Table 6).

Table 6: Calculation of Cost to Distribute Iodine and Other Durable Goods

Land routes from Bissau (round trip)	Kilometers	Diesel (liters)	Tolls (number)	Toll costs (USD)	Driver days
Cabedu and Buba	650	130	Jugudul (2)	1.67	3
Biombo and Canchungo	200	40	Ponte A. Cabral (2)	7.50	1
Farim and Ingore	500	100	Ponte A. Cabral (2) Jugudul (1)	5.00	1

Source: Authors' calculations.

Therapeutic Zinc

Children with chronic diarrhea are treated in health centers, whereas those with acute diarrhea associated with dehydration are sent to hospitals and treated by doctors. A course of therapeutic zinc is recommended for 10–14 days for children with diarrhea, along with standard treatment including oral rehydration solution.

The total number of diarrhea cases in 2015 was 4,331, with 906 being treated for chronic diarrhea at health centers and the remainder at hospitals. In 2015, 20,000 packs of zinc totaling 200,000 tablets were acquired for treatment of diarrhea.[11] Because this figure is higher than the calculated number of diarrhea cases for 2015, it is likely to include a stock supply of zinc as well as tablets actually used for treatment. The costs involving the transport of supplies are assumed to be shared with the distribution of prenatal appointment tablets for iron and folic acid supplementation.

[11] UNICEF Bissau Supply Plan 2015.

Management of Moderate Acute Malnutrition

The UN's World Food Programme runs a supplementary feeding program to manage moderate acute malnutrition for children and pregnant women. In practice, however, only children were treated in 2015.[12] Given the low prevalence of moderate acute malnutrition among pregnant and lactating women, support for this demographic was expected to officially stop in 2016.

Health technicians from one of the 146 CRENAM centers, with the help of a community health worker, screen and diagnose children for acute malnutrition in health facilities. Those found to have moderate acute malnutrition are referred to the supplementary feeding program for treatment. The health technician must measure and weigh the child and, depending to the results, refer her for appropriate treatment based on GIDA criteria. Children with moderate acute malnutrition are treated with a ready-to-use supplementary food (Plumpy'Doz™ by Nutriset) which provides the necessary nutrients for the child to recover and gain appropriate weight. Regardless of the nutrition assessment (normal or malnourished), the technician must also educate the caregiver on nutrition.

The World Food Programme overseas all logistics of the management of moderate malnutrition, including acquiring, transporting, and distributing Plumpy'Doz™ buckets, as well as administrative costs incurred throughout health districts. Until recently, the feeding program for children lasted an average of 60 days, during which each child with moderate acute malnutrition received a weekly supplement of one bucket of Plumpy'Doz™, which provided 47 grams of the supplement per day. From 2016 on, Plumpy'Doz™ will be replaced by SuperCereal plus (corn soya blend++; consumed at a rate of 200 grams per day).

The World Food Programme provided data on the total cost and the number of beneficiaries, distinguishing only between commodity and associated costs. It was not possible to obtain further disaggregation of the data. The MoPH provided data on the number of CRENAM centers and their staff. Also, according to information obtained from the MoPH services, health technicians at CRENAM centers dedicate about 10% of their working time to screening the population during regular health facility visits, assessing potential cases of malnutrition, and diagnosing these cases. The cost of transporting the patient to the CRENAM center is borne by the households. Table 7 summarizes unit cost—that is, the cost per beneficiary—calculated based on the assumptions outlined above.

[12] WFP (World Food Programme), 2015, cost per beneficiary of health and nutrition actions.

Table 7: Unit Cost (Cost per Beneficiary) of the High-Impact Nutrition Interventions *2015 USD*

Intervention	Unit cost (USD)
Iron and folic acid supplementation during pregnancy	2.14
Vitamin A supplementation for children	0.76
Deworming for children	0.85
Breastfeeding counseling	44.20
Complementary feeding education	31.13
Treatment of severe acute malnutrition without complications	133.00
Treatment of severe acute malnutrition with complications	334.09
Salt iodization	0.05
Therapeutic zinc supplementation for the treatment of diarrhea	5.53
Management of moderate acute malnutrition	18.85

Assumptions about the Scale-Up of Interventions

The costs presented in the Results section (Part III) include both the costs of maintaining the current coverage of the intervention as well as the additional cost of expanding the coverage during the five-year period envisaged in PEN. For the eight interventions with baseline coverage below 90 percent (see Table 8), a linear scale-up from the baseline level in 2016 to 90 percent in 2021 is assumed. For the two interventions where the baseline coverage exceeded 90 percent (vitamin A supplementation and deworming, 97 percent coverage for both) no scale up is assumed but rather maintenance at the current coverage level.

Table 8: Assumed Baseline and End Line Coverage

Intervention	Baseline coverage (%, 2016)	Maximum coverage (%, 2021)[a]
Iron and folic acid supplementation during pregnancy	0	90
Vitamin A supplementation for children	97	n.a.(maintained at 97)
Deworming for children	97	n.a.(maintained at 97)
Breastfeeding counseling	14	90
Complementary feeding education	22	90
Treatment of severe acute malnutrition without complications	0	90
Treatment of severe acute malnutrition with complications	0	90
Salt iodization	8	90
Therapeutic zinc supplementation for the treatment of diarrhea	17	90
Management of moderate acute malnutrition	0	90

Note: A linear scale up is assumed from the baseline level in 2016 to full coverage in 2021. n.a. = not applicable.

For four interventions—treatment of severe acute malnutrition without complications, treatment of severe acute malnutrition with complications, iron and folic acid supplementation, and management of moderate acute malnutrition—no coverage data were available, even though these interventions are currently implemented in Guinea-Bissau. For the purposes of these analyses, zero coverage for those interventions is assumed.

The increased program coverage in terms of the number of beneficiaries was calculated by subtracting the current coverage rate from full coverage and multiplying this difference by the size of the target population for each intervention. Target population estimates are based on demographic data obtained from a combination of MICS and UNICEF data. The prevalence of child stunting (height-for-age Z-score < -2), underweight (weight-for-age Z-score < -2), and wasting (weight-for-height Z-score < -2) among children under five years of age in each region were obtained from the Multiple Indicator Cluster Survey (MICS) 2014. Projected population growth rates were obtained from UNDP World Population Prospects.

Estimating Benefits and Cost-Effectiveness

The projected number of lives saved and cases of childhood stunting averted were calculated using the Lives Saved Tool (LiST), which translates changes in the coverage of the interventions into estimates of mortality reduction and changes in the prevalence of under-five stunting. LiST allows for modeling the impact of the scale-up interventions only—that is, the tool projects incremental changes in mortality, morbidity, and nutrition status of children under five as the coverage in the interventions increases. One limitation of LiST is that it does not permit an estimate of the annual impact and benefit resulting from maintaining the current coverage of the interventions. Therefore, this section focuses on the cost, impact, and benefits of expanding the current coverage.

Because the coverage of vitamin A supplementation and deworming exceeded 90 percent and no scale-up was projected, the impact of those two interventions could not be modeled. Furthermore, LiST does not include the impact of salt iodization (because it affects cognitive development rather than morbidity or mortality) or iron and folic acid supplementation in pregnancy (because it affects maternal morbidity, but not child morbidity or mortality). Therefore, cost-effectiveness and prioritization analyses only included breastfeeding promotion, complementary feeding education, therapeutic zinc for the treatment of diarrhea, the treatment of severe acute malnutrition (both complicated and uncomplicated), and the management of moderate acute malnutrition.

Estimates of reductions in morbidity and mortality were used to calculate disability-adjusted life years (DALYs) averted. DALYs are a measure that combine mortality and morbidity, and therefore allow comparisons of the impact of interventions affecting different conditions (for example, stunting and wasting). The methodology used to calculate DALYs is described in Appendix B. Cost per DALY averted was used to assess the cost-effectiveness of the package of the interventions and to compare the cost-effectiveness of different interventions. The cost per case of stunting averted was also calculated to assess which of the interventions are the most cost-effective for preventing stunting and averting death, thus determining which are most effective in reducing child mortality. The method uses population attributable fractions (PAF) based on the comparative risk assessment project (Ezzati et al. 2002; Ezzati et al. 2004) to estimate the burden of infectious disease attributable to different forms of undernutrition using most recent *Global Burden of Disease Study* (IHME 2010). DALY estimates in this study are neither discounted nor age-weighted, in line with the methodology used in the *Global Burden of Disease Study* and the WHO *Global Health Estimates* (2012).

Estimates of benefits were combined with information on costs to produce the cost-effectiveness measures for each intervention as well as for the overall package of interventions. The measures for the cost-effectiveness of the interventions were calculated in terms of cost per DALY averted, cost per life saved, and cost per case of stunting averted. The evaluation of the cost-effectiveness ratio in terms of DALYs averted is based on the categorization used by WHO-CHOICE (Choosing Interventions that are Cost-

Effective):[13] an intervention is considered to be "very cost-effective" if the range for the cost per DALY averted is less than the GDP per capita;[14] it is considered to be "cost-effective" if it is between one and three times the GDP per capita; and it is considered "not cost-effective" if it exceeds three times the GDP per capita (WHO 2014a).

COST-BENEFIT ANALYSIS

The cost-benefit analysis is based on the estimated economic value of the benefits attributable to nutrition-specific interventions. In order to arrive at a dollar value for the impact on mortality and morbidity of a five-year scale-up plan, estimates of the number of lives saved and the reduction in stunting prevalence produced by the LiST were used. Following established practice, a life year saved is valued as equivalent to gross national product (GDP) per capita (current USD, 2015); this is considered to be a conservative measure because it accounts for only the economic and not the social value of a year of life. In order to estimate the economic benefits generated from the reductions in stunting prevalence, the methodology used in Hoddinott et al. (2013), which valuates a year of life lived without stunting as a 21 percent increase in wage earnings. Benefits are discounted at three discount rates: 0, 3, and 5 percent. The net present value and internal rate of return of the investment are also estimated. A detailed explanation of the benefit estimation methodology can be found in Appendix C.

[13] Information on the cost-effectiveness thresholds used by WHO-CHOICE can be found at http://www.who.int/choice/costs/CER_levels/en/

[14] Guinea-Bissau's GDP per capita in current U.S. dollars was USD 563.75 in 2013 (Alderman et al. 2013).

PART III – RESULTS

UNIT COSTS

Table 9 presents unit costs of each intervention as well as cost composition—that is, the percentage of the unit cost by a specific cost category or component. Program costs constitute the most significant cost driver for vitamin A supplementation, deworming, breastfeeding counseling, and complementary feeding education. For the infant and young child feeding package, direct service delivery costs account for only about 20 percent of the total intervention costs. Those costs include the labor of the health care providers and incentives for mothers (19 percent of the total costs), communication materials for mothers (0.4 percent of the total costs), and materials for cooking demonstrations (foodstuffs and cooking fuel, 0.4 percent of the total costs). The remaining 80 percent of the total costs cover promotional activities—including community theater (42 percent of the total costs); spots on local radio (9 percent); and promotional items such as hats, t-shirts, stickers (26 percent). In contrast, only about 10 percent of the program cost for vitamin A supplementation and deworming was for demand creation activities and the remaining 90 percent was for supervision and monitoring and evaluation. For the remaining interventions, it was not possible to capture what proportion of the total cost was attributed to program costs.

Drugs and supplies account for the highest percentage of unit cost for iron and folic acid supplementation, treatment of severe acute malnutrition with complications, salt iodization, and therapeutic zinc supplementation for the treatment of diarrhea. Human resources account for the highest percentage cost for the treatment of uncomplicated severe acute malnutrition and management of moderate acute malnutrition.

Table 9: Unit Costs and Cost Components per Intervention
2015 USD

Intervention	Unit cost (USD)	Drugs and supplies (%)	Human resources (%)	Transport (%)	Program (%)
Iron and folic acid supplementation during pregnancy	2.14	77	22	2	n.a.
Vitamin A supplementation for children	0.76	8	26	20	46
Deworming for children	0.85	3	28	21	48
Breastfeeding counseling	44.20	n.a.	13	1	86
Complementary feeding education	31.13	n.a.	19	1	79
Infant and young child feeding package combined	75.33	n.a.	18	1	81
Treatment of severe acute malnutrition without complications	133.00	23	74	3	n.a.
Treatment of severe acute malnutrition with complications	334.09	51	46	3	n.a.
Salt iodization	0.05	95	3	2	n.a.
Therapeutic zinc supplementation for the treatment of diarrhea	5.53	58	5	37	n.a.
Management of moderate acute malnutrition	18.85	28	45	27	n.a.

Note: The percentages do not necessarily sum to 100 percent because of rounding. n.a. = not applicable.

Total Costs of Implementing High-Impact Interventions and the Incremental Costs of Coverage Expansion

The total costs of implementing the 10 nutrition-specific interventions over five years in Guinea-Bissau are estimated to be about USD 17 million (see Table 10). About USD 3.1 million would be needed to maintain the interventions at the current level, and an additional USD 13.9 million would be needed to scale-up the interventions (Figure 7). The small difference between the total cost (USD 17 million) and the scale-up cost (USD 13.9 million) is because most of the interventions have low baseline coverage and will need significant scale-up (the baseline coverage rates are shown in Table 7). In addition to the expansion of intervention coverage, projected population growth also contributes to costs increasing over time. Therefore, even for the two interventions where the baseline coverage exceeds 90% (vitamin A supplementation and deworming) and no coverage expansion is modeled, costs increase as a result of population growth.

Table 10: Total Five-Year Costs of Implementing 10 Nutrition-Specific Interventions in Guinea-Bissau

USD

	Annual cost						
Intervention	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total cost**
Iron and folic acid supplementation during pregnancy	7,132	19,216	37,668	62,929	95,462	135,750	358,157
Vitamin A supplementation for children	172,156	176,322	180,589	184,959	189,435	194,019	1,097,479
Deworming for children	193,394	198,074	202,867	207,777	212,805	217,955	1,232,871
Breastfeeding counseling	58,534	265,477	632,169	1,169,846	1,890,280	2,805,804	6,822,108
Complementary feeding education	39,281	105,834	207,459	346,588	525,765	747,656	1,972,582
Treatment of severe acute malnutrition without complications	0	391	1,603	3,695	6,727	10,766	23,182
Treatment of severe acute malnutrition with complications	0	6,124	25,087	57,811	105,263	168,454	362,739
Salt iodization	1,808	5,926	14,403	27,547	45,683	69,149	164,515
Therapeutic zinc supplementation for the treatment of diarrhea	51,910	190,096	421,381	752,280	1,189,622	1,740,559	4,345,847
Management of moderate acute malnutrition	0	10,909	44,692	102,990	187,523	300,096	646,210
Total	524,213	978,368	1,767,917	2,916,420	4,448,564	6,390,208	17,025,690

Figure 7: Annual Cost of Maintaining Current Intervention Coverage and Expanding the Coverage to 90%
2015 USD, millions

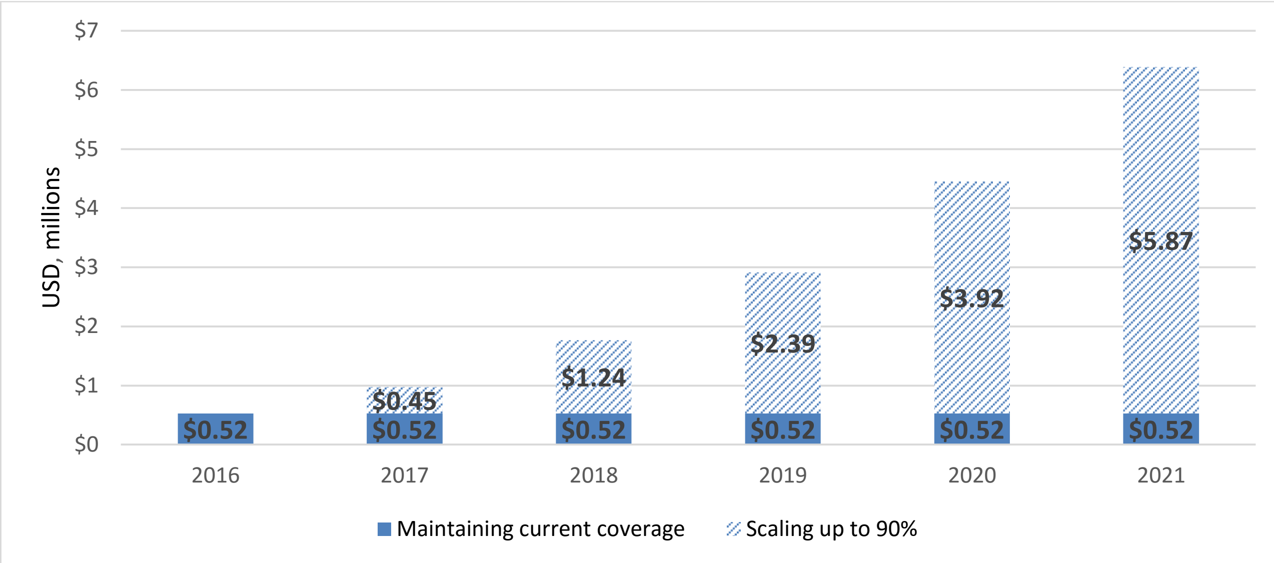


Table 11: Incremental (Additional) Cost of Expanding the Coverage of 10 Nutrition-Specific Interventions

2015 USD

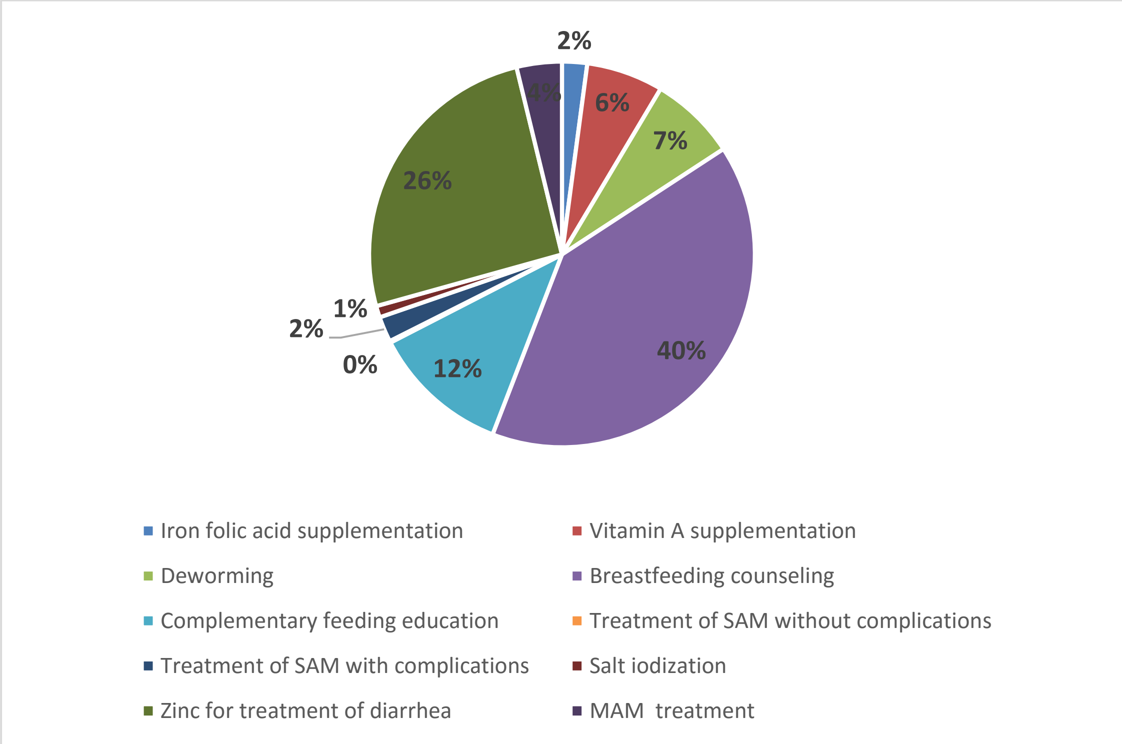
	Annual cost						
Intervention	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total cost**
Iron and folic acid supplementation during pregnancy	n.a	12,084	30,536	55,797	88,330	128,618	315,364
Vitamin A supplementation for children	n.a	4,166	8,433	12,803	17,279	21,864	64,546
Deworming for children	n.a	4,680	9,474	14,383	19,411	24,561	72,509
Breastfeeding counseling	n.a	206,943	573,635	1,111,312	1,831,746	2,747,270	6,470,905
Complementary feeding education	n.a	66,553	168,178	307,307	486,484	708,375	1,736,897
Treatment of severe acute malnutrition without complications	n.a	391	1,603	3,695	6,727	10,766	23,182
Treatment of severe acute malnutrition with complications	n.a	6,124	25,087	57,811	105,263	168,454	362,739
Salt iodization	n.a	4,118	12,595	25,739	43,875	67,342	153,670
Therapeutic zinc supplementation for the treatment of diarrhea	n.a	138,187	369,471	700,370	1,137,712	1,688,649	4,034,390
Management of moderate acute malnutrition	n.a	10,909	44,692	102,990	187,523	300,096	646,210
Total	n.a	454,155	1,243,704	2,392,207	3,924,351	5,865,994	13,880,411

Note: n.a. = not applicable.

Breastfeeding promotion accounts for the largest portion of the total five-year cost (about 40 percent; see Figure 8). This is the result of a large target group (all pregnant and lactating women) and of the high cost per person (USD 44.20). Excluding the cost of demand creation and promotion activities, the unit cost drops to USD 5.80 per person and the total cost declines from USD 6.8 million to less than USD 900,000 over five years.

Providing therapeutic zinc supplementation for the treatment of diarrhea accounts for the second-largest portion of the total cost (26 percent). Even though its unit cost is relatively low (USD 5.05 per child per treatment), a large population is projected to be in need of this intervention. Based on diarrhea prevalence reported in MICS (11 percent) and extrapolating this prevalence over 12 months, over 300,000 children would need to be treated every year.

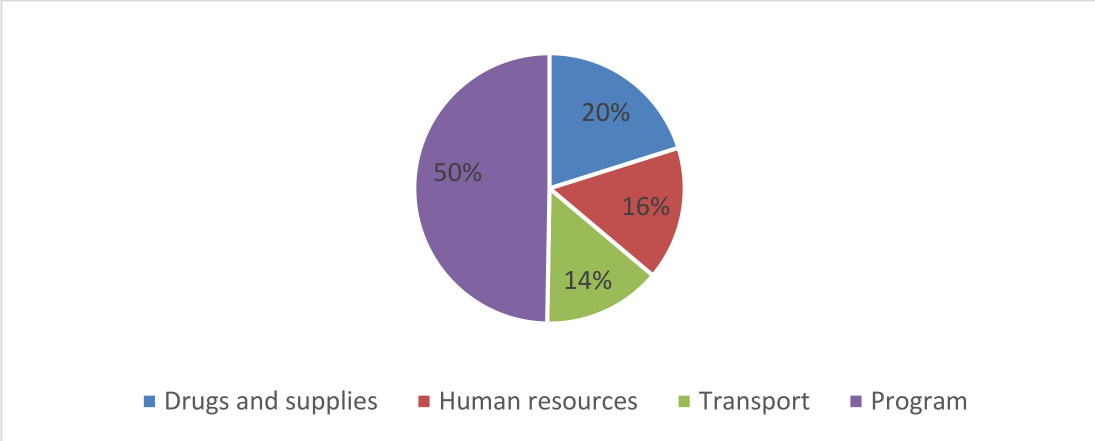
Figure 8: Total Five-Year Costs by Intervention



Note: MAM = moderate acute malnutrition; SAM = severe acute malnutrition.

Program costs account for 50 percent of the total five-year costs of implementing nutrition interventions in Guinea-Bissau. Because it was not possible to capture program costs for multiple interventions, it is likely that the proportion of program costs is in fact higher. Drugs and supplies account for about 20 percent of the total cost, human resources for 16 percent, and transport for the remaining 14 percent (see Figure 9). The distribution of the costs across categories is virtually the same for the scale-up costs.

Figure 9: Total Five-Year Costs by Cost Component



Estimation of Costs by Region

Bissau accounts for about a quarter of the total costs, Gabu for about 15 percent, Bafatá for 14 percent, Cacheu for 13 percent, Oio for 11 percent, and the other six regions for the remaining 33 percent of the costs (see Figure 10). The distribution of costs across regions directly reflects the distribution of the population: the costs are higher in more populated regions and lower in less population regions (see Table 12).

Figure 10: Total Five-Year Costs by Region

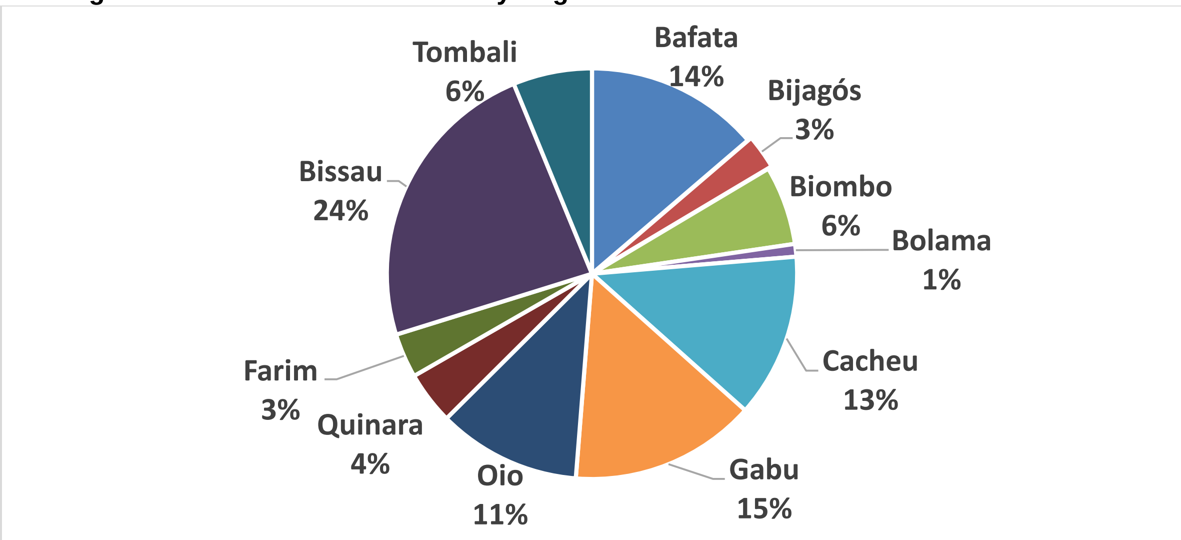


Table 12: Distribution of the Population Under Five Years of Age, Total Cost, and Additional Scale-Up Costs across Regions

Region	Population under five (%)	Total cost (%)	Additional scale-up costs (%)
Bafatá	14	14	14
Bijagós	2	3	2
Biombo	6	6	6
Bolama	1	1	1
Cacheu	13	13	13
Gabu	14	15	14
Oio	12	11	12
Quinara	4	4	4
Farim	3	3	3
Bissau	25	24	25
Tombali	6	6	6
National	100	100	100

PRIORITIZATION AND COST-EFFECTIVENESS ANALYSIS

In order to examine the potential impact of the scale-up of each intervention, as well as its cost-effectiveness, opportunities for prioritization, and monetary benefits, the cost estimates presented above were combined with estimates of the impact of the interventions generated using LiST.

Prioritization was based on two key indicators: the cost per disability-adjusted life year (DALY) and the cost per case of stunting averted. DALYs averted is a key measure used in health economics to evaluate and compare the cost-effectiveness of health programs and interventions. DALY is a measure that combines mortality and morbidity in a single metric. Simply put, it captures the number of years of a person's life saved by a given intervention, and adjusts it by the health status that person is expected to have during those years. For example, if an intervention saves a person life and that person is expected to live in perfect health for next 30 years, the intervention would avert 30 DALYs. However, if that person would be expected to live some portion of those years in less than perfect health—that is, with an illness or disability—the number of DALYs averted would be reduced (see Salomon et al. 2013). It should be noted that, because of the nature of the measure, interventions that impact mortality generate the greatest impact in terms of DALYs (avert the greatest number of DALYs). For more information regarding how DALYs were estimated see Appendix B.

In addition to DALYs, the cost per case of stunting averted was calculated. This is because preventing stunting has benefits that go beyond health (mortality and morbidity). More specifically, chronic malnutrition affects a child's cognitive development, and, as mentioned in the introduction of this report, has impact on his or her learning, educational attainment, economic productivity, and wages. Those impacts are not captured by DALYs, which is strictly a health measure.

The analysis using the LiST model shows that scaling up all the interventions with a baseline coverage below 90% to 90% across the entire country would allow to prevent over 2,400 child deaths and over 4,300 cases of stunting in children under five years of age over the course of five years and avert over 39,000 DALYs (see Table 13). Using the package of interventions, preventing one death would cost about USD 5,800; preventing one case of stunting, about USD 3,200; and averting one DALY, USD 356. The treatment of severe acute malnutrition is, overall, the most cost-effective intervention in the package in terms of DALYs. Averting one DALY through treatment of severe acute malnutrition costs only about USD 30. Complementary feeding education is the most cost-effective intervention from the point of view of stunting prevention. Preventing one case of stunting through complementary feeding education would cost about USD 500. Finally, treatment of severe acute malnutrition is the most cost-effective intervention from the point of view of mortality reduction, with the cost per death prevented of less than USD 450.

Table 13: Cost, Health Outcomes, and Cost per Outcome per Intervention over the Five-Year Scale-Up

Intervention	Scale-up cost (USD)	Deaths averted	Cases of stunting averted	DALYs averted	Cost per death averted (USD)	Cost per case of stunting averted (USD)	Cost per DALY averted (USD)
Iron and folic acid supplementation	315,364	n.a.[a]	n.a.[a]	n.a.[a]	n.a.[a]	n.a.[a]	n.a.[a]
Vitamin A supplementation	64,546	n.a. [c]	n.a. [c]	n.a. [c]	n.a. [c]	n.a. [c]	n.a. [c]
Deworming	72,509	n.a. [c]	n.a. [c]	n.a. [c]	n.a. [c]	n.a. [c]	n.a[c]
Breastfeeding counseling	6,470,905	929	1,577	14,999	6,965	4,104.17	431
Complementary feeding education	1,736,897	96	3,375	1,536	18,093	514.62	1,131
Infant and young child feeding package (breastfeeding counseling and complementary feeding education combined)	8,207,802	1,025	4,952	16,536	8,008	1,657.54	496
Treatment of severe acute malnutrition	385,921	861	n.a.[b]	13,976	448	n.a.[b]	28
Salt iodization	153,670	n.a. [d]	n.a. [d]	n.a. [d]	n.a. [d]	n.a. [d]	n.a. [d]
Therapeutic zinc for treatment of diarrhea	4,034,390	293	n.a.[b]	4,839	13,769	n.a.[b]	834
Management of moderate acute malnutrition	646,210	228	n.a.[b]	3,681	2,834	n.a.[b]	176
Total	13,880,411	2,407	4,335	39,031	5,767	3,202	356

Note: n.a. = not applicable
a Iron and folic acid supplementation do not affect child or maternal mortality and morbidity, with the exception of maternal anemia; the impact on maternal anemia cannot currently be modeled using LiST, and therefore it is not included in the analyses.
b Based on available evidence, this intervention does not impact the risk of stunting.
c Current coverage of this intervention exceeds 90%; no scale-up was modeled.
d Salt iodization does not impact mortality and morbidity; its impact of cognitive development was included in the calculation of economic benefits.

Regional Prioritization

As discussed in the Methodology section (Part II), it was not possible to model the impact of interventions separately for each region. Therefore, for the regional analysis, it is assumed that the portion of lives saved and cases of stunting averted will be proportional in each region to the percentage of the target population living in each region. For example, about 33.5 percent of all cases of severe acute malnutrition were reported in Bissau (MICS 2014). Therefore, it is assumed that the same proportion (33.5 percent) of deaths averted thanks to the treatment of severe acute malnutrition would occur in that region. The same approach to apportioning health outcomes to regions was used for stunting and DALYs.

The greatest number of deaths, cases of stunting, and DALYs would be averted in Bissau, because the largest percentage of the population lives in that region; the smallest number would be averted in Bolama and Bijagós (see Table 14). Therefore, the total cost of the scale-up would be the lowest in Bolama and Bijagós and the highest in Bissau. The analysis shows that the cost per DALY averted would be lowest in

Bissau (about USD 322) and highest in Biombo and Bijagós (USD 526 and USD 523, respectively). The cost per case of stunting averted would be lowest in Oio and Bafatá. This is probably because the prevalence of stunting, and therefore the risk of stunting, is highest in those two regions (35 percent and 34 percent, respectively) (MICS 2014). Therefore the impact of interventions lowering the likelihood of stunting in terms of the absolute number of cases of stunting prevented would also be the highest in those regions.

This suggests that focusing on scaling-up interventions that prevent stunting—especially the promotion of exclusive breastfeeding and appropriate complementary feeding practices in Oio and Bafatá—may be the most cost-effective strategy for short-term reductions in the number of stunted children in Guinea-Bissau.

The cost of one death averted would be lowest in Bissau and Farim (below USD 5,300) and Bafatá and Gabu (below USD 5,500). This suggest that the rapid scaling up of the life-saving interventions, in particular severe acute malnutrition treatment (the most cost-effective live-saving intervention) in those regions may be the most cost-effective short-term strategy to reduce malnutrition-related mortality.

Table 14: Cost, Health Outcomes, and Cost per Outcome per Region over the Five-Year Scale-Up

Region	Scale-up cost (USD)	Deaths averted	Cases of stunting averted	DALYs averted	Cost per death averted (USD)	Cost per case of stunting averted (USD)	Cost per DALY averted
Bafatá	1,950,114	357	765	5,794	5,458	2,548	337
Bijagós	222,931	26	35	426	8,471	6,387	523
Biombo	858,020	101	227	1,631	8,530	3,785	526
Bolama	99,876	12	16	196	8,262	6,229	510
Cacheu	1,754,022	275	574	4,464	6,372	3,058	393
Gabu	2,008,218	367	694	5,948	5,475	2,893	338
Oio	1,604,608	281	660	4,562	5,704	2,431	352
Quinara	571,950	88	172	1,424	6,515	3,321	402
Farim	463,787	88	108	1,428	5,267	4,287	325
Bissau	3,479,315	666	818	10,803	5,223	4,252	322
Tombali	867,570	145	265	2,357	5,969	3,270	368
Total	13,880,411	2,407	4,335	39,031	5,767	3,202	356

BENEFIT-COST ANALYSIS

In the base-case scenario of a 3 percent discount rate, which is the standard in health economics, the scale-up of the interventions from the current level to 90 percent would result in total benefits from increases in economic productivity of about USD 120 million over the productive lives of the children who benefited from the interventions. Under this scenario, the benefit-cost ratio would be 9.8, which means that every dollar invested in nutrition would bring about 10 dollars in economic benefits. It should be noted that the bulk of the benefits—over 95 percent—result from improvements in cognitive development thanks to the prevention of chronic malnutrition and iodine deficiency and subsequent improvements in economic productivity. Only 4.5 percent of economic benefits results from child mortality averted.

Table 15: Cost, Benefits, and Benefit-Cost Ratios under Different Discount Rates

	Discount rate		
	0%	3%	5%
Total cost (USD, millions)	13.8	12.3	11.4
Net benefits (USD, millions)	380.1	120.6	57.8
Benefit-cost ratio	27.4	9.8	5.0

As part of a sensitivity analysis, the discount rate was varied from 0 percent to 5 percent, according to the WHO CHOICE methodology (see Table 15). Even assuming the highest discount rate of 5 percent, the benefit-cost ratio of 5.0 remains comfortably above 1, indicating that the benefits of investing in nutrition significantly outweigh the costs.

For this analysis, it was assumed, pessimistically, that Guinea-Bissau would grow only about 2 percent over the productive lives of the intervention beneficiaries. Changing this assumption to a 3 percent growth rate per year but keeping the standard 3 percent discount rate increases the expected net benefits to USD 175.8 million and the benefit cost-ratio to 14.2.

PART IV – CONCLUSIONS AND POLICY IMPLICATIONS

The two key conclusions of this report are, first, that investing in nutrition in Guinea-Bissau is cost-effective based on international standards and, second, that investments in nutrition can generate very substantial health and economic benefits, with one dollar spent on nutrition interventions resulting in about 10 dollars of returns over the productive lives of children covered by high impact nutrition interventions.

The analysis shows that the total costs over five years of implementing 10 high-impact nutrition-specific interventions in Guinea-Bissau are estimated to be about USD 17 million (see Table 9). About USD 3 million is needed to continue current coverage of the interventions and a further USD 14 million is required to finance the scale up of interventions. Very large benefits from the investment in this scale-up are estimated: over 2,400 child deaths and 4,300 cases of stunting could be averted. Investing in life-saving measures would give each child in Guinea-Bissau more years of good health and productivity and thus contribute to the country's growth and prosperity. Indeed, these estimates suggest increases in economic productivity of about USD 120 million over the productive lives of the children who benefited from the interventions.

Two interventions—breastfeeding promotion and complementary feeding education—comprise more than half of the total cost for scaling up, mainly as a result of larger increases needed in program coverage rates and very high unit costs. The unit cost of each of the two interventions is almost USD 40 per child, as compared to between USD 5 and USD 7 in other African countries in which the World Bank has conducted similar analyses (the Democratic Republic of Congo, Kenya, Nigeria, Mali, and Togo). The high unit costs in Guinea-Bissau are mainly driven by expenditure on advocacy and outreach efforts (for example, radio spots, community theaters, promotional materials including t-shirts and hats), rather than the costs of the counseling. No data are available to determine whether or to what extent those activities have led to increased uptake of breastfeeding and complementary feeding counseling and education in Guinea-Bissau. However, the unit costs, which are substantially higher than in other countries in West Africa, suggest a need to focus on increasing technical efficiency (reducing cost per outcome) in delivering breastfeeding promotion and complementary feeding education programs, and thereby lowering unit costs and cost per outcome of these two important interventions. Agencies implementing those interventions should consider whether such high expenditures on promotional activities are necessary to ensure sufficient demand for counseling.

Deworming and vitamin A supplementation have very high coverage rates and do not need to be scaled up further. Small additional costs are needed only to match increases in population. Nevertheless, it is imperative to continue financing them because both are high-impact, cost-effective interventions (Bhutta et al. 2013). This is particularly important given the high risk of helminthic diseases and their impact. In the short term, helminthic infections potentially cause anemia and increase morbidity, undernutrition, and the impairment of mental and physical development (Hotez et al. 2008). In the long term, infected children are estimated to have an average IQ loss of 3.75 points per child and they earn less as adults (43 percent) than those who grew up free of worm infections (Bleakley 2007).

The analysis shows that the treatments of severe and moderate acute malnutrition are the most cost-effective interventions in terms of DALYs, even though they have relatively high unit costs. Their cost-effectiveness is likely the result of a high incidence of severe and moderate acute malnutrition in Guinea-Bissau combined with baseline low current intervention coverage rates. An exacerbating factor is the high incidence of infectious diseases, including diarrhea, which increases the risk of mortality from severe acute malnutrition.

It needs to be noted that, as a mortality-morbidity measure, DALYs give highest weight to interventions that help prevent death and acute illness. They do not capture non-health benefits, such as more optimal cognitive development, or the resulting improvements in educational attainment or higher wages in adulthood. This is why interventions that are effective at preventing stunting (for example, complementary feeding education/infant and young child nutrition packages) but not mortality are less cost-effective when DALYs are used as a basis for determining cost-effectiveness.

This also points to an important policy tradeoff. The analysis shows that different packages of interventions and different geographic prioritization may be needed to tackle stunting than are needed to tackle mortality and acute conditions resulting from malnutrition. If preventing premature death and morbidity is the priority, it would be important to begin the coverage expansion with Bissau, which has the lowest cost per DALY and deaths averted and is the most populous region. Key life-saving interventions to start with include scaling up the treatment of severe acute malnutrition and breastfeeding promotion. If, on the other hand, preventing stunting is prioritized, it would be important to focus on scaling up infant and young child feeding in Bafatá and Oio, where the costs per case of stunting prevented are the lowest. Summing up: if facing budget constraints, in addition to the ambitious goals laid out in PEN, the national programs may need to decide on short-term priorities.

Compared with estimates from other African countries (Shekar, Dayton Eberwein, and Kakietek 2016), an annual investment of under USD 14 million per year in Guinea-Bissau is very affordable (Table 16). The cost per DALY and cost per death averted in Guinea-Bissau are relatively high compared with other countries in Africa where similar analyses have been conducted. This is likely because the costs of breastfeeding promotion—the key lifesaving intervention—are, as mentioned above, much higher in Guinea-Bissau than in the other countries. Nevertheless, despite the relatively high cost per DALY averted, scaling up the nutrition interventions package in Guinea-Bissau is very cost-effective by WHO standards (WHO 2014).

Table 16: Costs and Benefits of Scaling Up a Package of 10 Nutrition-Specific Interventions in the Democratic Republic of Congo, Guinea-Bissau, Mali, Nigeria, and Togo
USD

Country (year)	Annual public investment required (USD, millions)	Annual estimated benefits		Cost-effectiveness estimates	
		DALYs averted (millions)	Lives saved	Cost per DALY averted	Cost per life saved
Congo, Dem. Rep. (2015)	371	2.6	77,000	143	4,929
Guinea-Bissau (2016)[a]	*14*	*0.04*	*2,407*	*356*	*5,767*
Mali (2015)	64	0.5	14,000	178	6,276
Nigeria (2014)	837	6.3	180,000	141	4,865
Togo (2015)	13	0.1	3,000	127	4,635

Source: Results from the Democratic Republic of Congo, Mali, Nigeria, and Togo are from Shekar, Dayton Eberwein, and Kakietek 2016.
Note: a Includes costs and benefits of the scale-up of interventions and excludes costs and benefits of continuing current coverage of two interventions that do not scale up.

It is estimated that the scale-up of key interventions would contribute substantially to reducing stunting among children in Guinea-Bissau, thereby improving their health and later productivity. Guinea-Bissau's rising health expenditures that result from its disease burden must be slowed, especially as most families are currently paying for health care out of pocket. Not only can preventing stunting and treating wasting significantly reduce health spending, with fewer children needing to be treated for illnesses, but, perhaps more importantly, it provides a foundation of human capital that yields a lifetime of benefits and contributes toward a more productive society.

The analysis shows that investment in nutrition interventions would result in substantial economic benefits and that most of those benefits stem from increased economic productivity and wages of children who reach their full cognitive potential. The estimates of the impact of stunting prevention on cognitive ability, productivity, and wages is based on a randomized controlled trial (the Oriente study) in a low-income setting (Guatemala) and it is possible that, at the population level, the impact of stunting prevention may be smaller than that reported by Hoddinott et al. (2013). However, it needs to be noted that the data from the Oriente study are surprisingly consistent with cross-sectional cross-country estimates of the relationship between adult height and adult wages, which includes low-, middle-, and high-income countries (see, for example, Horton and Steckle 2013). Furthermore, it is clear that wage benefits will be subject to constraints related to the supply of jobs (those demanding greater cognitive ability and jobs in general). However, it is likely that, as the stock of human capital in Guinea-Bissau increases thanks to better nutrition and more optimal early childhood development, employment opportunities will expand as well.

Salt iodization does not directly impact mortality or morbidity (with the exception of goiter) or risk to stunting and it is not included in the LiST model. That is why it was not possible to estimate the impact of this intervention on deaths or cases of stunting prevented or DALYs averted. However, salt iodization was included in the estimate of economic benefits because of its impact on cognitive development. As noted above, improvements in cognitive development as a result of stunting prevention and increases in the coverage of iodized salt account for some 95% of total economic benefits. This finding highlights the importance of scaling up this intervention in Guinea-Bissau.

Because of the limitation of the LiST tool, it is not possible estimate the impact of maintaining the current coverage of vitamin A supplementation for children and iron and folic acid supplementation in pregnancy in a way that would be comparable with the other interventions (see the discussion in the Methodology section in Part II). However, data from other countries, as well as global analyses (for example, Kakietek et al. 2016), suggest that vitamin A in particular is very cost-effective both in terms of stunting prevention and DALY reductions.

The cost estimates presented here are based on information collected from the key actors currently delivering interventions in Guinea-Bissau. Therefore the estimates presented in this report can serve as a reasonable approximation of what the scale-up of the interventions may cost and a reasonable basis for cost-effectiveness analysis. It is possible that alternative delivery platforms would have different costs, impact, and cost-effectiveness. Cost-effectiveness assessment of different delivery platforms for specific interventions is outside the scope of this report. However, if data are available, such analysis would be an important next step for determining the priority of nutrition investments.

The interventions included in this report include only a small portion of all actions considered for the inclusion under PEN. The current draft of PEN is multisectoral in character and includes nutrition-sensitive interventions in agriculture, social protection, food security, education, and other sectors, as well as actions aimed at strengthening nutrition governance, coordination capacity, and M&E systems in Guinea-Bissau. Currently the available evidence regarding the impact of nutrition-sensitive interventions is insufficient to allow for modeling their impact and, consequently, for comparative cost-effectiveness analysis (see Ruel et al. 2013). Similarly, based on currently available data, it is impossible to estimate the impact of the strengthening of governance on specific health and nutrition outcomes, which is why this report focuses on only nutrition-specific interventions. Exploring nutrition-sensitive interventions, which are integrated with other programs, will be important as a next step for the Government of Guinea-Bissau to identify even more cost-effective and practical approaches to reducing malnutrition.

APPENDIXES

Appendix A: Stunting, Underweight, and Wasting Prevalence by Region

Region	Stunting prevalence (HAZ <−2)	Underweight prevalence (WAZ <−2)	Wasting prevalence (WHZ <−2)
Bolama/Bijagós	14	6.2	10.4
Bissau	20	5.5	12.7
Biombo	21	3.5	11.9
Quinara	25	4.6	15.7
Tombali	26	5.6	16
Cacheu	27	5.1	16.1
Gabu	30	7.6	19.4
Bafatá	34	7.2	23.9
Oio	35	6.4	20
Total	27	6	17

Note: HAZ = height-for-age Z-score; WAZ = weight-for-age Z-score; WHA = weight-for-height Z-score.

APPENDIX B: METHODOLOGY FOR ESTIMATING DALYS AVERTED, LIVES SAVED, AND CASES OF STUNTING AVERTED

Estimating DALYs averted

To estimate the disability-adjusted life years (DALYs) averted from each intervention, the lives saved, and stunting cases averted are first modeled using LiST.[15] LiST is a part of an integrated set of tools that comprise the Spectrum policy modeling system. Once the demographic and health data have been updated, the coverage and scale-up plan for each intervention is introduced into LiST. Table B1 presents data sources.

Table B1: Guinea-Bissau LiST Estimates: Data Sources

Variable	Source
Demographic data	
First year population	UN DESA 2015
Sex ratio at birth	UN DESA 2015
Life expectancy	UN DESA 2015
Family planning	
Unmet need	LiST default, based on averages calculated for countries with similar levels of fertility
Total fertility rate	UN DESA 2015
Age-specific fertility rate	UN DESA 2015
Health, mortality, economic status	
Vitamin A deficiency	Black et al. 2013
Zinc deficiency	Wessells and Brown 2012
Diarrhea incidence	Fischer Walker 2012: 2010 data from this paper; 2005 data from unpublished addendum
Severe pneumonia incidence	Rudan et al. 2013
Malaria exposure (women)	Guerra et al. 2008
Stunting distribution	MICS 2006; data are drawn from DHS, MICS, and other nationally representative household surveys
Wasting distribution	None specified; default is to recalculate data for consistency across countries, using DHS and MICS datasets
Neonatal mortality	UN IGME No date; estimates for years 1996–2015; dataset last updated September 2015
Infant mortality	UN IGME No date; estimates for years 1996–2015; dataset last updated September 2015
Child mortality	UN IGME No date; estimates for years 1996-2015; dataset last updated September 2015
Distribution of causes of death	WHO estimates (2000–2015); publication forthcoming
Maternal mortality ratio	WHO estimates (2000–2015); publication forthcoming
Household poverty status	World Bank national poverty estimates (population living below USD 1.25 per day)
Household size	Data are drawn from DHS, MICS, and other nationally representative household surveys

Note: DHS = Demographic and Health Survey; IGME = Inter-agency Group for Child Mortality Estimation; MICS = Multiple Indicator Cluster Survey.

[15] See http://livessavedtool.org/ for more information on LiST.

LiST can estimate the impact of each intervention in isolation from other implemented interventions or calculate the simultaneous impact of a set of interventions implemented at the same time. The second, simultaneous method is likely to yield slightly lower estimates because interventions may have overlapping benefits. This analysis presents the individual or isolated results of the 10 interventions for full coverage (with totals calculated using the simultaneous method).

For each intervention, deaths averted are disaggregated by cause of death. To estimate the impact of interventions in terms of DALYs, the years of life lost (YLL) and years lost to disability (YLD) are estimated separately:

$$(\textit{YLL averted})_{CoD} = (\textit{Deaths averted})_{CoD} * (\textit{Life expectancy at average age of death})_{CoD}$$

$$(\textit{Total YLL averted})_{intervention} = \sum(\textit{YLL averted})_{CoD}$$

$$(\textit{YLD averted})_{CoD} = (\textit{YLL averted})_{CoD} * [(\textit{Total annual YLD})_{CoD} / (\textit{Total annual YLL})_{CoD}]$$

$$(\textit{Total YLD averted})_{intervention} = \sum(\textit{YLD averted})_{CoD}$$

where

CoD = cause of death.

For each cause of death impacted by an intervention, YLL averted are calculated as a product of the number of deaths averted and the average age at death from that cause (Yang et al. 2013). Results from the 2013 update of *Global Burden of Disease* (IHME 2013) are used to create a ratio of age-specific total YLD and total YLL for each cause of death in a country. This ratio is then used as a multiplier for YLL averted to estimate the YLD averted for each cause (Montagu et al. 2013; Weinberger, Fry, and Hopkins 2015). For curative interventions, it is assumed that there will be some disability prior to provision of the intervention and the intervention will only avert half of the YLD.
DALYs averted by each intervention is estimated as the sum of YLL averted and YLD averted across all causes of death impacted by a given intervention:

$$(\textit{DALY averted})_{intervention} = (\textit{total YLL averted})_{intervention} + (\textit{total YLD averted})_{intervention}$$

The estimated DALYs averted will be presented as such (for example, undiscounted) and will also be discounted by 3 percent, which is the standard discount rate for health interventions and is also recommended by the WHO for cost-effectiveness analysis (WHO 2014a). Sensitivity analysis will be performed by varying the discount rate between 0 percent and 7 percent, as recommended by the WHO.

Estimating Lives Saved

The projected number of lives saved is also calculated using LiST, which translates measured coverage changes into estimates of reductions in mortality. Because of limitations in LiST, the calculation for the number of lives saved is based on only subset of the 10 interventions;[16] thus the estimates presented are likely to underestimate the actual number of lives saved.

Estimating Cases of Stunting Averted

In order to estimate the number of cases of under-five stunting averted attributable to the annual investment in the scaling up of nutrition interventions, LiST is used to model changes in the prevalence of stunting over five years, during which the interventions are projected to have reached 90 percent of the target population. Next, changes in the prevalence of stunting over five years with no scale-up of the interventions are

[16] These interventions include breastfeeding counseling, complementary feeding education, vitamin A supplementation, zinc supplementation for the treatment of diarrhea, the treatment of severe acute malnutrition, and the management of moderate acute malnutrition.

modeled. Then the difference between the estimated stunting prevalence in Year 5 with the scale-up and the prevalence in Year 5 absent the scale-up is taken, and this percentage point difference is multiplied by the total population of children under five years of age.

The reason for using stunting prevalence in Year 5 relates to the assumptions built into the LiST model, which assumes that stunting is itself a risk factor for becoming stunted in the next time period. As a result, stunting prevalence remains flat during the first two years of the scale-up, before dropping precipitously until Year 5, after which the prevalence begins to level out. The assumption is made that continuing investments to maintain scale after Year 5 will serve to maintain the gains in stunting prevalence reduction, and therefore this reduction is presented as a benefit attributable to a one-year investment in scaling up nutrition.

On the other hand, when estimating stunting reduction (and lives saved) attributable to a five- year scale-up plan, this scale-up is modeled directly in LiST and the annual results over five years are used in the cost-benefit analysis. Using annual results over five years provides a more accurate portrayal of the direct benefits attributable to a five-year scale-up plan, and it does not assume that the scale will necessarily be maintained following the end of the period covered in the plan.

Appendix C: Methodology for Estimating Economic Benefits

Benefits were calculated based on estimates of lives saved and cases of stunting averted obtained from the LiST model (see above). In the base-case scenario, one life saved at age five was valuated as one times GDP per capita. One case of stunting averted was valuated at 21 percent of GDP per capita based on estimates of the impact of childhood stunting on adult wages (Hoddinott et al. 2013) and further adjusted to account for the proportion of income from wages (52 percent) (based on Lubker 2007). Benefits resulting from the prevention of cognitive losses resulting from iodine deficiency were also included.

The following equation summarizes the approach to the valuation of health outcomes and calculation of monetary benefits:

$$B = LS * (1 - P) * GDPpc + LS * P * GDPpc *(1 - S)* L + CS * GDPpc * S * L + IS * GDPpc * I$$

where:

B = monetary benefits
LS = unique lives saved
CS = unique cases of stunting prevented
IS = additional children who benefited from salt iodization
P = prevalence of stunting
$GDPpc$ = GDP per capita
S = percent of wage income gained as a result of the child not being stunted
I = percent of wage income gained as a result of the child not suffering from iodine deficiency
L = proportion of income from labor

The benefits were calculated over the lifetime of children benefitting from the interventions. Conservatively, it was assumed that the children would start earning wages at the age of 18 and earn until the age of 55 (the life expectancy at birth in Guinea-Bissau).

LiST is a cohort model that produces annual estimates of prevalence and mortality in a cohort of children 0–59 months of age. Over five years, the same child would contribute to stunting prevalence and mortality averted five times as he or she ages through the cohort (once at 0–11 months, then again at 12–23 months, and so forth). Consequently, the same child could be saved from being stunted or from dying multiple times during that time period (for example, a child could be at risk of dying from diarrhea at age 1, then again at age 2, then again at age 3 and so forth).

To avoid counting and assigning a monetary value multiple times to stunting or mortality averted in the same child, based on the LiST output, estimates were made of unique lives saved and unique cases of stunting averted. More specifically, every year, the number of cases of stunting averted and lives saved in children 48–59 months old who would be aging out of the LiST cohort in that year were estimated. Consistent with the extant literature, it was assumed that after children reach five years of age, their stunting status is irreversible and that children who are not stunted at age five would remain not stunted and vice versa.

Net present value was calculated using the following formula:

$$NPV = \sum_{t=0}^{n} \frac{(Benefits - Costs)_t}{(1+r)^t}$$

where:

r = discount rate
t = year
n = analytic horizon (in years)

REFERENCES

Alderman, H. H., L. K. Elder, A. Goyal, A. W. Herforth, Y. T. Hoberg, A. Marini, J. Ruel Bergeron, J. Saavedra Chanduvi, M. Shekar, S. Tiwari, and H . Zaman. 2013. *Improving Nutrition through Multisectoral Approaches.* Washington DC: World Bank Group. http://documents.worldbank.org/curated/en/625661468329649726/Improving-nutrition-through-multisectoral-approaches

Beaton, G. H., R. Martorell, K. A. Aronson, B. Edmonston, G. McCabe, A. C. Ross, and B. Harvey. 1993. "Effectiveness of Vitamin A Supplementation in the Control of Young Child Morbidity and Mortality in Developing Countries." ACC/SCN State-of-the-Art Series, Nutrition Policy Paper No. 13. Administrative Committee on Coordination/Subcommittee on Nutrition (ACC/SCN) Geneva, Switzerland.

Bhutta, Z. A., J. K. Das, A. Rizvi, M. F. Gaffey, N. Walker, S. Horton, P. Webb, A. Lartey, and R. E. Black for the Maternal and Child Undernutrition Study Group. 2013. "Evidence-Based Interventions for Improvement of Maternal and Child Nutrition: What Can Be Done and At What Cost?" *Lancet* 382 (9890): 452–77, Maternal and Child Nutrition series.

Black, R. E., L. H. Allen, Z. A. Bhutta, L. E. Caulfield, M. de Onis, M. Ezzati, C. Mathers, and J. Rivera for the Maternal and Child Undernutrition Study Group. 2008. "Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences." *Lancet* 371 (9608): 243–60.

Black, R. E, C. G. Victoria, S. P. Walker, Z. A Bhutta, P. Christian, M. de Onis, J. Ezzati, S. Grantham-McGregor, J. Katz, R. Martorell, and R. Uauy for the Maternal and Child Undernutrition Study Group. 2013. "Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries." *Lancet* 382 (9890): 427–51. Maternal and Child Nutrition series.

Bleakley, H. 2007. "Disease and Development: Evidence from Hookworm Eradication in the American South." *Quarterly Journal of Economics* 122 (1):73–117.

Direção Geral do Orçamento, Guinea-Bissau. 2012. Tabela de Passagem [standard wage rates in the public health sector].

Direção Geral da Saúde de Bafatá, Guinea-Bissau. 2015. Campanha de Suplmentação de Vitamina A.

Direção Regional da Saúde de Gabú, Guinea-Bissau. 2015. Apresentação da Campanha de Suplementação da Vitamina A.

DSANSC (Direção de Serviço de Alimentação, Nutrição e de Sobrevivência das Crianças). 2015. Orçamento para acção "Alimentar-se bem" (4 regions).

Ejemot, R. I., J. E. Ehiri, M. M. Meremikwu, and J. A. Critchley. 2008. "Hand Washing for Preventing Diarrhoea." *Cochrane Database of Systematic Reviews* January 23 (1). doi: 10.1002/14651858.CD004265.pub2.

Ezzati M., A. D. Lopez, A. Rogers, and C. J. Murray. 2004. "Comparative Quantification of Health Risks: The Global and Regional Burden of Disease Attributable to Selected Major Risk Factors." Geneva: World Health Organization.

Ezzati, M., A. D. Lopez, A. Rogers, S. Vander Hoorn, and C.J. Murray. 2002. "Selected Major Risk Factors and Global and Regional Burden of Disease." *Lancet* 360: 1347–60.

Fawzi, W. W., T. C. Chalmers, M. G. Kerrera, and F. Mosteller. 1993. "Vitamin A Supplementation and Child Mortality: A Meta-Analysis." *Journal of the American Medical Association* 269 (7): 898–903.

Fischer Walker, C. L., J. Perin, M. J. Aryee, C. Boschi-Pinto, and R. E. Black. 2012. "Diarrhea Incidence in Low- and Middle-Income Countries in 1990 and 2010: A Systematic Review." *BMC Public Health* 12: 220.

Glasziou, P. P. and D. E. Mackerras. 1993. "Vitamin A Supplementation in Infectious Diseases: A Meta-Analysis." *British Medical Journal* 306: 366–70.

Guerra, C. A., P. W. Gikandi, A. J. Tatem, A. M. Noor, D. L. Smith, and S. I. Hay. 2008. "The Limits and Intensity of *Plasmodium falciparum* Transmission: Implications for Malaria Control and Elimination Worldwide." *PLoS Medicine* 5 (2): e38.

Heckman, J. J. and D. Masterov. 2004. The Productivity Argument for Investing in Young Children. Technical Report working Paper No. 5, Committee on Economic Development.

Hoddinott J., H. Alderman, J. R. Behrman, L. Haddad, and S. Horton. 2013. "The Economic Rationale for Investing in Stunting Reduction." *Maternal and Child Nutrition* 9 (2): 69–82. doi:10.1111/mcn.12080

Hoddinott, J., J. A. Maluccio, J. R. Behman, R. Flores, and R. Martorell. 2008. "Effect of a Nutrition Intervention during Early Childhood on Economic Productivity in Guatemalan Adults." *Lancet* 371 (9610): 411–16.

Hoddinott J., J. Maluccio, J. Behrman, R. Martorell, P. Melgar, and A.R. Quisumbing. 2011. The Consequences of Early Childhood Growth Failure over the Life Course. Discussion Paper 1073, Washington, DC: International Food Policy Research Institute.

Horton, S., M. Shekar, C. McDonald, A. Mahal, and J. K. Brooks. 2010. *Scaling Up Nutrition: What Will It Cost*? Directions in Development Series. Washington, DC: World Bank.

Horton S. and R. Steckel. 2013. "Global Economic Losses Attributable to Malnutrition 1900–2000 and Projections to 2050." In *The Economics of Human Challenges*, edited by B. Lomborg. Cambridge, U.K.: Cambridge University Press.

Hotez, P., P. J. Brindley, J. M. Bethony, C. H. King, E. J. Pearce, and J. Jacobson. 2008. "Helminth Infections: The Great Neglected Tropical Disease." *The Journal of Clinical Investigation* 118 (4): 1311–21.

IHME (Institute for Health Metrics and Evaluation). 2010. *Global Burden of Disease Study.* Institute for Health Metrics and Evaluation. http://www.healthmetricsandevaluation.org/gbd

———. 2013. Country Profile: Guinea-Bissau. 2013. http://www.healthdata.org/guinea-bissau

Kakietek, J., M. Shekar, J. Dayton Eberwein, and D. Walters. 2016. "Financing Needs to Reach the Four Global Nutrition Targets: Stunting, Anemia, Breastfeeding, and Wasting." In *An Investment Framework for Nutrition: Reaching the Global Targets for Stunting, Anemia, Breastfeeding, and Wasting,* by M. Shekar, J. Kakietek, J. Dayton Eberwein, and D. Walters, 169–86. Washington, DC: The World Bank Group.

Khan, W. U. and D. W. Sellen. 2011. "Zinc Supplementation in the Management of Diarrhoea: Biological, Behavioral and Contextual Rationale." e-Library of Evidence for Nutrition Actions (eLENA): A–Z List of Interventions, WHO. http://www.who.int/elena/titles/bbc/zinc_diarrhoea/en/

Locatelli-Rossi, L. 2015. UNICEF's Guinea-Bissau Salt Iodization Program, Consultant Feed-back Report.

Lubker, M. 2007. "Labour Shares." Policy Brief, Policy Integration Department, International Labour Office. Geneva.

Martorell, R., B. L. Horta, L. S. Adair, A. D. Stein, L. Richter, C. H. D. Fall, S. K. Bhargava, S. K. Dey Biswas, L. Perez, F. C. Barros, C. G. Victora, and Consortium on Health Orientated Research in Transitional Societies Group. 2010. "Weight Gain in the First Two Years of Life Is an Important Predictor of Schooling Outcomes in Pooled Analyses from Five Birth Cohorts from Low- and Middle-Income Countries." *Journal of Nutrition* 140: 348–54.

Maternal Mortality Estimation Inter-Agency Group. No date. Guinea-Bissau: Maternal Mortality in 1990–2015. http://www.who.int/gho/maternal_health/countries/gnb.pdf

MICS (Multiple Indicators Cluster Survey) Guinea-Bissau. 2006. *Guinée-Bissau Enquête par Grappes à Indicateurs Multiples 2006.* Ministère de l'Economie, United Nations Children's Fund (UNICEF), World Bank, Plan Guinéé-Bissau, United Nations Population Fund (UNFPA), and United Nations Development Programme (UNDP). http://mics.unicef.org/surveys.

———. 2010. *Guiné-Bissau Inquérito aos Indicadores Múltiplos 2010*. Ministério da Economia, do Plano e Integração Regional – Direcção-Geral do Plano, Instituto Nacional de Estatística, UNICEF. http://mics.unicef.org/surveys.

———. 2014. *Guiné-Bissau Inquérito aos Indicadores Múltiplos 2014*. Ministério da Economia, do Plano e Integração Regional – Direcção-Geral do Plano, Instituto Nacional de Estatística, UNICEF. http://mics.unicef.org/surveys.

MoPH (Ministério da Saúde Pública [Ministry of Public Health]). 2015a, Abridged accounts for the 2015 Supplementation Campaign of Vitamin A and Mebendazol.

———. 2015b. *Plano Operacional de Nutrição (2nd term 2015)*

——— . No date. Republique de Guinee-Bissau. Politique Nationale de Nutrition.

Prüss-Üstün A., R. Bos, F. Gore, and J. Bartram. 2008. *Safer Water, Better Health: Costs, Benefits and Sustainability of Interventions to Protect and Promote Health.* Geneva: World Health Organization.

Rudan, I., K. L. O'Brien, H. Nair, L. Liu, E. Theodoratou, S. Qazi, I. Lukšić, C. L. Fischer Walker, R. E. Black, H. Campbell, and the Child Health Epidemiology Reference Group (CHERG). 2013. "Epidemiology and Etiology of Childhood Pneumonia in 2010: Estimates of Incidence, Severe Morbidity, Mortality, Underlying Risk Factors and Causative Pathogens for 192 Countries." *Journal of Global Health* 3 (1): 010401. doi:10.7189/jogh.03.010401

Ruel, M. T., H. Alderman, and Maternal and Child Nutrition Study Group. 2013. "Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and Child Nutrition?" *The Lancet* 382 (9891): 536–51.

Salomon, J. A., T. Vos, D. R. Hogan, M. Gagnon, M. Naghavi, A. Mokdad, . . . and M. R. Farje. 2013. "Common Values in Assessing Health Outcomes from Disease and Injury: Disability Weights Measurement Study for the Global Burden of Disease Study 2010." *The Lancet* 380 (9859): 2129–43.

Save the Children. 2015. *State of the World's Mothers: The Urban Disadvantage*. Fairfield, CT: Save the Children. http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/SOWM_EXECUTIVE_SUMMARY.PDF

Scaling Up Nutrition. 2015. *SUN Movement Annual Progress Report*. http://scalingupnutrition.org/wp-content/uploads/2015/10/SUN_AnnualReport2015_EN.pdf

Shekar, M. J. Dayton Eberwein, and J. Kakietek. 2016. "The Costs of Stunting in South Asia and the Benefits of Public Investment in Nutrition." *Maternal & Child Nutrition* 12 (Suppl. 1): 186–95.

Stevens, G. A., M. M. Finucane, L. M. De-Regil, C. J. Paciorek, S. R. Flaxman, F. Branca, J. P. Rena-Rosas, Z. A. Bhutta, and M. Ezzata. 2013. "Global, Regional, and National Trends in Haemoglobin Concentration and Prevalence of Total and Severe Anaemia in Children and Pregnant and Non-Pregnant Women for 1995–2011: A Systematic Analysis of Population-Representative Data." *Lancet Global Health* 1 (1): e16–e25.

UN (United Nations). 2003, "Circulaire d'harmonisation de certains coûts des indemnités et de frais de transport et de traduction."

UNData. 2013. http://data.un.org/Data.aspx?d=SOWC&f=inID:106

UN DESA (United Nations, Department of Economic and Social Affairs), Population Division. 2015. "World Population Prospects: The 2015 Revision, Key Findings and Advance Tables." Working Paper No. ESA/P/WP.241.

UNDP (United Nations Development Programme). 2015. Briefing Note for Countries on the 2015 Human Development Report: Guinea-Bissau. http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/GNB.pdf

UNICEF (United Nations Children's Fund). 2011. Infant and Young Child Feeding: Programming Guide. http://www.unicef.org/nutrition/files/Final_IYCF_programming_guide_2011.pdf

———. 2012. Pneumonia and Diarrhoea: Tackling the Deadliest Diseases for the World's Poorest Population. http://data.unicef.org/corecode/uploads/document6/uploaded_pdfs/corecode/Pneumonia_Diarrhoea_2012_35.pdf

———. 2013. Guinea-Bissau Statistics. http://www.unicef.org/infobycountry/guineabissau_statistics.html

———. 2015. Situation Analysis of Women and Children. UNICEF-Guinea Bissau.

———. 2016. Vitamin A Supplementation Interactive Dashboard. http://data.unicef.org/resources/vitamin-a-supplementation-interactive-dashboard.html

UNICEF, WHO, and World Bank (United Nations Children's Fund, World Health Organization, and World Bank). 2016. *Joint Child Malnutrition Estimates*. Global Database on Child Growth and Malnutrition (accessed December 1, 2016). http://www.who.int/nutgrowthdb/estimates2014/en/

UN IGME (United Nations Inter-agency Group for Child Mortality Estimation). No Date. Child Mortality Estimates: Guinea-Bissau (database). http://www.childmortality.org/index.php?r=site/graph#ID=GNB_Guinea-Bissau

Wessels, K. R. and K. H. Brown. 2012. "Estimating the Global Prevalence of Zinc Deficiency: Results Based on Zinc Availability in National Food Supplies and the Prevalence of Stunting." *PLOS One* 2012 7 (11): E50568. doi:10.1371/Journal.Pone.0050568. Epub 2012 Nov 29.

WFP (World Food Programme). 2016. Guinea-Bissau: Current Issues and What the World Food Programme Is Doing. https://www.wfp.org/countries/guinea-bissau

WHO (World Health Organization). 2009. Global prevalence of vitamin A deficiency in populations at risk 1995–2005. WHO Global Database on Vitamin A Deficiency. Geneva: WHO.

———. 2012*. Global Health Estimates*. Geneva: WHO. http://www.who.int/healthinfo/global_burden_disease/en/

———. 2015. *The Global Prevalence of Anaemia in 2011.* Geneva: WHO.

———. 2016. Neglected Tropical Diseases PCT Databank. http://www.who.int/neglected_diseases/preventive_chemotherapy/sth/en/

———. No date. Guinea-Bissau Neonatal and Child Health Country Profile. http://www.who.int/maternal_child_adolescent/epidemiology/profiles/maternal/gnb.pdf

World Bank. 2006*. Repositioning Nutrition as Central to Development: A Strategy for Large-Scale Action.* Washington, DC: World Bank.

———. 2013. World Development Indicators (database). World Bank, Washington, DC (accessed December 1, 2016). http://data.worldbank.org/data-catalog/world-development-indicators

———. 2015. *Guinea-Bissau - Country Economic Memorandum: Terra Ranca! A Fresh Start*. Washington: DC: World Bank Group. http://documents.worldbank.org/curated/en/347181468036532328/Guinea-Bissau-Country-economic-memorandum-Terra-ranca-A-Fresh-Start

———. 2016. World Development Indicators (database). World Bank, Washington, DC (accessed December 1, 2016). http://data.worldbank.org/data-catalog/world-development-indicators

This paper builds on global experience and Guinea-Bissau's specific context to identify an effective nutrition approach along with costs and benefits of key nutrition interventions. It is intended to help guide the selection of the most cost-effective interventions as well as strategies for scaling these up. We estimate that the costs and benefits of implementing 10 nutrition-specific interventions in all regions of Guinea-Bissau would require a public investment of USD 17 million over five years (with about USD 3 million needed to maintain the current coverage of the interventions and USD 14 million needed to expand the coverage to reach 90 percent of the population). The two key conclusions of this paper are, first, that investing in nutrition in Guinea-Bissau is cost-effective based on international standards and, second, that investments in nutrition can generate very substantial health and economic benefits, with one dollar spent on nutrition interventions resulting in about 10 dollars of returns over the productive lives of children covered by high-impact nutrition interventions. Economic productivity could potentially increase by USD 120 million (discounted at 3 percent) over the productive lives of the beneficiaries, with an impressive internal rate of return of 9 percent annually. These findings point to a powerful set of nutrition-specific interventions that represent a highly cost-effective approach to reducing child malnutrition and stunting in Guinea-Bissau.

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