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COSTED PLAN FOR SCALING UP NUTRITION: *NIGERIA*

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WORLD BANK GROUP
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Health, Nutrition and Population (HNP) Discussion Paper

Costed Plans for Scaling Up Nutrition: *Nigeria*

Meera Shekar, Christine McDonald, Ali Subandoro, Julia Dayton Eberwein, Max Mattern and Jonathan Kweku Akuoku

Abstract: This paper estimates country-specific costs and benefits of scaling up key nutrition investments in Nigeria. Building on the methodology established in the global report *Scaling Up Nutrition: What will it cost?*, we first estimate the costs and benefits of a nationwide scale up of ten effective nutrition-specific interventions. This would require an annual public investment of $837 million and would yield enormous benefits: over 8.7 million DALYs and 183,000 lives would be saved annually, while more than 3 million cases of stunting among children under five would be averted. As it is unlikely that the Government of Nigeria or its partners will find the $837 million necessary to reach full national coverage, we also considers five potential scale-up scenarios based on considerations of burden of stunting, potential for impact, resource requirements and capacity for implementation in Nigeria. Using cost-benefit analyses we propose scale-up scenarios that represent a compromise between the need to move to full coverage and the constraints imposed by limited resources. This analysis takes an innovative approach to nutrition costing by not only estimating the costs and benefits of nutrition-specific interventions, but also exploring costs for a selected number of nutrition-sensitive interventions implemented outside of the health sector. We identify and cost four candidate nutrition-sensitive interventions with high impact potential for Nigeria, including biofortification of cassava, aflatoxin control, school-based deworming, and school-based promotion of good hygiene. Overall, these findings point to a selection of nutrition-specific interventions and a candidate list of nutrition-sensitive approaches that represent a cost-effective approach to reducing child malnutrition in Nigeria. Moving forward, these results are intended to help guide decision makers as they plan future efforts to scale-up action against malnutrition in Nigeria and develop nutrition financing plans that bring together the health, education and agriculture sectors.

Keywords: nutrition-specific interventions, nutrition-sensitive interventions, cost of nutrition interventions, cost-benefit analysis, nutrition financing.

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GLOSSERY OF TERMS

ANC	antenatal clinics
ARI	acute respiratory infections
BMGF	Bill and Melinda Gates Foundation
CCT	conditional cash transfers
CIDA	Canadian International Development Agency
C-IMCI	community-based approach to integrated management of childhood illnesses
CHAI	Clinton Health Access Initiative
CMAM	community-based management of acute malnutrition
CNPs	community nutrition programs
CIFF	Children's Investment Fund Foundation
DALYs	disability adjusted life years
EU	European Union
FGoN	Federal Government of Nigeria
GAIN	Global Alliance for Improved Nutrition
GMP	growth monitoring and promotion
GNI	gross national income
GNP	gross national product
HKI	Helen Keller International
IFA	iron folic acid
IITA	International Institute for Tropical Agriculture
LiST	Lives Saved Tool
M&E	monitoring and evaluation
MAM	management of acute malnutrition
MI	Micronutrient Initiative
MICS	Multiple Indicator Cluster Survey
MoH	Ministry of Health
NAFDAC	National Agency for Food and Drug Administration
NDHS	Nigeria Demographic and Health Survey
NPV	net present value
NTD	neglected tropical disease
ORS	oral rehydration solution
R4D	Results For Development
SAM	severe acute malnutrition
SMART	Standardized Monitoring and Assessment of Relief and Transitions
SOML	Saving One Million Lives
UNICEF	United Nations Children's Fund
UHC	Universal Health Coverage
USAID	United States Agency for International Development
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WINNN	Working to Improve Nutrition in Northern Nigeria

GLOSSARY OF TECHNICAL TERMS

Aflatoxins are a group of toxic compounds produced by certain molds, especially *aspergillus flavus*, which contaminate stored food supplies such as animal feed, maize and peanuts. Research shows that human consumption of high levels of aflatoxins can lead to liver cirrhosis (Kuniholm et al., 2008) and liver cancer in adults (Abt Associates 2014). It is widely understood that there is a relationship between aflatoxin exposure and child stunting but this relationship has not yet been adequately quantified in the published literature (Unnevehr and Grace 2013, Abt Associates 2014).

Biocontrol (also called biological control) is the use of an invasive agent to reduce pest or mold population below a desired level. Aflatoxins can be reduced through biocontrol and the most effective method involves a single application of a product (such as AflaSafeTM) containing strains unique to the specific country or location.

Biofortification is the idea of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding, or through genetic engineering.

A **DALY** is a **Disability Adjusted Life Year**, and 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 advantages of the DALY is that it is a metric that is recognized and understood by external audiences such as the WHO and the NIH. It helps to gauge the contribution of individual diseases relative to 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.

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 a part of an integrated set of tools that comprise the Spectrum policy modeling system.

Stunting is an anthropometric measure of low height-for-age. It is an indicator of chronic undernutrition and is the result of prolonged food deprivation and/or disease or illness. It is measured in terms of Z-score (or standard deviation score; see definition below) and a child is considered stunted with a height-for-age Z-score of -2 or lower.

Underweight is an anthropometric measure of low weight-for-age. It is used as a composite indicator to reflect both acute and chronic undernutrition, although it cannot distinguish between them. It is measured in terms of Z-score (or standard deviation score; see definition below) and a child is considered underweight with a Z-score of -2 or lower.

Wasting is an anthropometric indicator of low weight-for-height. It is an indicator of acute undernutrition and the result of more recent food deprivation or illness. It is measured in terms of Z-score (or standard deviation score; see definition below) and a child is considered stunted with a Z-score of -2 or lower.

A **Z-score** or standard deviation score is calculated with the following formula:

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

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EXECUTIVE SUMMARY

1. **The overall objective of this programmatic Knowledge Product is to support the Federal Ministry of Health in the Government of Nigeria to develop a costed scale-up plan for nutrition. This scale-up plan will be complemented with a health-sector fiscal space analysis financed by the Children's Investment Fund Foundation (CIFF) and conducted by Results For Development (R4D).** The executive summary is written for policy makers; it highlights the main findings and discusses the implications for nutrition policy in Nigeria. The paper itself is more technical in nature and is written for planners and programmers. The analysis seeks to estimate the potential impact and allocative efficiency of investments in nutrition, with the goal of guiding Nigeria's ongoing nutrition strategic planning process. The report has benefitted tremendously from a strong partnership with the FMOH and SOML, as well as extensive consultation with partners such as DFID, UNICEF, USAID, Save the Children, CIFF, CHAI and other stakeholders in Nigeria.

2. **Nigeria is home to the third largest population of chronically undernourished (stunted) children in the world.** Within Nigeria, there is enormous geographic variation in nutrition outcomes, with the worst malnutrition concentrated in the North-Eastern and North-Western regions. Vitamin and mineral deficiencies (*hidden hunger*) are also pervasive, of which anemia and vitamin A deficiencies are the most prevalent.

3. **Malnutrition, particularly in very young children, leads to increased mortality, greater susceptibility to illness, and long-term effects on cognitive abilities, resulting in irreversible losses in human capital that contribute to future losses in economic productivity.** Undernutrition is responsible for approximately half of under-five child mortality and one-fifth of maternal mortality in developing countries, and children who have been malnourished early in life are more likely to experience cognitive deficiencies and poor schooling outcomes. Over the long-term, stunting results in 10-17 percent loss of wages, and it is estimated that Nigeria loses over US$1.5 billion in GDP annually to vitamin and mineral deficiencies alone (Government of Nigeria 2014; World Bank 2009).

4. **At the same time, nutrition interventions are consistently identified as among the most cost effective development actions, and the costs of scaling up nutrition interventions are modest.** Cost-benefit analysis shows that nutrition interventions are highly effective (Hoddinott et al 2013; World Bank 2010a). It is estimated that investing in nutrition can increase a country's gross domestic product (GDP) by at least 3 percent annually (Horton and Steckel 2013). Globally, the cost of scaling up key nutrition interventions across 68 countries is estimated at $10.3 billion per annum, and would provide preventive nutrition services to about 356 million children, save at least 1.1 million lives and 30 million DALYs, and reduce the number of stunted children by about 30 million worldwide (World Bank 2010a).

5. **This report builds on the global costing exercise to identify country-specific estimates of the costs and benefits of scaling up key nutrition investments in Nigeria. It is intended to help guide the development of the National Strategic Plan of Action for Nutrition, and aims to maximize allocative efficiencies by identifying the most cost effective package of interventions.** The methodology is based on the costing framework established by *Scaling Up Nutrition: What will it cost?* (World Bank 2010a), which is adapted to the country-specific context of Nigeria. By combining costing with estimates of impact (in terms of DALYs saved, lives saved, and cases of childhood stunting averted) this report strengthens the "case for nutrition" and guides policy makers in prioritizing investments in situations where financial and human resources are constrained. Furthermore, this analysis takes an innovative approach by also exploring the costs and benefits of selected (albeit not exhaustive) nutrition-sensitive interventions implemented outside of the health sector.

6. **We first estimate the costs and benefits of a nationwide scale up of all ten nutrition-specific interventions.** These ten interventions were selected as a starting point because they have demonstrated effectiveness in improving child nutrition and have clear delivery scenarios that allow them to achieve scale. We refer to this as the "full coverage" scenario, [1] and estimate that it would require an annual public investment of $837 million. The expected benefits are enormous: over 8.7 million DALYs and 183,000 lives would be saved annually, while more than 3 million cases of stunting among children under five would be averted.

7. **Given resource constraints, few countries are able to effectively scale-up all ten nutrition-specific interventions to full national coverage simultaneously. We therefore consider 5 potential scale-up scenarios based on considerations of burden of stunting, potential for impact, resource requirements and capacity for implementation in Nigeria.**

- **Scenario 1**: Scale up by region
- **Scenario 2**: Scale up by intervention
- **Scenario 3**: Scale up by state
- **Scenario 4**: Scale up by state and by intervention
- **Scenario 5**: Scale up by levels of program coverage

8. **Scenarios 4 and 5 represent the most cost effective means of scaling up, when measured in terms of cost per DALY saved, cost per life saved and cost per case of childhood stunting averted. We further refine our analysis by comparing variations of these scenarios:**

- **Scenario 4a:** scale up critical interventions, including community nutrition programs, micronutrient supplementation, deworming and community-based management of

[1] "Full" program coverage levels are 100 percent coverage for all interventions except for the public provision of complementary food for prevention of moderate acute malnutrition and community-based management of severe acute malnutrition for which "full" coverage is 80 percent.

severe acute malnutrition to full program coverage levels in states where stunting prevalence exceeds 25 percent**.**

- **Scenario 4b**: scale up critical interventions, including community nutrition programs, micronutrient supplementation, deworming and community-based management of severe acute malnutrition in states where stunting prevalence exceeds 35 percent.
- **Scenario 5a:** scale up all 10 interventions to partial coverage levels.[2]
- **Scenario 5b**: scale up micronutrient and deworming interventions[3] to partial coverage levels in all 36 states, and scale up community nutrition programs and community-based management of severe acute malnutrition to partial coverage levels in states where stunting prevalence exceeds 35 percent.

The table below presents estimated costs and benefits for each of these scenarios.

Estimated Costs and Benefits of 5 Scenarios

Recommended Scenarios	**Annual Public Investment (US$ million)**	**Annual Benefits**			**Cost per Benefit Unit**		
		DALYs Saved	**Lives Saved**	**No. of Cases of Stunting Averted**	**DALY Saved**	**Lives Saved**	**Cases of Stunting Averted**
Scenario 4a	$337	4,694,076	96,092	n/a	66	3,229	n/a
Scenario 4b	$271	3,439,969	70,911	n/a	72	3,496	n/a
Scenario 5a	$353	4,388,415	96,463	1,434,988	85	3,849	259
Scenario 5b	$184	2,256,091	58,519	n/a	82	3,152	n/a

Source: Authors' calculations.

9. **The analysis further identifies three scenarios (4a, 4b and 5a) that have the potential to significantly improve nutrition outcomes in a highly cost-effective manner, while also prioritizing the use of scarce resources.** Scenario 4b represents the lowest-cost option, and would scale up critical interventions, including community nutrition programs, micronutrient supplementation, deworming and community-based management of severe acute malnutrition in states where the prevalence of stunting among children under five exceeds 35 percent. Scenario 4a is slightly more expensive,

[2] "Partial" program coverage is as follows: 35 percent coverage for public provision of complementary food for prevention of moderate acute malnutrition and community-based management of severe acute malnutrition; 50 percent coverage for community programs for growth promotion; 80 percent coverage for therapeutic zinc supplements with ORS; 90 percent for vitamin A supplements, micronutrient powders, deworming, iron folic-acid supplements for pregnant women; and 100 percent for iron fortification of staple foods and salt iodization.

[3] This includes deworming, vitamin A supplementation, zinc supplementation, multi micronutrient powders, iron fortification of staple foods and salt iodization

but increases the coverage of these interventions to all states with stunting rates higher than 25 percent. Scenario 5a is the most expensive of the three proposed scenarios but is also the most politically attractive: it scales up all interventions in all 36 states, while focusing primarily on increasing the coverage of low-cost, high-impact interventions such as micronutrient supplementation.

10. **Recognizing the difficulty of scaling up to full coverage in one year, and following the five-year time frame of the Federal Government's National Strategic Plan of Action for Nutrition, we estimate the cost of scaling up these interventions over five years to be $769 million for scenario 4b, $987 million for scenario 4a, and $912 million for scenario 5a.**[4] This is significantly less than the $2.4 billion needed for the five year scale up of the "full coverage" scenario, but still represents a significant increase over current spending on nutrition in Nigeria.

11. **Scenario 5a is considered a highly attractive investments, with positive returns on investment and significant additions to economic productivity.** [5] When scaled up gradually over 5 years, this scenarios has the potential to add over US$1 billion annually to the Nigerian economy over the productive lives of children who would otherwise have died or become stunted. Moreover, these investments in Nigeria's human capital result in a positive net present value (NPV) and internal rates of return (IRR) exceeding 18 percent.

12. **The costs discussed thus far relate to the scale up from current coverage, and therefore do not take into account the financing necessary to maintain existing coverage levels, which R4D estimates at approximately US$49 million annually in a draft fiscal space analysis of nutrition in Nigeria (2014).** The R4D analysis also identifies several sources of "planned" investments for nutrition estimated at about $175 million over the next 4 years. This suggests a planned increase in funding for nutrition of approximately $126 million over four years. Our analysis predicts financing needs over five years of between $769 million and $987 million for scaling up under the three proposed scenarios, resulting in an estimated financing gap of between $543 and $861 million over five years. Therefore, any scale up of nutrition interventions will not only require additional financing, but also the prioritization of interventions based on need, cost-effectiveness and allocative efficiencies.

13. **While every attempt has been made to use actual program costs in these estimates, in reality the estimates likely overestimate the costs and underestimate the benefits.** In many cases, actual program costs will be lower than estimated because they

[4] For scenarios 4a and 4b we assume that coverage scales up progressively over 5 years, with 20% achieved in year 1, 40% in year 2, 60% in year 3, 80% in year 4 and 100% in year 5. The scale up of Scenario 5a matches the assumptions in Nigeria's National Strategic Plan of Action for Nutrition (NSPAN), and therefore does not follow the same scale up pattern. For more information on the scale up of Scenario 5a, please see Chapter IV-B

[5] Scenario 5a is the only one for which we were able to calculate NPV and IRR.

can be added to existing programs. Program experience shows that the incremental costs of adding to an existing program are lower, as existing implementation arrangements can be used, thereby containing costs for staffing, operations and training. Moreover, we do not account for potential savings achieved through expected economies of scale. With respect to the benefits, given the limitations of the LiST tool, it is only possible to estimate the benefits of some of the interventions. As a result, we likely underestimate the potential benefits of scaling up the ten proven nutrition specific interventions.

14. **This analysis takes an innovative approach by not only estimating the costs and benefits of nutrition-specific interventions, but also exploring those of selected nutrition-sensitive interventions implemented outside of the health sector**. While recognizing that the evidence base for impact of nutrition-sensitive interventions is less conclusive, we consider four nutrition-sensitive interventions in the agriculture and education sectors that have shown some potential for improving nutrition outcomes. In Nigeria, these include biofortification of cassava, aflatoxin control, school-based deworming, and school-based promotion of good hygiene. The first two of these interventions would be implemented through the agriculture sector, and the second two through the education sector. The estimated annual costs are modest: US$25 million for biofortification of cassava, US$65 million for aflatoxin control, US$8 million for school-based deworming and US$60 million for school-based promotion of good hygiene. However, these must be considered rough approximations, as there are significant limitations in the available data and in the methodological approaches, especially in contextualizing these global costs to the Nigerian situation. In addition we were not able to estimate the benefits of these interventions due to data and methodological shortcomings, although we do report benefits estimated by other reports.

15. **Overall, these findings point to a selection of nutrition-specific interventions and a candidate list of nutrition-sensitive approaches that represent a cost-effective approach to reducing child malnutrition in Nigeria. Most of the malnutrition that occurs in the first 1000 days of a child's life is essentially irreversible.** Therefore, investing in early childhood nutrition interventions offers a window of opportunity to permanently lock-in human capital and to super-charge the potential demographic dividend in Nigeria. This fits into the President's Transformational Agenda for Nigeria and the government's flagship Saving One Million Lives (SOML) initiative, which focus on six pillars, one of which is nutrition. However, despite strong commitments to address malnutrition, there are currently no financial allocations for nutrition in FGoN's 2014 budget.

16. **Moving forward, these results will be useful to decision makers as they plan future efforts to scale-up action against malnutrition in Nigeria and develop nutrition financing plans that bring together the health, education and agriculture sectors**. In the health sector, plans for financing Universal Health Coverage (UHC) and SOML must include these costs under the nutrition pillar of SOML. There also exist several opportunities to incorporate these highly cost-effective interventions into the World Bank's existing and pipeline investments in Health (e.g. the State Health Project

and planned support for SOML), agriculture (such as FADAMA III) and education (e.g. the State Education Project and the Global Partnership on Education).

PART I – BACKGROUND

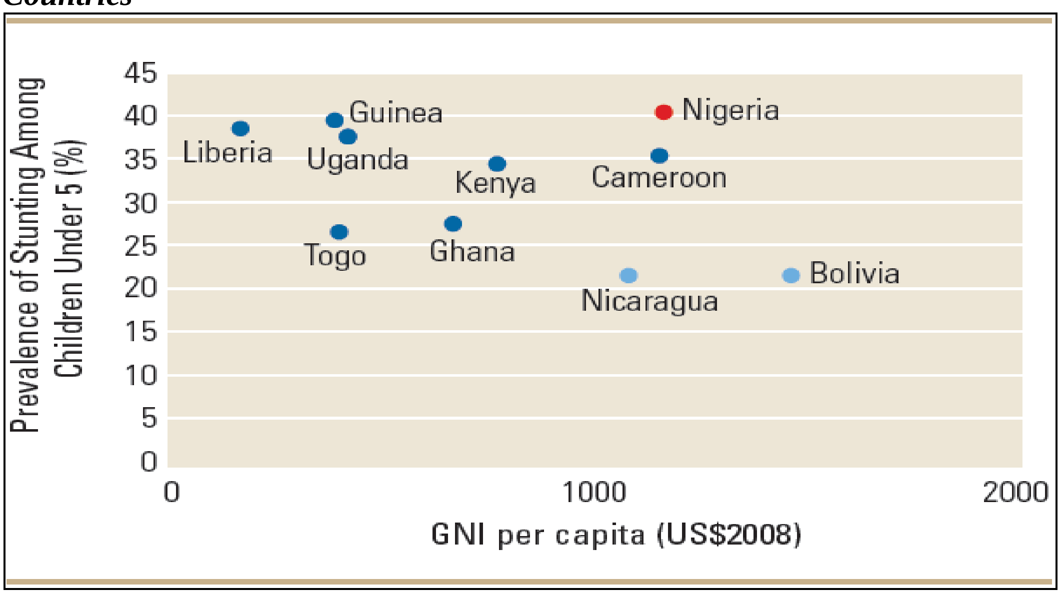
A. COUNTRY CONTEXT

1. **With an estimated 163 million inhabitants, Nigeria is the most populous country in Africa, and despite strong GDP growth that averaged more than 8 percent over the past decade, Nigeria's poverty rate remains persistently high (World Bank 2013a).** Nigeria currently ranks 156th out of 187 countries on the Human Development Index, and the estimated life expectancy is 52 years. In 2010, 46 percent of the population lived below the poverty line, a prevalence which represents a decline of less than three percentage points since 2004. A recent World Bank poverty analysis highlighted a combination of two economic patterns at the sub-national level: i) increased poverty and decreased urbanization in Northern States with most important economic activities taking place in Southern States; and ii) within the North and South, Western States perform relatively better than Eastern States (World Bank, 2013a). The same analysis also showed that the degree of inequality in Nigeria has increased: from 2004 to 2010 the Gini index increased from 0.38 to 0.41.

B. HEALTH AND NUTRITIONAL STATUS IN NIGERIA

2. **Nigeria is home to the third largest population of chronically undernourished children in the world**, with an under-five mortality rate of 157 deaths per 1,000 live births, and an infant mortality rate of 75 per 1,000 (NDHS 2008). These rates remain stubbornly above sub-Saharan Africa's regional average. In 2013, the prevalence of stunting among children under five years of age was 37 percent, which is a very modest decline from 43 percent in 2003 (NDHS 2003 and 2013). The stunting rate is higher than in several other countries in the region with similar incomes (**Figure 1**). Nigeria's failure to make substantial headway in reducing poverty has translated into limited progress in improving health and nutrition indicators, and vice versa.

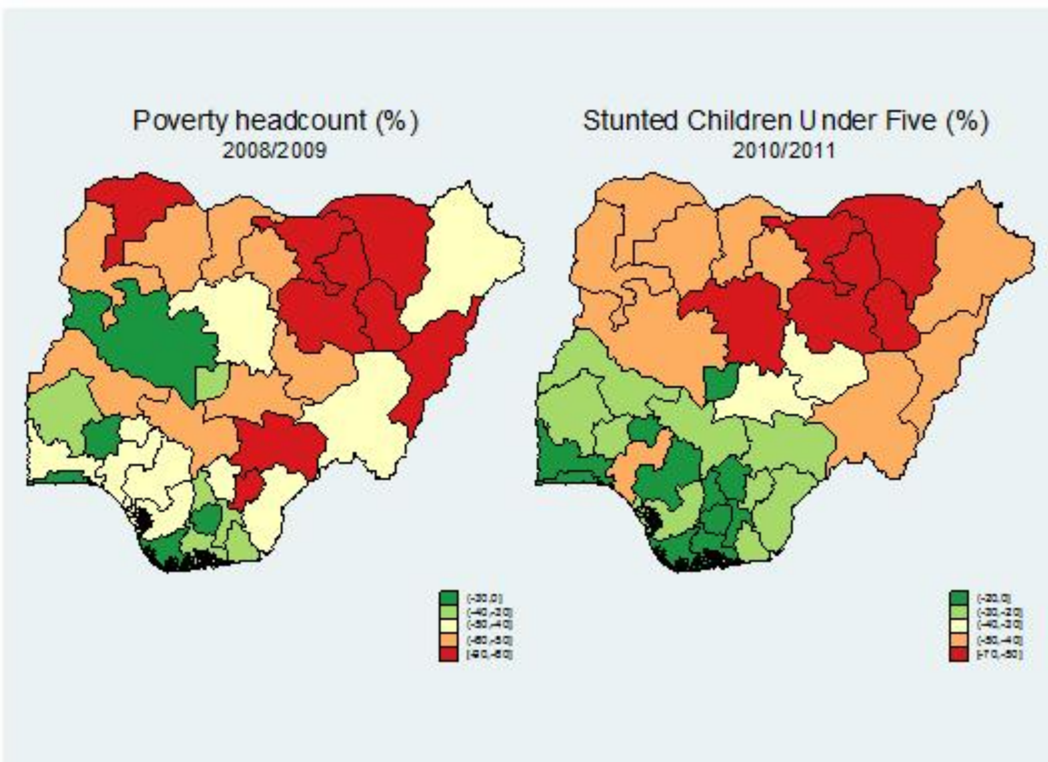
Figure 1: Prevalence of Stunting and GNI per capita in Nigeria and Selected Peer Countries



Data Sources: WHO Global Database on Child Growth and Malnutrition; World Bank World Development Indicators, Nigeria MICS 2011.

3. **There is great regional variation in child stunting and the prevalence of stunting actually increased in 5 of the 6 regions between 2003 and 2008.** The national average masks dramatic geographical disparities within the country. **Figure 2** demonstrates striking disparities between northern and southern regions, in which *all* states in North-Eastern and North-Western have stunting prevalence above 40 percent, whereas the majority of states in the southern regions have stunting prevalence below 25 percent (Nigeria MICS 2011). The prevalence of stunting in the North West region is 2.5 times the prevalence in the South East region. In Lagos, only 8.9 percent of children under five are stunted, whereas in the state of Katsina, the prevalence is 61.9 percent. The same figure also shows that the disparities in poverty closely mirror the disparities in malnutrition, but the patterns are not identical. Many states with relatively lower poverty rates (i.e. Niger, Ondo, and Oyo) still have high rates of stunting. Child wasting (low weight-for-height) rates, which reflect acute nutritional deficits that are often compounded by infection or disease, are also highly variable by state: in FCT (Abuja) the prevalence is 3.4 percent, whereas in Borno, it is 18.7 percent.

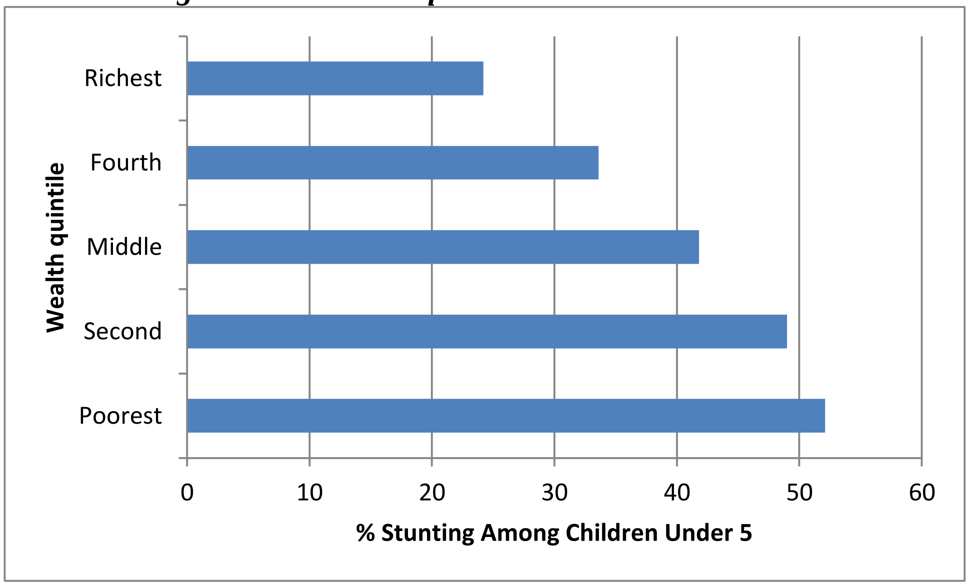
Figure 2. State-level prevalence of stunting (2011) and poverty estimates (2009)



Source: Poverty map from World Bank, 2013; Stunting map created from sub-national stunting data from Nigeria MICS 2011.

4. **Inequities in child undernutrition across wealth quintiles are also pronounced in Nigeria. Stunting rates in the poorest households (52 percent) are more than twice those in the richest households (24 percent) (Figure 3).** However, while stunting rates are highest among the poorest quintile, somewhat surprisingly even in the richest households, nearly one-quarter of children are stunted. This shows that while poverty is associated with stunting, other factors are also involved. Non-food influences, such as informational asymmetries, disease and optimal feeding and caregiving practices have a major role to play in causing malnutrition.

Figure 3. Wealth inequities in child undernutrition



Source: NDHS 2008

5. **Vitamin and mineral deficiencies (*hidden hunger*) and are also pervasive in Nigeria.** It is estimated that 30 percent of Nigerian children under five and 20 percent of pregnant women are vitamin A deficient (Maziya-Dixon *et al*. 2006). Vitamin A deficiency increases child mortality, increases vulnerability to infectious diseases such as measles and leads of blindness among children under five years-old. Coverage of vitamin A supplementation is low in Nigeria, with only 65.2 percent of children 6-59 months of age receiving a supplement in the past six months (Nigeria MICS 2011).[6] Data from DHS 2008 indicates even lower vitamin A coverage (26 percent) and the coverage actually decreased from 34 percent in 2003 (**Figure 4**).[7] Given the strong evidence that high coverage with twice-annual doses of Vitamin A supplementation has the potential to reduce child mortality by 23 percent on average, this is a lost opportunity. The most recent data available indicate that 76 percent of preschool-aged children and 67 percent of pregnant women are anemic, with approximately half of all anemia caused by inadequate dietary intake of iron, and the rest due to infections and parasites. One in five households does not consume adequately iodized salt (), thereby predisposing these children to IQ losses of up to 13 points, increasing the risk of still births, and wasted pregnancies.

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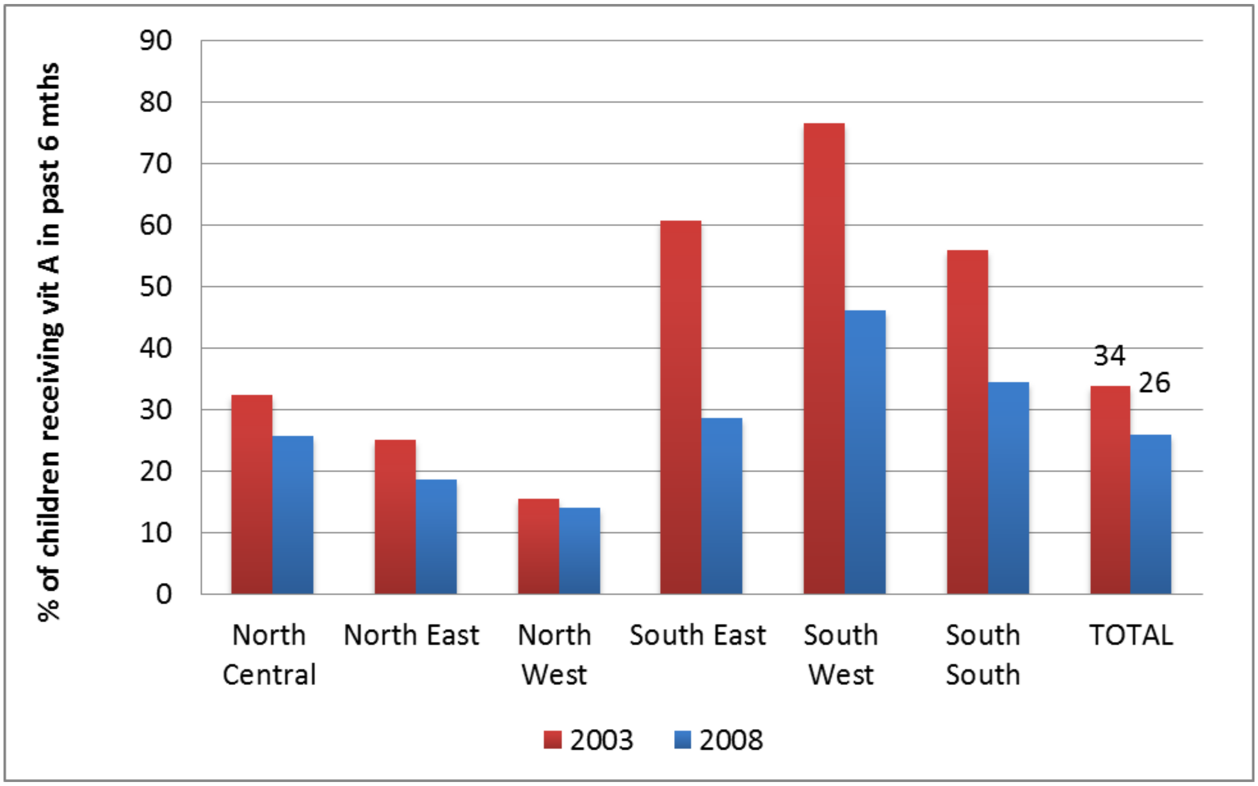
[6] There is a discrepancy between the DHS (2008) and the MICS (2011).

[7] No data available on children who received twice-annual doses so this indicator is used as a proxy.

Figure 4: Vitamin A supplementation in Nigeria by region, 2003 and 2008.



Source: Nigeria DHS, 2008

6. **Another health burden in Nigeria is the high levels of aflatoxins, which are naturally occurring carcinogenic (cancerous) by-products of common fungi that grow on crops such as maize and peanuts**. A recent review of published articles shows that the mean level of aflatoxin contamination in maize and groundnuts in Nigeria is well above safe levels (Abt Associates 2014) and well above levels in other African countries (Liu and Wu, 2010). Groundnut contamination is generally higher in the south and maize contamination is higher in the north and west. Evidence shows that consumption of high levels of aflatoxins can lead to liver cirrhosis (Kuniholm et al., 2008) and liver cancer in adults (Abt Associates 2014). Further, it is widely understood that there is a relationship between aflatoxin exposure and child stunting, albeit the evidence base is more tentative, and this relationship has not yet been adequately quantified in the published literature (Unnevehr and Grace 2013, Abt Associates 2014). Using data on aflatoxin exposure and growth from other countries, one study estimated that up to 4.4 million children in Nigeria become stunted from consuming maize and groundnuts that are contaminated with aflatoxin (Khlangwiset 2011). Almost 8,000 deaths/year from liver cancer in Nigeria are attributed to aflatoxin exposure, resulting in over 100,000 lost DALYs. This translates into a monetized impact of between 0.2 percent and 1.6 percent of Nigeria's GDP (Abt Associates 2014). While the evidence on the links between aflatoxins and child stunting is still tentative, the links with liver cancer are well established, and provide sufficient impetus for actions to control aflatoxin exposure in Nigeria.

7. **Approximately 87,100 children under five die each year in Nigeria from diarrhea. Nearly 90 percent is directly attributed to poor water, sanitation and hygiene** (World Bank 2012)**.** Diarrheal episodes exacerbate the relationship between malnutrition and infection, as

children tend to eat less, absorb fewer nutrients and reduced resistance to infections. Prolonged diarrheal episodes lead to impaired growth and development (Ejemot et al. 2006). 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.

8. **In Nigeria, 45 percent of school-age children, totaling nearly 12 million, are estimated to be infected with parasitic intestinal worms (helminthic infections).** In the short term, helminthic infections potentially cause anemia, increase morbidity, undernutrition and 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 grow up free of worms (Bleakley 2007).

C. THE IMPORTANCE OF INVESTING IN NUTRITION

9. **Undernutrition is an underlying cause of approximately half of deaths (3.1 million) in children under five and one-fifth of maternal deaths in developing countries.** The joint effect of suboptimum breastfeeding and fetal growth restriction in neonatal period alone contributes 1.3 million deaths or 19 percent of all deaths of children under five (Black et al. 2013). Undernourished children are more likely to die from common childhood illnesses such as diarrhea, measles, pneumonia, malaria or HIV/AIDS.

10. **For those malnourished children who survive, there are long-lasting health and schooling consequences, including cognitive deficits and poorer schooling outcomes.** Children with impaired cognitive skills have lower school enrollment, attendance and graduation, which in turn results in lower productivity, earnings and economic well-being. Stunted children lose 0.7 grades of schooling, and are more likely to drop out of school. Iodine deficient children lose on average 13 IQ points and iron deficiency anemia reduces performance on tests by 8 IQ points, making them less educable (World Bank 2006). Behrman and colleagues (2009) showed improved schooling and test scores from participation in nutrition programs in early childhood.

11. **In Nigeria, being underweight in the early years of life accounts for 8 percent of Disability-Adjusted-Life-Years (DALYs).** This was the biggest risk factor affecting DALYs, with micronutrient deficiencies and suboptimal breastfeeding also among the 15 highest risk factors (Murray *et al.* 2013). The DALYs lost from Vitamin A deficiency in Nigeria is nearly 800,000 annually, with virtually all losses occurring in children under five years of age (Menakshi et al. 2010).

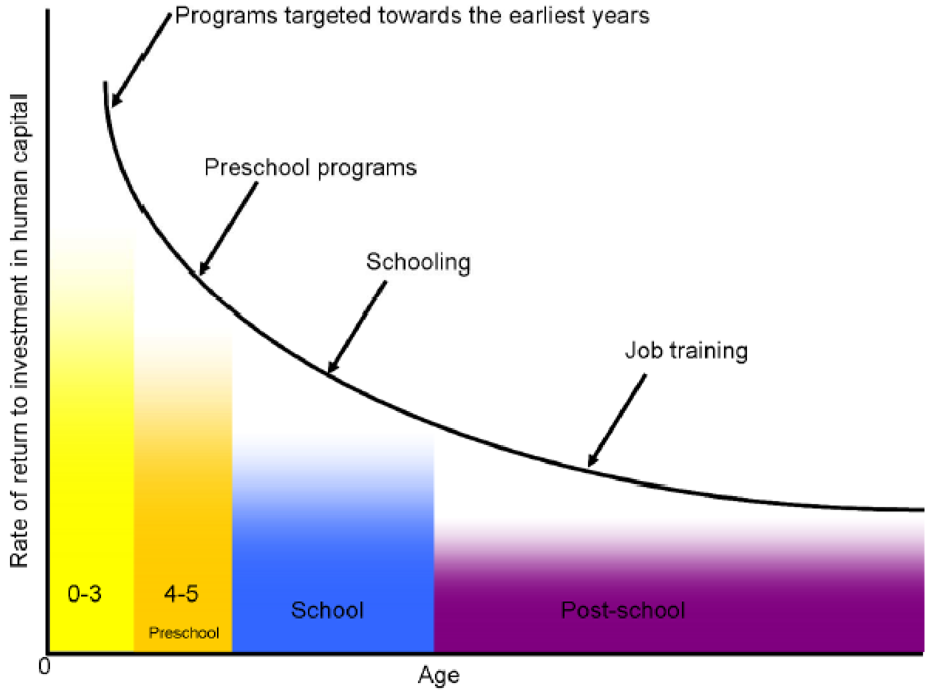
12. **Malnutrition costs developing countries billions in lost revenue through reduced economic productivity, particularly through lower wages, lower physical and mental capabilities and more days away from work as a result of illness.** Childhood stunting is estimated to reduce at least 10 percent of potential lifetime earnings (World Bank 2006). Other studies have shown that a 1 percent loss in adult height results in a 2–2.4 percent loss in productivity (Caulfield et al. 2004, Strauss and Thomas 1998). In addition, micronutrient deficiencies in childhood and adulthood have tremendous economic cost. Childhood anemia alone is associated with a 2.5 percent drop in adult wages. Anemia in adults has been estimated to be equivalent to 0.6 percent of GDP, and goes up to 3.4 percent when including the secondary effects of retarded cognitive development in children (Horton 1999). Horton and Ross (2003) estimate that eliminating iron-deficiency anemia would result in a 5–17 percent increase in adult

productivity. Collectively, micronutrient deficiencies alone in Nigeria add up to an estimated loss of over US$1.5 billion in GDP every year (World Bank 2010b). The economic costs of undernutrition affect the most vulnerable and the poorest in the developing world. A recent analysis estimates these losses at 11 percent of GDP in Africa and Asia each year (Horton and Steckel 2013). This equals about $149 billion of productivity losses.

13. **Investing in early childhood nutrition interventions has the potential to super-charge the potential demographic dividend in Nigeria**. Demographic dividend refers to the growth in a country's economy resulting from changes in the age structure leading to a youth bulge and reduced dependency ratios in the population. This dividend is more likely to be realized if these cohorts are better nourished and productive. By increasing investment in human capital as fertility rates decline, Nigeria could potentially harness the demographic dividend by: (i) increasing GDP by nearly 50 percent and sustain that gain indefinitely; (ii) raise per capita incomes by 30 percent or more by 2030, and (iii) lift around 32 million additional people out of poverty by 2030 (Bloom et al. 2010).

14. **Most of the malnutrition that occurs in the first 1000 days of a child's life is essentially irreversible. Therefore, the window of opportunity for preventing malnutrition is the first 1000 days between pregnancy and two years of age**. After that age, most actions are too little, too late and too expensive (World Bank 2006; Black *et al*. 2008, 2013). **Figure 5** shows that the rates of return from nutrition investments are highest for programs targeting towards the earliest years since these investments build a foundation for future learning and productivity, prevent irreversible losses, and lock-in human capital for life (Heckman and Masterov 2004).

Figure 5. Rates of return to investment in human capital



Source: Heckman and Masterov (2004)

15. **Malnutrition and poverty are interrelated and exacerbate each other.** A recent study (Hoddinott et al. 2011) concludes that individuals who are not stunted at 36 months are one-third less likely to live in poor households as adults. Poverty increases the risk of malnutrition by lowering poor households' purchasing power, reducing access to basic health services, and exposing them to unhealthy environments, thereby compromising food intakes (both quality and quantity), and increasing infections. Poor households are also more likely to have frequent pregnancies, larger family sizes with high dependency ratios, more infections and increased health-care costs. Conversely, malnutrition causes poor health status, poor cognitive development and less schooling, resulting in in poor human capital and long-term productivity losses. However, as Figure 2 shows, *while child stunting rates are highest among the poorest two quintiles in Nigeria, even among the richest quintile nearly 25 percent children are stunted.* This suggests a need to design somewhat different strategies to address undernutrition among the poorest, vs those among the non-poor.

16. **Nutrition interventions are consistently identified as cost effective development actions and the costs of scaling up nutrition interventions are modest.** Hoddinott and colleagues (2013) estimated that for every dollar invested in programs to reduce stunting would generate between $24.4 and $26.6 in economic returns. Others have estimated global benefit-cost ratios for integrated child care programs to be between 9 and 16; for iodine supplementation for women, between 15 and 520; for vitamin A supplementation for children under 6 years, between 4 and 43; for iron supplementation for pregnant women, between 6 and 14; and for iron fortification per capita, between 176 and 200 (World Bank 2010). A recent World Bank publication estimated that investing in nutrition can increase a country's gross domestic product (GDP) by at least 3 percent annually. The same study estimated these investment costs at $10.3 billion per annum globally, to be financed through domestic public and private sector and donor resources (World Bank 2010a). These investments would provide preventive nutrition services to

about 356 million children, save at least 1.1 million lives and 30 million DALYs, and reduce the number of stunted children by about 30 million worldwide. Bhutta et al. (2013) came up with very similar estimates. In another study, Hoddinott, Rosegrant and Torero (2012) estimate that, for just $100 per child, interventions including micronutrient provision, complementary foods, treatments for worms and diarrheal diseases, and behavior change programs, could reduce chronic under-nutrition by 36 percent in developing countries. Clearly there is huge potential pay-off from dedicating more resources to the scale-up of evidence-based, cost-effective nutrition interventions.

D. A MULTI-SECTORIAL APPROACH FOR IMPROVING NUTRITION

17. **The determinants of malnutrition are multi-sectorial. Therefore, to successfully and sustainably improve nutrition outcomes, a multi-sectorial approach is needed.** At a proximate level, access to food, health, hygiene and adequate child care practices are key to reducing malnutrition. At a more distal level, poverty, women's status and other social factors play an important role. It has been demonstrated that direct actions to address the proximate determinants of malnutrition can be further enhanced by action on some of the more distal levels. For example, programs supporting improved infant and young child feeding practices will be more effective if they are complemented with programs to address gender issues through, for example, the reduction of women's workloads, thus allowing women more time for childcare. Similarly, conditional cash transfer programs that target the poor, if designed appropriately, have the potential not just to address poverty, but also to increase demand for nutrition services and good nutrition behaviors.

18. **While the health sector is key in delivering "nutrition-specific" interventions to the poor (such as Vitamin A supplementation or deworming), multisectoral "nutrition-sensitive" actions through agriculture sector, social protection, water and sanitation and poverty reduction programs have the potential to strengthen nutritional outcomes in several ways.** Examples of these include**:** (a) improving the context within which the nutrition-specific interventions are delivered, for example through investment in food systems, empowerment of women and equitable education; (b) integrating nutrition considerations into programs in other sectors as delivery platforms (such as conditional cash transfer programs) that will potentially increase the scale and coverage of nutrition-specific interventions,; and (c) by increasing "policy coherence" through government-wide attention to policies or strategies and trade-offs, which may have positive or unintended negative consequences on nutrition. The synergy with other sectors is critical to break the cycle of malnutrition and sustain the gains from direct nutrition-specific interventions (World Bank 2013b).

19. **There is currently very limited guidance on costing for nutrition-sensitive interventions for at least two reasons.** First, evidence on effectiveness of "nutrition-sensitive" interventions with respect to nutritional outcomes is limited. Second, compared with nutrition-specific interventions, estimating and attributing the costs of nutrition-sensitive interventions is more complex since these interventions have multiple objectives, improved nutrition outcomes being only one of them. Notwithstanding these limitations, the availability of costing information is crucial to assess cost effectiveness of these interventions, and this paper makes a first-ever attempt to address these issues.

20. **We identify and cost four selected nutrition-sensitive interventions that are relevant for scale-up in the Nigerian context, for which there is evidence of the positive impact on nutrition outcomes, and for which there is some cost information.** These include two interventions delivered through the agriculture sector—biofortification of cassava and aflatoxin reduction through biocontrol intervention—and two delivered through the education sector—school-based deworming and school-based promotion of good hygiene. Other potential nutrition-sensitive interventions include the reduction of women's work-loads through appropriate technologies in agriculture, social safety nets and conditional cash transfers targeted to the poor and designed to have an impact on nutrition outcomes, and water and sanitation programs that reduce the exposure to infections and childhood diseases.

21. **Biofortification has the potential to reduce micronutrient deficiencies in a highly cost-effective manner.** Biofortification uses plant breeding techniques to enhance the micronutrient content of staple foods. Evaluation of the orange-flesh sweet potato biofortification program in Uganda and Mozambique showed high farmer adoption, significant increase in vitamin A intakes and improvement of child vitamin A status (Arimond et al, 2011; Hotz et al. 2010). An ex-ante cost study of biofortification in 14 countries suggests that most cost per DALY averted fall in the "highly" cost-effective category, particularly in South Asia and Africa (Menakshi et al. 2010). A recent study by HarvestPlus that ranked countries using country-level data according to their suitability for investment in biofortification interventions identified Nigeria as "top priority" country for benefiting from biofortification (Asare-Marfo et al. 2013).

22. **Nigeria formally launched biofortified cassava to address vitamin A deficiency in 2012.** Cassava is one of the four most important staple foods (along with rice, maize and wheat) in the country. In 2013, three new cassava varieties are being introduced to 50,000 farmers household in Nigeria and could reach as many as 2 million farmers in the next three years. The three launched varieties have the potential to meet 25 percent of the daily vitamin A needs of consumers. Collaborating with HarvestPlus, the government will continue to work with farmers and the private sector to significantly scale up vitamin A-biofortified cassava dissemination.

23. **Biocontrol of aflatoxins has the potential to reduce aflatoxins in maize and groundnuts by at least 80-90 percent (Bandyopadhyay and Cotty 2013).** Field testing of biocontrol products in Burkina Faso, Kenya, Nigeria and Senegal, although not formally published, is producing extremely positive results. The method involves a single application of a product (AflaSafeTM) containing strains unique to that country. Efforts are already underway in Nigeria to build on this experience and expand the use of biocontrol products to control aflatoxins (Abt Associates 2014).

24. **School-based deworming has been proven to be an efficient and cost-effective intervention to address health and nutrition outcomes, with cost per DALY saved estimated at US$4.55 (J-PAL 2012)**. The cost of delivering deworming tablets through schools is inexpensive because it uses the existing infrastructure and delivery platforms in schools and community links with teachers. Teachers only need minimal training to safely administer the delivery, thus it does not add significantly to teachers' workloads. The delivery costs of school-based deworming in schools are about $0.04 per treatment (Guyatt 2003), yet the benefits are enormous. Bi-annual deworming significantly increased school attendance and reduced self-reported illness and anemia, while providing modest gains in height-for-age Z-scores in Kenya

(J-PAL 2012). Evidence from India also suggests that deworming has the potential to reduce cases of childhood stunting and underweight (Awasthi et al, 2013). In the long term, deworming improved self-reported health, increased total schooling years, and increased earnings by 20 percent (Baird et al 2011).

25. **School-based deworming in Nigeria is included in integrated Neglected Tropical Diseases (NTD) control policy and plan, a school health policy and school feeding guidelines.** In early 2013, Nigeria launched a multi-year national plan for the control and elimination of NTDs (NTD Master Plan). The NTD Master Plan provides a platform for Nigeria to stimulate global efforts to reach elimination and control of diseases under the London Declaration and the Millennium Development Goal 6. Nigeria's NTD plan, worth $332 million, will provide treatment for more than 60 million people annually over the next five years. In late 2012, Nigeria received a donation of 23,025 million tablets to support the scale-up of treatment to combat NTDs. The donated tables will be sufficient to treat nearly eight million school children and adults in 12 states.

26. **Improved hygiene behaviors through promotion of hand-washing and good hygiene behavior would decrease the risk of stunting in one in three children**. Correct hand washing at critical times can reduce diarrhea by 42 -47 percent and lower the incidence of diarrhea for children by 53 percent and reduce the incidence of acute respiratory infections (ARI's) by 44 percent (World Bank 2012). A recent campaign promoting hand washing with soap in primary schools in Egypt, China and Colombia demonstrated significant reduction in absenteeism related to diarrhea and respiratory-illness (UNICEF 2012). A study in Brazil showed a relationship between the effects of early childhood diarrhea on later school readiness and school performance, revealing the potential long-term human and economic costs of early childhood diarrhea (Lorntz et al. 2006).

27. **Effectiveness of promoting good hygiene behavior in schools is demonstrated by its long terms impact and broad effect on communities.** Schools are ideal settings for hygiene education, where children can learn and sustain lifelong proper hygiene practices through peer-to-peer teaching, classroom sessions with focused training materials and role-playing or interactive songs. A study on the long-term effect of hygiene education program for both adults and children found that hygiene behaviors are sustained beyond the end of an intervention. The study also found that educated students can also influence family members by sharing this information, which may in turn affect behavior change at the community level (Bolt and Cairncross 2004).

E. PARTNER EFFORTS TO ADDRESS MALNUTRITION IN NIGERIA

28. **Many partners are supporting the Federal Ministry of Health to address malnutrition in Nigeria and most of the interventions are in the north where malnutrition is most severe.** Partners include UNICEF, DFID, Helen Keller International (HKI), Micronutrient Initiative, Save the Children UK, Global Alliance for Improved Nutrition (GAIN), Action Against Hunger, Valid International and Food Basket International (Government of Nigeria 2014). UNICEF implements nutrition programs in 36 states and mainly provides support for Infant and young child feeding, micronutrient deficiency control and treatment of severe acute malnutrition through Community Management of Acute Malnutrition (CMAM). DFID supports the Working to Improve Nutrition in Northern Nigeria (WINNN) program which provides key

services to children under five in five states in Northern Nigeria. Interventions include community-based management of acute malnutrition, vitamin A supplementation and deworming, and promotion of improved infant and young child feeding practices. Nigeria is a priority country for Save the Children's *Global Child Survival Campaign* and Save the Children UK supports the Katsina State Ministry of health. GAIN works with the National Agency for Food and Drug Administration (NAFDAC) to fortify wheat and maize flour with iron, vegetable oil with vitamins A and B and sugar with vitamin A. (**Appendix 1** provides a list of region- and state-specific partner interventions.)

PART II – RATIONALE AND OBJECTIVES FOR DEVELOPING A SET OF COSTED SCALE-UP SCENARIOS FOR NIGERIA

29. **The overall objective of this programmatic Knowledge Product (KP) is to support the Government of Nigeria to develop a costed scale-up plan for nutrition. This scale-up plan will be complemented with a health-sector fiscal space analysis financed by the Children's Investment Fund Foundation (CIFF), conducted by Results For Development (R4D).** These efforts will provide the Government of Nigeria with the tools needed to leverage adequate resources from their domestic budgets, as well as from development partners in support of the costed scale-up plan. Within this context, the objectives of this analysis are as follows:

i. To estimate scale-up costs in Nigeria for a set of well-proven nutrition-specific interventions that have the potential to be scaled-up through tested delivery mechanisms;
ii. To conduct a basic economic analysis to calculate the potential benefits and cost effectiveness associated with the proposed scale up;
iii. To propose a series of scenarios for a costed scale-up plan that rolls out this package of nutrition-specific interventions in phases, based on considerations of impact, geography, implementation capacity and costs;
iv. Explore initial costs for a limited number of nutrition-sensitive interventions through the agriculture and education sectors.

30. **While the economic arguments for increasing investments in nutrition are sound, one of the first questions raised by key decision-makers in any country is "How much will it cost?"** In 2010, the World Bank spearheaded a study, *Scaling Up Nutrition: What will it Cost?* to answer that question at the global level. The analysis estimated the level of global financing required to scale up 10 evidence-based nutrition-specific interventions in 36 countries that account for 90 percent of the world's stunting burden and 32 smaller countries which also have a high prevalence of undernutrition. The results of the study highlighted the global financing gap, underscored the importance of investing in nutrition at the global level, and laid out a methodology for estimating the costs for nutrition-specific interventions. However, these global estimates did not capture the nuances and context in each country, nor were these estimates contextualized to every individual country's policy and capacity setting or its fiscal constraints. This report builds on the early work to address this gap, and contextualize the cost estimates for Nigeria.

31. **Further, the multisectoral approach requires nutrition-sensitive approaches or interventions that can be delivered through other sectors.** As discussed above, there is currently very limited guidance on costing for nutrition-sensitive interventions. Therefore, this is an exploratory analysis, to be used primarily to engage other sectors in planning for nutritional outcomes. This initial exercise will contribute to a broader discussion about methodological and other issues for costing nutrition-sensitive interventions, and will thereby encourage the formulation of standard definitions, methodologies and guidance for costing these interventions in the future.

PART III – METHODOLOGY

A. SCOPE OF THE ANALYSIS AND DESCRIPTION OF THE INTERVENTIONS

32. **The costed scale up plan is presented in two sections. The first section** presents estimated costs and benefits for the set of 10 nutrition-specific interventions that were included in World Bank 2010 and are primarily delivered through the health sector. These interventions and the associated target population and current coverage for each intervention are specified in **Table 1**. In the next section, we explore the costs of implementing a few selected the nutrition-sensitive interventions that will be delivered through the agriculture and education sectors. A description of these interventions, associated target populations, and responsible sectors are listed in **Table 2**.

33. **The nutrition-specific interventions considered are a modified package of the interventions included in the 2008 and 2013 *Lancet* series on Maternal and Child Undernutrition**. These ten interventions are based on current scientific evidence and there is general consensus from the global community around the impact of these interventions. Some interventions, such as deworming and iron-fortification of staple foods, which were included in the 2008 *Lancet* series but no longer listed in the 2013 *Lancet* series are included here as they remain relevant. Others, such as calcium supplements for women, or prophylactic zinc supplementation are excluded because delivery mechanisms are not available in client countries and/or there are no clear WHO protocols or guidelines for large scale programming. In other cases, there are limited capacities for scaling up the interventions. Only those nutrition-specific interventions that have strong evidence of effectiveness, have a WHO protocol, and a feasible delivery mechanism for scale-up are included in the proposed scale-up package below.

Table 1. Nutrition-Specific Interventions Delivered Primarily Through Health Sector

Intervention	Description	Target Population	Current coverage
1. Community nutrition programs for growth promotion	Behavior change communication focusing on optimal breastfeeding and complementary feeding practices, proper hand-washing, sanitation and good nutrition practices	Children 0-23 months of age	Negligible
2. Vitamin A supplementation	Semi-annual doses	Children 6-59 months of age	67.2% (MICS 2011)
3. Therapeutic zinc supplementation with ORS	As part of diarrhea management with ORS	Children 6-59 months of age	Negligible
4. Multiple micronutrient powders	For in-home fortification of complementary food (60 sachets between 6-11 months of age, 60 sachets between 12-17 months of age, and 60 sachets between 18-23 months of age).	Children 6-23 months of age not receiving fortified complementary food*	Negligible
5. Deworming	Two rounds of treatment per year	Children 12-59 months of age	28.4% (FMOH)
6. Iron-folic acid	Iron-folic acid supplementation	Pregnant women	28.5% (MICS

supplementation	during pregnancy		2011)
7. Iron fortification of staple foods	Fortification of wheat flour with iron	General population	Negligible
8. Salt iodization	Iodization of centrally-processed salt	General population	77.5% (MICS 2011)
9. Public provision of complementary food for prevention of moderate acute malnutrition	Provision of a small amount (~250 kcals per day) of nutrient-dense complementary food for the prevention of moderate malnutrition (moderate acute malnutrition and/or moderate stunting)	Twice the prevalence of underweight (WAZ < -2) among children 6-23 months of age*	Negligible
10. Community-based management of severe acute malnutrition	Includes the identification of severe acute malnutrition, community or clinic-based treatment (depending on the presence of complications), and therapeutic feeding using ready-to-use therapeutic food	Incidence (estimated as twice the prevalence) of severe wasting (WHZ <-3) among children 6-59 months of age	34.5% (data from 11 states provided by UNICEF)

34. **In the follow-on section, the analysis focuses on nutrition-sensitive interventions that have the potential to have an impact on nutrition outcomes.** As discussed above, there is not as much evidence-based research on nutrition-sensitive interventions as there is for nutrition specific interventions. Therefore, our estimates are exploratory and are limited to four potential interventions that can be scaled up and have potential for impact on nutrition outcomes. Additional interventions were not included in these initial estimates because the impact on nutrition is yet to be clearly documented (Masset et al. 2011; World Bank 2013; Ruel et al. 2013), and because this is an exploratory instead of an exhaustive effort. Furthermore, cost attribution is complex because these interventions are designed for multiple purposes.

Table 2. Multi-Sectorial, Nutrition-Sensitive Interventions – an exploratory process

Intervention	Description	Target Population	Potential for impact
Interventions to be delivered through the agricultural sector			
Biofortification	Promote use of vitamin A-rich cassava varieties to 50,000 farming households in 2013 and potentially expanded to 1.8 million farmers	General population	Increase in vitamin A intakes and improve vitamin A status (Hotz 2012a, 2012b)
Aflatoxin control	Promote use of biocontrols such as AflaSafeTM for maize and groundnuts	General population	Improve child nutrition status (stunting) and reduce morbidity (Khlangwiset and Wu 2011)
Interventions to be delivered through the education sector			
School-based deworming	Distribution of mebendazole/albendazole to school-age children and training to school teachers, community workers and health workers	School-aged children	Reduce anemia and morbidity, improve cognitive outcomes (Miguel and Kremer 2004)

School-based promotion of good hygiene	Hygiene education program to teach healthy practices in schools	School-aged children	Improve child nutrition outcomes (stunting)(Spears 2013)

B. ESTIMATION OF TARGET POPULATION SIZES, CURRENT COVERAGE LEVELS AND UNIT COSTS

35. Target population estimates are based primarily on demographic data obtained from the Federal Ministry of Health and UNICEF Nigeria and are provided in Appendix 2. UNICEF Nigeria projected the sizes of the various subgroups at the state level in 2013 using data from Nigeria's National Population Commission. The prevalence of child stunting (height-for-age Z-score <-2), underweight (weight-for-age Z-score <-2), and severe wasting (weight-for-height Z-score <-3) among children under five years of age in each state were obtained from the 2013 Nigeria MICS survey data.

36. Data on current coverage levels for interventions was obtained from various sources. Current coverage levels for community nutrition programs for behavior change communication, zinc supplementation with ORS, multiple micronutrient powders for home fortification, iron fortification of staple foods, and provision of complementary food for the prevention of moderate malnutrition were set to zero percent either because the intervention was not being implemented and coverage was very minimal or because current reliable data were not available. Coverage data for vitamin A supplementation were obtained from the 2011 Nigeria MICS report. Data on deworming coverage were from programmatic data from the first round of MNCH weeks in 2012 as reported by the Federal Ministry of Health (FMOH). For coverage of iron folic acid supplementation for pregnant women, MNCH programmatic data from the FMOH were used for all states. The 2011 Nigeria MICS survey data were used to estimate the proportion of households consuming adequately iodized salt in each state. Finally, UNICEF provided data on the number of children treated for severe acute malnutrition in the 11 states where programs for Community Management of Acute Malnutrition (CMAM) supported by the Children Investment Fund Foundation (CIFF) are in operation. Data from the more recent semi-annual SMART surveys were explored, but were considered unsuitable for these purposes because of concerns about validity.8 Preliminary results from the Nigeria DHS 2013 provided estimates of the current incidence of severe acute malnutrition and moderately acute malnutrition. We also used the DHS 2013 to classify the states according to levels of stunting

37. **Whenever possible, the unit costs of the nutrition-specific interventions were estimated using programmatic data that were provided by local implementing partners, the Federal Ministry of Health, and state governments based on program experience.** The estimated unit costs and the delivery platforms are listed in **Table 3**. In cases where the intervention was not yet being implemented or local data were not available, the global unit cost estimate from the World Bank (2010a) was used. A complete index of data sources and relevant assumptions for these interventions can be found in **Appendix 3**.

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[8] For example, the state-levels estimates of stunting (a long-term measure of malnutrition) varied tremendously from one semi-annual survey to the next. Even with changes to the growth reference used, erratic patterns remained and could not be reconciled.

Table 3. Unit Costs and Delivery Platforms Used in the Calculations for Nutrition-specific Interventions

Intervention	Unit Cost (US$ per beneficiary per year)	Costed Delivery Platform
1. Community nutrition programs for growth promotion of children*	$5.00	Community nutrition programs
2. Vitamin A supplementation for children*	$0.44	MNCH weeks
3. Therapeutic zinc supplementation with ORS for children*	$0.86	MNCH weeks
4. Multiple micronutrient powders for children**	$3.60	Community nutrition programs
5. Deworming for children*	$0.44	MNCH weeks
6. Iron-folic acid supplementation for pregnant women*	$1.79 (MNCH weeks) $2.00 (community nutrition programs)	40% via MNCH weeks 60% via Community nutrition programs
7. Iron fortification of staple foods for general population**	$0.20	Market-based delivery system
8. Salt iodization for general population**	$0.05	Market-based delivery system
9. Public provision of complementary food for prevention of moderate acute malnutrition in children**	$51.10	Community nutrition programs
10. Community-based management of severe acute malnutrition in children *	$80.00	Primary health care and Community Nutrition programs

*denotes unit cost based on cost data from Nigeria.
** denotes unit cost based on global estimates.

38. **For the nutrition-sensitive interventions, the unit costs were estimated using global estimates with the exception of aflatoxin control.** The unit cost for aflatoxin per hectare comes from the International Institute for Tropical Agriculture (IITA) in Nigeria (Bandyopadhyay 2013). The other interventions are not yet implemented and no programmatic data are available from local implementing partners so the only data available are global data. The unit costs and the delivery platforms are listed in **Table 4**.

Table 4. Unit Costs and Delivery Platforms Used in the Estimations for selected nutrition-sensitive Interventions

Intervention	Unit Cost (US$ per beneficiary per year)	Costed Delivery Platform
1. Biofortification of vitamin A-rich yellow cassava	n/a	Agriculture production
2. Aflatoxin control through biocontrol application	$15.60 per hectare	Agriculture production
3. School-based deworming	$0.08	School-based deworming

		distribution
4. School-based promotion of good hygiene	$2.00	Hygiene education campaign

C. ESTIMATION OF COSTS AND BENEFITS

39. **The "program experience" methodology employed in World Bank (2010a is used for calculating the cost of scaling up in Nigeria.** The "program experience" approach generates unit cost data that capture all aspects of service delivery (e.g. costs of commodities, transportation and storage, personnel, training, supervision, monitoring and evaluation, relevant overhead, wastage etc.) for each intervention from actual programs that are in operation in Nigeria 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 (for example, number of visits to a health center) (e.g. in Bhutta et al. 2013). Although the "program experience" approach tends to yield cost estimates that are higher than the "ingredients approach," the estimates more accurately reflect real programmatic experience, including inefficiencies in service delivery. It should, however, be noted 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.

40. **We calculate the annual public investment required to scale up the interventions as follows:**

$$Y = (x_1 + x_2) - x_3$$

where:
Y = annual public investment required to scale up to full coverage
x_1 *= additional total cost to scale up to full coverage*
x_2 *= additional cost for capacity development, M&E, and technical assistance*
x_3 *= cost covered by households living above poverty line for selected interventions*

Appendix 4 describes the methodology in detail.

The expected benefits from scaling up nutrition interventions are calculated in terms of: (i) DALYs saved; (ii) number of lives saved; (iii) cases of childhood stunting averted; and (iv) increased program coverage. To calculate the number of DALYs, we use the method employed by Black et al. (2008) to estimate the averted morbidity and mortality from scaling up different nutrition interventions. The method uses population attributable fractions (PAF) based on the comparative risk assessment project (Ezzati et al. 2004; Ezzati et al. 2002) to estimate the burden of infectious diseases attributable to different forms of undernutrition using most recent Global Burden of Disease study (2010). DALY estimates in this study are neither discounted nor age-weighted, in line with the methodology used in the IMHE Global Burden of Disease 2010 and the WHO Global Health Estimates 2012. **Appendix 5** describes the detailed methodology for calculation of DALYs. The projected number of lives saved and cases of childhood stunting averted are calculated using the Lives Saved Tool (LiST), which translates measured coverage changes into estimates of mortality reduction and changes in the prevalence of under five stunting. This analysis included all ten interventions to calculate the number DALYs saved. However, due to methodological limitations of the LiST tool, the calculation for number of lives saved is based on only six[9] of the ten interventions, and cases of childhood stunting averted is based on only four[10] of the ten. As such, our estimates are likely to underestimate the number of lives saved and cases of childhood stunting averted. **Appendix 6** describes the methodology for the LiST estimates.

41. **The measures for cost-effectiveness of nutrition-specific interventions are calculated in terms of "cost per DALY saved", "cost per life saved" and "cost per case of stunting averted."** Estimates of benefits were combined with information on costs to produce the cost effectiveness measures for each intervention as well as for overall package of intervention. The evaluation of cost-effectiveness ratio in terms of DALYs saved is based on the categorization used by WHO-CHOICE (Choosing Interventions that are Cost-Effective):[11] an intervention is considered as "very cost-effective" if the range for the cost per DALY averted is less than GDP per capita[12], "cost-effective" if it is between 1 to 3 times GDP per capita, and "not cost-effective" if it exceeds 3 times GDP per capita (WHO 2014). Due to limitations in the available data, we were unable to calculate the number of cases of stunting averted for some of the scenarios.

42. **Cost-benefit analysis (CBA) is conducted 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, we use estimates of number of lives saved and reduction in stunting prevalence produced by the LiST tool. Following established practice, a life year saved is valued as equivalent to GNI per capita, which we consider to be a conservative measure as it only accounts for the economic and not social value of a year of life. In order to estimate the value of the reduction in stunting, we follow the methodology used in Hoddinott et al. (2013), which values a year of life lived without stunting based on the assumption that stunted individuals lose an average of 66 percent of lifetime earnings. Future benefits are then age-adjusted and discounted at three potential discount rates (3, 5 and 7 percent) in order to arrive at their present value. The present value of future benefits is then compared with the annual public investment required, which allows us to estimate the net present value (NPV) and internal rate of return (IRR) of the investment. A detailed explanation of the benefit estimation methodology can be found in **Appendix 7**.

43. **The annual increase in economic productivity attributable to each package of interventions is calculated based on the same estimates of future benefits.** Although these benefits only occur once beneficiaries have reached productive age, we assume that these

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[9] The six interventions are community nutrition programs for growth promotion, vitamin A supplementation, therapeutic zinc supplementation with ORS, iron-folic acid supplementation, the public provision of complementary food for the prevention of moderate acute malnutrition and community-based management of severe acute malnutrition.

[10] The four interventions are community nutrition programs for growth promotion, vitamin A supplementation, iron-folic acid supplementation and the public provision of complementary food for the prevention of moderate acute malnutrition.

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

[12] Nigeria's GDP per capita in current USD was $3,010 in 2013 (World Bank 2013)

benefits serve as an approximation of the present value of economic productivity lost each year as a result of mortality and morbidity that would otherwise be prevented by scaling up nutrition interventions. Values presented are taken from a year in which all beneficiaries have reached productive age.

44. **The approach for estimating the potential costs and benefits of nutrition sensitive interventions differs from the methodology used for nutrition specific interventions.** Similar to nutrition specific interventions, the total cost for scaling up the interventions is calculated by multiplying the unit cost by the target population (local Nigerian unit costs or regional unit costs are used depending on availability). However, since most nutrition-sensitive interventions have multiple objectives, it is not always feasible to attribute the nutrition related benefits to the overall costs of the interventions. Because these constraints limit the accuracy of cost-effectiveness estimates, we instead rely on secondary sources/published literature when available, with cost-effectiveness presented in terms of cost per DALY saved.

D. SCENARIOS FOR SCALING UP NUTRITION INTERVENTIONS

45. **When estimating the costs and benefits of scaling up nutrition interventions, we begin with estimates for scaling all ten interventions to full national coverage, followed by estimates for various scale up scenarios.** The "full coverage" estimates can be considered the medium-term policy goal for FGoN, however, resource constraints will likely limit the government's ability to achieve full national coverage in the short-term. Therefore, we also propose 5 scenarios for prioritizing the scale up of nutrition interventions over a shorter-term time frame of 5 years:

- **Scenario 1**: Prioritize scale up by region
- **Scenario 2**: Prioritize scale up by intervention
- **Scenario 3**: Prioritize scale up by state
- **Scenario 4:** Prioritize scale up by state and by intervention
- **Scenario 5**: Prioritize scale up by target coverage

Within each scenario we consider several variations and analyze their cost-effectiveness in terms of cost per DALY saved, cost per life saved and cost per case of childhood stunting averted. After our initial analysis, we present the 5 most attractive scale-up scenarios and discuss them in more detail.

46. **"Full coverage" is defined as 100 percent of the target population for all interventions except the treatment of severe acute malnutrition, for which full coverage is assumed to be 80 percent.** This is consistent with the methodology used in World Bank, 2010a, and is based on the reality that few community-based treatment programs have successfully achieved more than 80 percent coverage at scale. Under Scenario 5, we also propose several "partial coverage" scenarios that reduce coverage targets to more realistic levels, including some coverage rates that are in line with the coverage envisioned in the Government's draft National Strategic Plan for Nutrition.

PART IV – RESULTS FOR NUTRITION-SPECIFIC INTERVENTIONS

A. TOTAL COST, EXPECTED BENEFITS AND COST EFFECTIVENESS

47. **The total additional public investment required to scale up 10 nutrition-specific interventions from current coverage levels to full coverage at the national-level in Nigeria is estimated at US$837 million annually (Table 5)**. This cost includes the additional cost of scaling up all ten interventions across the entire country (US$892 million per year) plus additional resources for monitoring and evaluation, operations research and technical support, and capacity development for program delivery (estimated at US$98 million). Of this total amount of US$991 million, part of the costs for iron fortification, multiple micronutrient powders, salt iodization and complementary food could be covered from private resources from households above the poverty line (estimated at US$153 million), which leaves a financing gap of US$837 million for a full scale-up nationwide.

Table 5. Estimated Cost of Scaling Up 10 Nutrition Specific Interventions to Full Coverage

Intervention	Annual Cost (US$ million)
Community programs for growth promotion of children	70
Vitamin A supplementation for children	5
Therapeutic zinc supplementation with ORS for children	27
Micronutrient powders for children	19
Deworming for children	18
Iron-folic acid supplementation for pregnant women	12
Iron fortification of staple foods for general population	35
Salt Iodization for general population	2
Public provision of complementary food for prevention of moderate acute malnutrition in children	413
Community-based management of severe acute malnutrition in children	294
Total cost for scaling up all 10 interventions	**892**
Capacity development for program delivery	80
M&E, operations research and tech. support	18
Household contributions	**(153)**
ANNUAL PUBLIC INVESTMENT REQUIRED	**837**

48. **A five-year budget for the scale up of all 10 interventions nationwide is estimated to cost between US$ 2.4 and 2.9 billion, depending on the how fast the program reaches full coverage.** We have provided these figures (**Table 6**) for the purpose of comparison only. When the 10 interventions are fully scaled up by year 3, the total programmatic costs over five years is estimated at US$2.9 billion. If full coverage is reached by year 4, then the total cost is US$2.7 billion. If it takes five years to reach full coverage, then the total five-year budget would be US$2.4 billion

Table 6. Scale up of all 10 Interventions Over 5 years, 3 Scenarios in US$ Millions

Time to Reach 100% Scale	Year 1 (20% coverage)	Year 2 (40% Coverage)	Year 3 (60% coverage)	Year 4 (80% coverage)	Year 5 (100% coverage)	Total Scale Up Costs Over 5 Years
3 Years	192	403	773	765	765	**2,897**
4 Years	192	403	576	765	765	**2,700**
5 Years	184	327	462	614	765	**2,351**

49. **The expected benefits from scaling up these ten nutrition-specific interventions across the entire country are enormous (Table 7).** Over 8.7 million DALYs and 183,000 lives would be saved annually, while more than 3 million cases of stunting among children under five would be averted. Program coverage is assumed to expand as follows:

- 14 million families with children 0-23 months reached by community programs for behavior change communication and growth promotion;
- 10.6 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 31.4 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 5.2 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 39.9 million children 12-59 months receive deworming medication;
- 6.3 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million people consume staple foods fortified with iron;
- 38.8 million more people who do not currently use iodized salt obtain it;
- 3.7 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 8.1 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

Table 7. Estimated Annual Benefits for Scaling Up 10 Nutrition Interventions to Full Coverage

Intervention	Beneficiaries Covered	DALYs Saved*	Lives Saved	Number of Stunting Cases Averted
Community nutrition programs for growth promotion of children	13,955,394	5,795,862	89,140	1,859,167
Vitamin A supplementation for children	10,545,198	161,396	10,718	303,844
Therapeutic Zinc supplementation with ORS for children	31,399,636	125,270	28,988	n/a
Micronutrient powders for children	5,217,156	426,585	n/a	n/a
Deworming for children	39,893,072	66,399	n/a	n/a
Iron-folic acid supplementation for pregnant women	6,276,280	269,893**	1,867	12,033
Iron fortification of staple foods for general population	174,442,422	n/a	n/a	n/a
Salt Iodization for general population	38,757,068	n/a	n/a	n/a
Public provision of complementary food for prevention of moderate acute malnutrition in children	8,072,408	126,677	14,445	2,006,577
Community-based management of severe acute malnutrition in children	3,669,417	1,735,878	91,340	n/a
Total when all interventions implemented simultaneously* **	n/a	8,707,960	183,411	3,056,494

* DALY estimates in this study are neither discounted nor age-weighted, in line with the methodology used in the IMHE Global Burden of Disease 2010 and the WHO Global Health Estimates 2012. For more information on the methodology used to calculate DALYs averted, see Appendix 5.
** DALY estimates for IFA supplementation are calculated for DALYs averted among pregnant women. They do not include the DALYs averted among children born to mothers who received these supplements.
*** The total of the interventions implemented simultaneously does not equal to the sum of the individual interventions. This is because some interventions affect nutrition outcomes via similar pathways causing their combined impact to be different than the individual sums.

50. **Most proposed nutrition-specific interventions are highly cost-effective (Table 8).** With the exception of the public provision of complementary food, our analysis finds that all interventions are "very cost-effective" according to WHO criteria (WHO 2014). Using the same criteria, the public provision of complementary food is considered to be "cost-effective". DALY estimates for salt iodization and iron fortification of flour in Nigeria are not available at this time.

51. **In countries such as Nigeria where fiscal and capacity constraints will limit scale-up, the public provision of complementary foods may be a lower priority.** Issues of governance, accountability, and supply logistics will further constrain the scale-up of the public provision of complementary foods. While the benefits are clear, the relatively high cost of this type of intervention, in addition to the aforementioned concerns, lead us to conclude that the public provision of complementary food should be implemented only once adequate capacity has been developed.

52. **For the package as a whole, the total cost per DALY saved is estimated at $102, the total cost per life saved is estimated at $4,865, and the total cost per case of stunting averted is estimated to be $292.**[13] Variation in costs among the interventions is high, with costs per life saved ranging from $433 for vitamin A supplementation to $28,557 for the public provision of complementary foods. Overall, these cost estimates translate into an increase in annual public resource requirements of $14.50 per child. This compares favorably to global estimates of $30 per child calculated in World Bank (2010a).

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[13] For the total cost per benefit unit, we divide the total annual program cost for all 10 interventions (excluding M&E, and capacity development costs, but before subtracting household contributions) by the benefits estimates available. Note that DALYs saved estimates are not available for 2 of the 10 interventions, lives saved estimates are not available for 4 of the 10 interventions and stunting reduction estimates are not available for 6 of the 10 interventions.

Table 8. Cost Effectiveness of Scaling Up 10 Nutrition Interventions to Full Coverage, US$

Intervention	Cost/DALY Saved		Cost/Life Saved	Cost/Stunted Case Averted
	Nigeria	Global		
Community nutrition programs for growth promotion of children	12*	53-153	783	38
Vitamin A supplementation for children	29*	3-16	433	15
Therapeutic Zinc supplementation with ORS for children	216*	73	932	
Micronutrient powders for children	44*	12		
Deworming for children	264*	n/a		
Iron-folic acid supplementation for pregnant women	43*	66-115	6,280	974
Iron fortification of staple foods for general population		n/a		
Salt Iodization for general population		n/a		
Public provision of complementary food for prevention of moderate acute malnutrition of children	3,256**	500-1000	28,557	206
Community-based management of severe acute malnutrition of children	169*	41	3,214	
TOTAL when all interventions implemented simultaneously* **	**102***	**n/a**	**4,865**	**292**

*Very cost-effective according to WHO-CHOICE criteria (WHO 2014).
**Cost-effective according to WHO-CHOICE criteria (WHO 2014).
*** The total of the interventions implemented simultaneously does not equal to the sum of the individual interventions. This is because some interventions affect nutrition outcomes via similar pathways causing their combined impact to be different than the individual sums.

B. POTENTIAL SCALE-UP SCENARIOS

53. **Scenario 1: Scale Up by Region**. **Table 9** shows the estimated costs and benefits of scaling up the ten nutrition specific interventions by region. The regions display significant disparities in malnutrition rates. All states in the North-Western region have stunting levels above 40 percent (nearly 2.5 times that in the South East) and this region accounts for almost 40 percent of the overall costs. The states with high malnutrition rates will disproportionately benefit from scaling up nutrition interventions as demonstrated by high expected benefits in terms of DALYs saved and lives saved.

Table 9. Scenario 1: Cost and Benefits of Scaling Up 10 Nutrition Interventions by Region

Region	Annual Public Investment (US$ million)	Annual Benefits	
		DALYs Saved	Lives Saved
North-Central	$81	1,255,680	24,530
North-Eastern	$134	1,205,553	27,570
North-Western	**$405**	**2,502,917**	**60,022**
South-Eastern	$58	899,369	16,278
South-South	$69	1,199,935	22,212
South-Western	$91	1,644,492	32,798
TOTAL	**$837**	**8,707,946**	**183,411**

54. **Given the high stunting rates in the North-West, the preferred scenario (Scenario 1) is to scale up interventions in states in the North-West region, with an annual public investment of $405 million. This scenario would save over 2.5 million DALYs and at least 60,000 lives.** It would also increase program coverage as follows:

- 3.6 million families with children 0-23 months reached by community programs for behavior change;
- 3.6 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 8.0 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 0.08 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 9 million children 12-59 months receive deworming medication;
- 1.2 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 44.3 million people able to consume staple foods fortified with iron;
- 16.6 million more people gain access to iodized salt;
- 2.0 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 16.5 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

However, because budgetary allocations in Nigeria are done by state, rather than by region, the regional scale-up approach is not a pragmatic option.

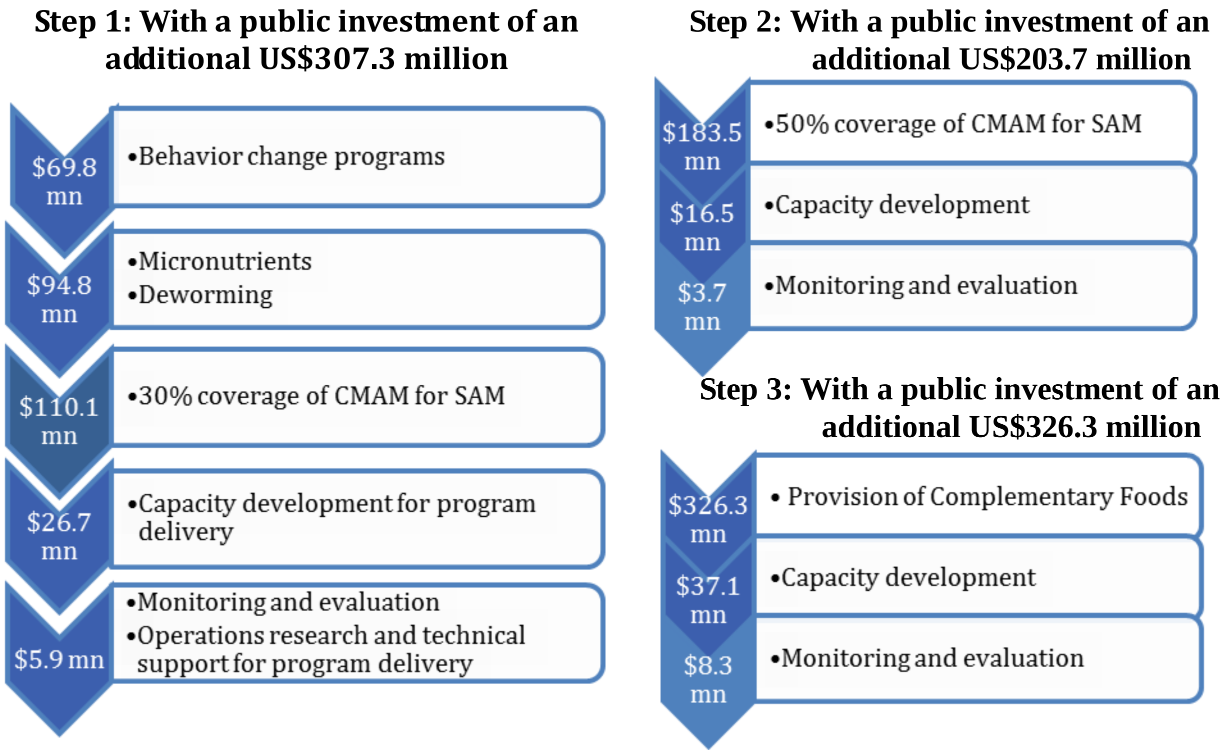
55. **Scenario 2: Scale Up by Intervention.** Scenario 2 is based on step-wise scale-up by intervention. The primary considerations for choosing the interventions in each step are cost effectiveness, recommended phasing of interventions, implementation capacity and delivery mechanisms. The proposed plan for a step-wise scale-up by intervention is summarized below and illustrated in **Figure 6**.

- **Step 1** focuses on a package of primarily preventive interventions that can be scaled up quickly, either with existing capacities or with modest investment in capacity-building for community nutrition programs and child health days. It also includes community-based management of severe acute malnutrition at 30 percent coverage. Although in most other country contexts, this is a resource-intensive intervention and relatively complex to implement, in Nigeria, efforts are already underway to implement community-based management of severe acute malnutrition in 11 states, and some capacities have been built, making the 30 percent coverage goal feasible. The cost of scaling up community nutrition programs for behavior change communication and all micronutrient and deworming interventions at full coverage in all states and community-based management of severe acute malnutrition to reach 30 percent of the target population is US$296.4 million. An additional US$26.7 million for capacity development and US$5.9 million for monitoring and evaluation, operations research, and technical support is budgeted, which brings the total cost of step one to US$329.0 million. The portion of scale up costs that could be covered by households above the poverty line is estimated at US$21.7 million. **Therefore the total public investment required for Step 1 is estimated at US$307.3 million**.

- **Step 2** includes the costs of a full scale up of treatment for severe acute malnutrition from a base of 30 percent in Step 1 to 80 percent coverage, with the assumption that additional implementation capacities are built in Step 1. The estimated cost of this scale-up is US$183.5 million. We also include an additional US$3.7 million for monitoring and evaluation, operations research, and technical support and US$16.5 million for capacity development in step two, which brings the total **public investment required for Step 2 to US$203.7 million**.
- **Step 3** adds scaling up of the public provision of complementary foods to prevent moderate acute malnutrition among children under 2 years of age. The total cost of this intervention is US$412.5 million. The additional cost for monitoring and evaluation, operations research, and technical support and capacity development in step three is US$45.4. Of the total cost, an estimated US$131.6 million could be resourced from private resources in households above the poverty line. This brings **the estimated public investment required for Step 3 to US$326.3 million**.

Step 3 interventions are assigned the lowest priority for the following reasons: (i) the 2013 *Lancet* nutrition series concluded that there are no additional benefits of public provision of complementary foods beyond those provided by dietary counseling and education; (ii) at US$6,849 per DALY saved, the cost-effectiveness of public provision of complementary foods is much less attractive than that of other proposed interventions; (iii) the total cost of complementary foods is overwhelming and accounts for more than half cost of the total cost of scaling up all interventions, while the benefits as estimated lives saved or DALYs saved are lower than other interventions; (iv) governance, accountability, supply-chain, and logistics are key challenges associated with large-scale food distribution and are not inconsequential in a country the size of Nigeria. The estimated benefits do not out-weigh these risks, and the costs are high, as compared with other interventions. Under these circumstances, rapid scale-up is neither feasible nor is it recommended.

Figure 6. Scenario 2: Step-wise Scale-Up by Intervention



Note: A portion of the intervention will be resourced from private resources from households above the poverty line, which explains why the arrows do not sum exactly to total. (See text for details.)
Source: Authors' calculations.

56. **The preferred scale-up Scenario 2 would be to scale up Step 1 and Step 2 interventions, requiring an annual public investment of $511 million. As shown in Table 10, this would save over 8.5 million DALYs and over 164,000 lives. It would also provide the following additional program coverage:**

- 14 million families with children 0-23 months reached by community programs for behavior change;
- 10.6 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 31.4 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 5.7 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 39.9 million children 12-59 months receive deworming medication;
- 6.3 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million people able to consume staple foods fortified with iron;
- 38.8 million more people gain access to iodized salt;
- 3.7 million more children 6-59 months treated for severe acute malnutrition using community-based management practices.

Table 10. Scenario 2: Cost and Benefits for Scaling Up 10 Nutrition-specific Interventions by Intervention

Interventions	Annual Public Investment (US$ millions)	Annual Benefits	
		DALYs Saved	Lives Saved
Step 1: Community nutrition programs for growth promotion, all micronutrient and deworming, 30% coverage of community-based management of severe acute malnutrition	**$307**	**7,496,345**	**122,638**
Step 2: 50% of community-based management of severe acute malnutrition	**$204**	**1,084,924**	**56,742**
SUBTOTAL (STEP 1 AND 2 INTERVENTIONS WHEN IMPLEMENTED SIMULTANEOUSLY)*	**$511**	**8,581,269**	**164,390**
Step 3: Public provision of complementary food for moderate acute malnutrition	$326	126,677	14,445
TOTAL when all interventions implemented simultaneously*	**$837**	**8,707,946**	**183,411**

** The total of the interventions implemented simultaneously does not equal to the sum of the individual interventions. This is because some interventions affect nutrition outcomes via similar pathways causing their combined impact to be different than the individual sums.*

57. **Scenario 3: Scale Up by State.** Scenario 3 proposes scaling up all 10 interventions in three steps using state-level geographic targeting criteria based on the prevalence of child stunting in these states. First are the **highest burden states** with a stunting prevalence above 35 percent. The **middle burden states** are those with a stunting prevalence between 25 and 35 percent and the **lowest burden states** are those with stunting prevalence below 25 percent. The step-wise scale-up by state is summarized below and **Table 11** shows the estimated cost and benefits for each step.

- For the **highest burden states**, all 10 interventions would be scaled up in the 13 states with a stunting prevalence above 35%. Eleven of the 13 states are in North-Western and North-Eastern regions, and one (Plateaux) is in the North-Central region. It is proposed that Nasarawa would also be included since it is currently participating in the results-based financing program. The total cost including costs of M&E operations research, technical assistance, and capacity development would be US$578.8 million. Adjusting for household contributions, **the annual public investment required for the highest burden states is estimated at US$506.9 million.**
- Next, for the **middle burden states**, all 10 interventions would be scaled up in 5 states with a stunting prevalence between 25 and 35 percent. The total cost including costs of M&E operations research, technical assistance, and capacity development would be US$132.1 million. After subtracting contributions from household living above the poverty line, **an annual public investment required for middle burden states is US$105.0 million**.

- For the **lowest burden states**, all 10 interventions would be scaled up in the remaining 19 states with a stunting prevalence below 25 percent. Most of states are in southern regions (South-East, South-South and South-West) with the exceptions of FCT Abuja, Kogi and Benue which are in the North-Central region. The total annual cost of this step including costs of M&E operations research, technical assistance, and capacity development would be US$279.8 million. After adjusting for contributions from households living above the poverty line, **the annual public investment required for the lowest burden states is US$ 225.4 million.**

58. **The preferred Scenario 3 is to prioritize the highest burden states, which would focus on scaling-up all interventions in the 13 states with the most severe stunting rates. This would require an annual public investment of $507 million; saving at least 3.5 million DALYs and over 80,000 lives.** Program coverage would increase as follows:

- 5.2 million families with children 0-23 months reached by community programs for behavior change;
- 5.3 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 11.7 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 0.6 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 13.1 million children 12-59 months receive deworming medication;
- 2.1 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 65.1 million people able to consume staple foods fortified with iron;
- 22.9 million more people gain access to iodized salt;
- 2.3 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 22.9 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

Table 11. Scenario 3: Costs and Benefits for Scaling Up 10 Nutrition-specific Interventions by State

States	Criteria	Annual Public Investment (US$ million)	Annual Benefits	
			DALYs Saved	Lives Saved
Highest Burden[1]	**13 States with >35% stunting and/or RBF States**	**$507**	**3,505,652**	**81,678**
Middle Burden[2]	5 States with 25-35% stunting	$105	1,276,744	28,835
Lowest Burden[3]	States with <25% stunting	$225	3,925,549	72,898
TOTAL		**$837**	**8,707,946**	**183,411**

[1]*Bauchi, Gombe, Taraba, Yobe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara, Nasarawa, Plateau.*
[2]*Borno, Adamawa, Niger, Kwara, Oyo.*
[3]*FCT Abuja, Benue, Kogi, Ondo, Ebonyi, Cross-Rivers, Abia, Anambra, Enugu, Imo, Akwa-Ibom, Bayelsa, Delta, Edo, Rivers, Ekiti, Lagos, Ogun, Osun.*

59. Scenario 4: Scale Up by State and by Intervention. Scenario 4 is a hybrid of Scenario 2 and 3 and proposes the scaling up by state and by selected interventions as listed in Table 12 below. The first variation, Scenario 4a, is to scale up step 1 and step 2 interventions in 18 states where stunting rates are higher than 25 percent (highest and middle burden states), requiring an annual public investment of $337 million, saving almost 4.7 million DALYs and 96,000 lives. Scenario 4a would provide the following program benefits:

- 7.2 million families with children 0-23 months reached by community programs for behavior change;
- 6.9 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 16.1 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 1.4 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 17.4 million children 12-59 months receive deworming medication;
- 2.9 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 89.1 million people able to consume staple foods fortified with iron;
- 28.3 million more people gain access to iodized salt;
- 2.8 million more children 6-59 months treated for severe acute malnutrition using community-based management practices.

Table 12. Scenario 4: Cost of Scaling Up 10 Nutrition Interventions by State and by Intervention, US Millions

Intervention/State	Highest Burden[1]	Middle Burden[2]	Lowest Burden[3]
Step 1 Interventions: Community nutrition programs for growth promotion, all micronutrient and deworming, 30% coverage of community-based management of severe acute malnutrition	**$144**	**$41**	$123
Step 2 Interventions: 50% of community-based management of severe acute malnutrition	**$128**	**$25**	$51
Step 3 Interventions: Public provision of complementary food for prevention of moderate acute malnutrition	$236	$39	$52

[1]*Bauchi, Gombe, Taraba, Yobe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara, Nasarawa, Plateau.*
[2]*Borno, Adamawa, Niger, Kwara, Oyo.*
[3]*FCT Abuja, Benue, Kogi, Ondo, Ebonyi, Cross-Rivers, Abia, Anambra, Enugu, Imo, Akwa-Ibom, Bayelsa, Delta, Edo, Rivers, Ekiti, Lagos, Ogun, Osun.*

Table 13. Annual Costs and Benefits from Scenarios 4a and 4b

Scenarios	Annual Public Investment (US$ million)	Annual Benefits	
		DALYs Saved	Lives Saved
Scenario 4a	$337	4,694,076	96,092
Scenario 4b	$271	3,439,969	70,911

60. **Scenario 4b would limit scaling up step 1 and step 2 interventions to the 13 states with the highest burden of stunting. Scenario 4b would require an annual public investment of $271 million, and would save over 3.4 million DALYs and 70,000 lives (Table 13).** Furthermore, Scenario 4b would provide the following program benefits:

- 5.2 million families with children 0-23 months reached by community programs for behavior change;
- 5.3 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 11.7 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 0.6 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 13.1 million children 12-59 months receive deworming medication;
- 2.1 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;

- 65.1 million people are able to consume staple foods fortified with iron;
- 22.9 million more people gain access to iodized salt;
  2.3 million more children 6-59 months treated for severe acute malnutrition using community-based management practices.

61. **Scenario 5: Scale up by varying program coverage targets**. As discussed above, the previous scenarios assume full program coverage. Scenario 5 allows for "partial" coverage rates as a way to scale-up to the eventual "full coverage" scenario (Table 14). These partial program coverage targets were agreed upon at a meeting between donors and the Government of Nigeria in February, 2014.[14]

Table 14. Full and Partial Program Coverage Targets

Intervention	Percent of target population covered by Year 5	
	Full Coverage (Scenarios 1-4)	Partial Coverage (Scenario 5)
Community nutrition programs for growth promotion of children	100	50
Vitamin A supplementation for children	100	90
Therapeutic zinc supplementation with ORS for children	100	80
Micronutrient powders for children	100	90
Deworming for children	100	90
Iron-folic acid supplementation for pregnant women	100	90
Iron fortification of staple foods for general population	100	100
Salt Iodization for general population	100	100
Public provision of complementary food for prevention of moderate acute malnutrition in children	100	35
Community-based management of severe acute malnutrition in children	80	35

[14] The interventions are expected to reach the following share of targeted coverage: 10% in year 1, 32.5% in year 2, 55% in year 3, 77.5% in year 4 and 100% by year 5. Capacity building is assumed to be 9% of total costs, and within that, 79% is for capacity building and training 13% is for resource mobilization and advocacy and 8% is for coordination. Capacity building will be distributed across the five years as follows: 20% in year 1, 30% in years 3 and 4, 10% in year 4 and the final 10% in year 5. Finally, monitoring and evaluation is estimated to be 2% of intervention costs.

Table 15. Scenarios Considered Within Scenario 5

Scenario	Annual Public Investment (US$ million)	Annual Benefits		
		DALYs Saved	Lives Saved	Cases of Stunting Averted
5a) All interventions in all states at "partial" coverage rates	$353	4,388,415	96,463	1,434,988
5b) Micronutrients and deworming interventions at "partial" coverage rates in all states and community nutrition programs and community-based management of severe acute malnutrition at "partial" coverage rates in highest burden states*	$184	2,256,091	58,519	n/a

**Highest burden states are Bauchi, Gombe, Taraba, Yobe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara, Nasarawa, Plateau.*

62. **Scenario 5a would scale up all 10 interventions to the partial coverage levels and would require total annual public investment of US$353 million (Table 15).** This includes the total cost of scaling up the 10 interventions of US$371 million plus US$34 million for capacity development and $8 million for monitoring and evaluation, operations support and technical support. We also assume households above the poverty line can contribute $59 million towards the costs of some interventions, yielding the net total of US$353.

63. **This scenario would save over 4.3 million DALYs, 96,000 lives, and avert over 1.4 million cases of stunting among children under five years of age.** (**Appendix 8** provides the estimates of cost and benefits by state). Additionally, this scenario would provide the following program benefits:

- 7.4 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 7.0 million families with children 0-23 months reached by community programs for behavior change;
- 25.1 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 4.9 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 34.3 million children 12-59 months receive deworming medication;
- 5.4 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million more people able to consume staple foods fortified with iron;
- 38.8 million more people gain access to iodized salt;

- 1.4 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 2.4 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

64. **Another scenario (Scenario 5b) would scale up interventions that require less capacity and lower dependence on strong health systems and are relatively low-cost (such as micronutrient and deworming interventions[15]) in all 36 states. It would also provide community nutrition programs and community-based management of severe acute malnutrition at "partial" coverage in the 13 states with the highest burden of stunting. Scenario 5b would require an annual public investment of $184 million, and would save over 2.2 million DALYs and 58,000 lives.** This option would provide the following program benefits:

- 7.4 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 2.6 million families with children 0-23 months reached by community programs for behavior change;
- 25.1 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 4.9 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 34.3 million children 12-59 months receive deworming medication;
- 5.4 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million more people able to consume staple foods fortified with iron;
- 38.8 million more people gain access to iodized salt;
- 0.9 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;

C. COST-BENEFIT ANALYSIS OF THE SCALE-UP SCENARIOS

65. **The scenario with the greatest impact per dollar spent is Scenario 2, with a cost per DALY saved of $56 and a cost per life saved of US$2,919.** Yet this scenario is also extremely costly and requires an annual public investment of US$511 million. We will therefore consider other scenarios that are also cost-effective but require fewer public resources.

66. **Table 16 presents a comparison of the various scenarios and shows that scenarios 4a, 4b, 5a and 5b are cost-effective and require relatively modest public investments in order to reach scale.** Scenarios 4a and 4b are more cost-effective but also target specific states. It is worth noting that the two scenarios under Scenario 5 may be more politically feasible, given that the interventions are scaled up in all Nigerian states.

Table 16. Costs and Benefits of Most Cost-Effective Scenarios

[15] This include deworming, vitamin A supplements, zinc supplements, multi micronutrient powders, iron fortification of staple foods and salt iodization

Scenario	Annual Public Investment (US$ million)	Annual Benefits			Cost per Benefit Unit (US$)		
		DALYs Saved	Lives Saved	Cases of Stunting Averted	DALY Saved	Life Saved	Case of Stunting Averted
Full National Coverage	$837	8,707,960	183,411	3,056,494	102	4,865	292
Scenario 1	$405	2,502,917	60,022	n/a	167	6,980	n/a
Scenario 2	$511	8,581,269	164,390	n/a	56	2,919	n/a
Scenario 3	$507	3,505,652	81,678	n/a	149	6,383	n/a
Scenario 4a	$337	4,694,076	96,092	n/a	66	3,229	n/a
Scenario 4b	$271	3,439,969	70,911	n/a	72	3,496	n/a
Scenario 5a	$353	4,388,415	96,463	1,434,988	85	3,849	259
Scenario 5b	$184	2,256,091	58,519	n/a	82	3,152	n/a

67. **Recognizing the difficulty of scaling to full coverage in one year, and following the five-year time frame of the Government's National Strategic Plan of Action for Nutrition, we consider the costs over five years for Scenarios 4a, 4b, 5a and 5b (Table 17).** Interventions are assumed to increase from current coverage as follows: 20 percent of coverage in year 1, 40 percent in year 2, 60 percent in year 3, 80 percent in year 4 and 100 percent in year 5. For these calculations, we consider the expenditures on capacity development and system strengthening required to scale to full coverage to be a fixed cost, with some additional funds allocated to refresher training and rehiring in the years after scale has been reached. Thus, the average annual amount spent on capacity development is allocated across the five years, rather than increasing in proportion to coverage as is the case with the other costs.

Table 17. Scale Up of Scenarios 4 and 5 in US$ Millions

Scenario	Year 1 (20% coverage)	Year 2 (40% Coverage)	Year 3 (60% coverage)	Year 4 (80% coverage)	Year 5 (100% coverage)	Total Scale Up Costs Over 5 Years
Scenario 4						
4a	$74	$134	$191	$254	$316	**$987**
4b	$59	$106	$173	$201	$251	**$769**
Scenario 5						
5a	$39	$113	$186	$251	$323	**$912**
5b	$20	$59	$97	$131	$169	**$476**

68. **A high burden of malnutrition negatively impacts a nation's human capital. Therefore, an investment in improving nutrition outcomes among children is also an investment in Nigeria's economic future.** The two main ways through which malnutrition affects economic productivity are increased mortality and morbidity, or in other words, lives lost and years lived with a disease or disability. For the purposes of this analysis, we estimate the potential economic benefits of scaling up nutrition interventions in terms of lives saved (reduction in mortality) and cases of stunting averted (reduction in morbidity). Because each life lost results in one less citizen contributing to the nation's economy, and because stunted children tend to earn and consume less, these impact estimates help us to arrive at approximations of the return on investment attributable to the scale up of a particular package of interventions.

69. **It should be noted that these estimates of economic benefits are based on a highly conservative methodology that does not necessarily account for all of the potential benefits associated with improving nutrition outcomes among Nigerian children.** However, they clearly demonstrate that the opportunity costs of *not* scaling up nutrition interventions are substantial: we estimate that a five-year scale up plan that brings all ten interventions to full national coverage could produce $2.6 billion in annual returns over the productive lives of the children affected.

70. **Although it was only possible to assess two scenarios (full coverage and Scenario 5a), our analysis finds that both yield positive net present values produce internal rates of return greater than 18 percent (Table 18)**. An increase in the assumed discount rate reduces the present value of future benefits, and therefore we perform a sensitivity analysis using 3 possible discount rates: 3, 5 and 7 percent. For the full national coverage the net present value varies between US$103 billion (3 percent discount rate) to US$34 billion for the 7 percent discount rate. For Scenario 5a it varies between US$40 and 12 billion.

71. **All scenarios have the potential to increase economic productivity by increasing the economic productivity of beneficiaries once they enter the labor force.** Reaching full national coverage for all 10 nutrition specific interventions could add as much as $2.6 billion annually. Scenario 5a also has a high positive impact on economic productivity with an annual addition to the Nigerian economy of $1.04 billion.

Table 18. Economic Benefits of Two Scenarios, 5 year scale up

Scenario	Net Present Value by Discount Rate (US$ billions)			Internal Rate of Return (percent)	Annual Increase in Economic Productivity[16] (US$ billions)
	3%	5%	7%		
Full National Coverage	$102.9	$57.6	$33.6	25.14%	$2.6
Scenario 5a	$40	$21.9	$12.4	18.54%	$1.04

D. PROPOSED SCENARIOS

72. **Based on their cost-effectiveness, economic contributions and resource requirements, we propose consideration of Scenarios 4a, 4b, and 5a for implementation.** First, these three scenarios require relatively modest public investments when compared with the requirements for reaching full national coverage. Second, each scenario is highly cost effective, with scenarios 4a/4b/5a featuring estimated costs of $66/$72/$85 per DALY saved and $3,229/$3,496/$3,849 per life saved. For Scenario 5a we were also able to calculate the cost per case of childhood stunting averted which is US$259 as compared with US$292 for the full coverage scenario. While Scenarios 4a and 4b are more cost-effective, Scenario 5a offers the political advantage of distributing benefits more evenly among the states, while Scenarios 4a and 4b focuses solely on states with the highest burden of stunting.

E. FINANCING CURRENT COVERAGE

73. **The costs discussed thus far relate to the scale up from current coverage and do not take into account the financing necessary to maintain existing coverage levels, which we estimate at approximately US$49 million annually (Table 19).** In order to estimate the cost of financing nutrition interventions at their current scale, this report uses a recent fiscal space analysis for nutrition in Nigeria conducted by R4D (2014). This analysis attempts to identify funding for nutrition by source, which we consider to be a proxy for the resources dedicated to fund existing interventions. However, because this analysis accounts for total funding, it is not possible to separate financing for program costs from overhead costs. Therefore, it is likely that these financing numbers overestimate the "sustaining costs" required for baseline intervention coverage.

74. **The R4D analysis has also identified several sources of "planned" investments in nutrition (Table 20) estimated at about $175 million over the next 4 years.** This represents a potential increase in funding of approximately $126 million between 2014 and 2017. Considering our previous analysis, which demonstrated financing needs over five years of between $769 million and $987 million for scaling up under the three proposed scenarios, the estimated financing gap ranges between $543 and $861 million over this time period, even after

[16] The annual increase in economic productivity is measured as the estimated annual addition to economic productivity once all beneficiaries have reached productive age.

accounting for the planned $126 million in increased investments and the $49 million in sustaining costs for maintaining current coverage. Our analysis predicts additional financing needs over five years of between $769 million and $987 million for scaling up under the three proposed scenarios, resulting in an estimated financing gap of between $543 and $861 million over five years. Therefore, there is clearly a need to leverage additional financing for scaling-up nutrition interventions, while also prioritizing these interventions based on both need and cost-effectiveness.

Table 19. Fiscal Space Analysis for Current National Nutrition Expenditures (2013)

Donor	Estimated 2013 Expenditure on Nutrition (US$ millions)
DFID*	17.71
Micronutrient Initiative	1.03
EU	0.93
ECHO	5.47
CIDA	1.25
CIFF	10.62
UNICEF (non-grant)	1.94
Federal Government	10.00
GAIN	TBC
TOTAL	**48.90**

**includes DFID Working to Improve Nutrition in Northern Nigeria program as well as contributions channeled through UNICEF.*
Source: R4D 2014.

Table 20. Projected Funding Available for Nutrition 2014-2017

Donor	Projected Funding for Nutrition 2014-2017 (US$ millions)
UNICEF –IYCF	6.40
UNICEF – CMAM	59.84
UNICEF - Policy Support	3.20
UNICEF – Micronutrients	10.56
DFID WINNN	55.00
Federal Government	40.00
Total Available Financing	**175.00**

Source: R4D 2014.

F. UNCERTAINTIES AND SENSITIVITY ANALYSES

75. **Because actual unit costs may differ from our estimates, it is important to consider the effects of either an increase or decrease in these costs on the overall cost of the interventions.** This uncertainty is greatest for higher-cost interventions, and less significant for those with lower-costs. For example, given the prevalence of information on and experience

with less expensive micronutrient and deworming interventions, there is a higher degree of certainty around their estimated costs and financing needs. On the other hand, the costs of community nutrition programs can vary greatly depending on their context, with the intensity of behavior change campaign campaigns, the number of community health workers employed, and the amount of incentives provided all affecting unit costs. Finally, there is very little information concerning the costs associated with the public provision of complementary food. In Nigeria, there is no delivery mechanism that can be used as a reference for these programs, while unit costs are highly dependent on the choice of targeting method and other factors such as widespread corruption and diversion of food supplies. In order to account for these uncertainties, we perform a partial sensitivity analysis on both the Full National Coverage Scenario and Scenario 5a (which also corresponds to the scale up used in in Nigeria's National Strategic Plan of Action for Nutrition). This sensitivity analysis considers the impact of variation in unit costs while holding other variables constant. The results of the sensitivity analysis are presented in **Appendix 9**.

PART V – NUTRITION-SENSITIVE INTERVENTIONS

76. **We present cost-benefit estimates for four nutrition-sensitive interventions delivered through the agriculture and education sectors**: **biofortification of cassava; aflatoxin reduction through biocontrol interventions; school-based deworming; and school-based promotion of good hygiene practices. Table 21** summarizes the cost of scaling up these interventions and, when available, DALYs saved and cost per DALYs saved. Biofortification of cassava, school-based deworming, and aflatoxin control through biocontrol are considered to be cost-effective scenarios in Nigeria. Costs per DALYs saved are not available for school-based promotion of good hygiene.

Table 21. Preliminary results for costing nutrition-sensitive interventions

Intervention	Annual Cost (US$ million)	DALYs Saved	Cost/DALY Saved
Biofortification of cassava	25	800,000	$0.3-0.5
Aflatoxin control (biocontrol)	65	1,537,790	$43.00
School-based deworming	8	n/a	$4.55*
School-based promotion of good hygiene	60	n/a	n/a

**Estimate for Kenya as cost/DALYs saved not available for Nigeria.*

A. BIOFORTIFICATION OF CASSAVA

77. **The projected total cost of scaling up biofortification of yellow cassava is US$ 25 million.** This cost includes only maintenance breeding and release and dissemination components. The R&D and adaptive breeding phases are already completed, thus the costs of these components are no longer relevant and have been excluded from the calculation. Given the unavailability of current programmatic costing information, the total cost of scaling up is obtained from the ex-ante assessment of biofortification in Nigeria (Fiedler 2010).

78. **The cost per DALY saved for biofortification of cassava in Nigeria is estimated to be between US$ 0.30 (optimistic) to US$0.50 (pessimistic), which is highly cost-effective (Birol et al. 2014).** The cost estimate of $25 million comes from Meenakshi et al. (2010). No estimations are currently possible for lives saved through biofortification.

B. AFLATOXIN REDUCTION THROUGH BIOCONTROL

79. **The total cost of scaling up aflatoxin reduction through biocontrol is estimated to be US$65 million.** The cost calculation uses the unit cost of Afla-safeTM biocontrol developed by IITA and tested in Nigeria, with a cost per hectare of approximately US$15.6, including material and distribution costs (Bandyopadhyay 2013). Crop area is based on FAO's 2010 projections of

Nigerian maize planting area, which is estimated at 4.19 million hectares. For the purposes of this exercise, it is assumed that AflaSafeTM will be applied to all maize fields.[17]

80. **The cost per DALY saved for biocontrol in Nigeria is US$ 43, which is considered highly-cost effective.** An ex-ante assessment of several aflatoxin control measures in Nigeria identified biocontrol as the most cost-effective for aflatoxin control compared to other agricultural interventions. The estimated DALYs saved annually and the tentative numbers of stunting cases prevented annually via biocontrol in Nigeria are 1,537,079 and 875,560, respectively, albeit stunting estimates are based on tentative evidence. By comparison, the postharvest intervention package will tentatively prevent 254,880 cases of stunting and save 439,329 DALYs (Khlangwiset 2011). No estimations are currently possible for lives saved through aflatoxin control.

C. SCHOOL-BASED DEWORMING

81. **The cost of scaling up school-based deworming is estimated to be US$8 million annually.** The unit cost (US$0.08) used in the calculation is obtained from regional estimates of delivery cost in schools for Ghana (Guyatt et al. 2003), assuming twice a year treatment. These estimates compare well with recent regional "bottom-up" cost analysis, based on NTD national plans from 36 sub-Saharan Africa countries (Sedosh et al. 2013) which estimates the unit cost of preventive chemotherapy (PCT) of five NTDs (lymphatic filariasis, onchocerciasis, schistosomiasis, trachoma and soil-transmitted helminthiasis) in the Africa region at $0.26. The major cost components for deworming are human resources, surveillance and mapping, non-donated drugs, advocacy, infrastructure and logistics, and implementation and management. The target population is school-age children (6-19 years-old) enrolled in primary and secondary schools and the current coverage is assumed to be negligible.

D. SCHOOL-BASED PROMOTION OF GOOD HYGIENE

82. **The cost of scaling up school-based promotion of hand-washing and good hygiene behavior is estimated to be US$60 million.** While promotion of WASH in schools normally includes sustainable, safe water supply points, hand-washing stands and sanitation facilities; the costing includes only the component for hygiene education. Due to unavailability of unit cost estimate specifically for Nigeria, the unit cost is obtained from UNICEF report (2012) on WASH in schools. The unit cost for hygiene education component is estimated to be US$2 per student and includes the cost of capacity building, monitoring, advocacy, social mobilization. The target population is school-age children and the current coverage is assumed to be negligible.

[17] Most maize is for human consumption in Nigeria but some is also for other purposes. We were not able to estimate how many hectares produce maize for human consumption versus other purposes.

PART VI – CONCLUSIONS AND POLICY IMPLICATIONS

83. **Systematic costing of highly effective nutrition interventions is important for priority-setting, resource mobilization and advocacy**. Combining costing with estimates of impact (in terms of DALYs and lives saved) and cost-effectiveness analysis will make the "case for nutrition" stronger and will aid in priority setting by identifying the most cost-effective packages of interventions in situations where financing is constrained. This will potentially be a powerful evidence-based advocacy tool for policymakers when making budget allocations (i.e. Ministry of Finance) as it provides useful evidence on what the government can "buy" (in terms of DALYs and lives saved) given available resources, thereby maximizing allocative efficiencies.

84. **Reaching full national coverage will be expensive and will require a significant increase in the amount of public resources devoted to nutrition in Nigeria.** As it is unlikely that the government or its partners will find the $837 million necessary to reach full national coverage, it is important to consider scenarios that make the most of the resources available. Therefore, our findings and recommendations are based on cost-benefit analyses that can help policy makers to prioritize the allocation of resources more effectively so as to maximize allocative efficiencies and potential for impact. The scenarios (4a, 4b, 5a and 5b) proposed in this report represent a compromise between the need to move to full coverage and the constraints imposed by limited resources.

85. **A high burden of malnutrition negatively impacts a nation's human capital. Therefore, an investment in improving nutrition outcomes among children is also an investment in Nigeria's economic future.** All scenarios have the potential to increase the economic productivity of beneficiaries once they enter the labor force. Reaching full national coverage for all 10 nutrition-specific interventions could add as much as $2.6 billion annually to the Nigerian economy, while the lower-cost scenario 5a would add US$1.04 billion annually. Our analyses also find that all scenarios yield positive net present values, and most produce internal rates of return greater than 18 percent. It should be noted that these estimates of economic benefits are based on a highly conservative methodology that does not necessarily account for all of the potential benefits associated with improving nutrition outcomes among Nigerian children.

86. **Although this report focuses extensively on nutrition specific interventions, the causes of malnutrition are multisectoral and therefore any longer-term approach to improving nutrition outcomes must include nutrition sensitive interventions.** This analysis takes an innovative approach to nutrition costing by not only estimating the costs and benefits of nutrition-specific interventions, but also exploring costs for a selected number of nutrition-sensitive interventions implemented outside of the health sector. We have identified four candidate nutrition-sensitive interventions with high impact potential for Nigeria, including biofortification of cassava, aflatoxin control, school-based deworming, and school-based promotion of good hygiene. However, these interventions are just a starting point, and as the Government begins to develop a multisectoral nutrition policy, it would be useful consult across sectors and ministries in order to identify other possible nutrition sensitive interventions that are cost-effective.

87. **Overall, these findings point to a powerful set of nutrition-specific interventions and a candidate list of nutrition-sensitive approaches that represent a highly cost-effective approach to reducing the high levels of child malnutrition in Nigeria. Most of the malnutrition that occurs in the first 1000 days of a child's life is essentially irreversible.** Investing in early childhood nutrition interventions offers a window of opportunity to permanently lock-in human capital, and to super-charge the potential demographic dividend in Nigeria. This fits in to the President's Transformational Agenda for Nigeria and the government's flagship Saving One Million Lives (SOML) initiative, which focus on six pillars, one of which is nutrition. However, despite strong commitments to address malnutrition, the government of Nigeria currently has no financial allocations for nutrition in FGoN's 2014 budget.

88. **Moving forward, these results will be useful to decision makers as they plan future efforts to scale-up action against malnutrition in Nigeria and develop nutrition financing plans that bring together the health, education and agriculture sectors**. In the health sector, plans for financing Universal Health Coverage (UHC) and SOML must include these costs under the nutrition pillar of SOML. There also exist several opportunities to incorporate these highly cost-effective interventions into the World Bank's existing and pipeline investments in Health (e.g. the State Health Project and planned support for SOML), agriculture (such as FADAMA III) and education (e.g. the State Education Project and the Global Partnership on Education).

APPENDICES

Appendix 1: Partners Collaborating on Nutrition in Nigeria, 2014

Region and State	Partners Present	Activities
NORTHWEST REGION		
Jigawa	Save the Children ACF MSF UNICEF	WINN, EveryOne Advocacy WINN, CMAM CMAM WINN; MNCHW; Zinc supp; IYCF
Kaduna	None	None
Kano	UNICEF World Bank WHO MCHPS	MNCHW, CMAM, IYCF, MNDC RBM MCHW, CMAM, IYCF, MNDC MNCHW, CMAM, IYCF, MNDC
Katsina	Save the Children	CMAM (cash transfers), FSL project, EveryOne Advocacy
Kebbi	UNICEF Save the Children ACF	WINN, CMAM, Zinc supp WINN WINN
Sokoto	UNICEF MSF Poland	CMAM and IYCF CMAM and SAM treatment
Zamfara	Save the Children Save the Children UK UNICEF ACF	WINN CMAM and IYCF WINN, CMAM; IYCF WINN
NORTH-CENTRAL REGION		
Benue	SPRING UNICEF and HKI	IYCF MNDC; IYCF; CMAM
FCT- Abuja	SPRING	IYCF
Kogi	None	None
Kwara	None	None
Niger	UNICEF	IYCF; MNDC; NISS
Nasarawa	UNICEF IHVN	MCHW; IYCF RUTF Supply
Plateau	None	None
NORTHEAST REGION		
Adamawa	UNICEF	CMAM; IYCF; MNDC
Bauchi	None	None
Borno	UNICEF HKI	
Gombe	ANJIHH Save the Children	MNCHW EveryOne Advocacy

	UNICEF	CMAM; IYCF
Taraba	MITSOAH UNICEF	MNCHW; SAM Treatment; IYCF; IDD Monitoring; Training
Yobe	Save the Children UNICEF ACF	WINN Project WINN Project WINN Project
SOUTHEAST REGION		
Abia	UNICEF BASICS II	IYCF; MNDC IYCF; MNDC
Anambra	None	None
Ebonyi	None	None
Enugu	UNICEF WHO GAIN	IYCF; MNDC; Treatment of SAM MNDC
Imo	None	None
SOUTH-SOUTH REGION		
SOUTHWEST REGION		
Ekiti	UNICEF	MNCHW; MNDC
Lagos	None	None
Ogun	UNICEF FBFI	SAM Treatment; MNCHW; MNDC; Training Support for IYCF
Ondo	UNICEF	MNCHW
Osun	None	None
Oyo	UNICEF	Vit A, Zinc, IFA Supp, Training, GMP equipment, IEC materials, RUTF supplies, MNCHW

Source: Government documents and consultation with partners.

Appendix 2: Target Population Size

Region	Total population and population to benefit from iron fortification of staples (1)	Children 0-23 months to cover under the community nutrition programs (2)	Children 6-59 months not covered by vitamin A supplementation (3)	Children 6-59 months to cover under the therapeutic zinc supplementation with oral rehydration salts (4)	Children 6-23 months not covered by multiple micronutrient powders (5)	Children 12-59 months not covered by deworming (6)	Pregnant women not receiving iron folic acid supplementation (7)	Population not consuming iodized salt (8)	Children 6-23 months to receive complementary feeding (9)	Children 6-59 months not treated for severe acute malnutrition (10)
North-Central	25,869,988	2,069,599	1,674,207	4,656,598	1,018,615	2,907,551	712,145	6,404,668	533,584	361,945
North-Eastern	23,699,434	1,895,955	2,107,576	4,265,898	555,785	2,091,285	1,001,205	6,428,538	866,181	733,398
North-Western	44,296,509	3,543,721	3,540,604	7,973,372	74,135	4,485,859	1,076,338	16,510,527	2,583,655	2,416,719
South-Eastern	20,037,552	1,603,004	755,367	3,606,759	927,210	2,904,244	847,783	2,053,174	275,043	348,090
South-South	26,104,018	2,088,321	1,137,854	4,698,723	1,165,903	3,172,578	996,739	2,944,841	400,338	346,023
South-Western	34,434,921	2,754,794	1,329,592	6,198,286	1,475,508	4,385,019	1,485,268	4,415,320	590,588	380,595
NATIONAL	**174,442,422**	**13,955,394**	**10,545,198**	**31,399,636**	**5,217,156**	**19,946,536**	**6,119,478**	**38,757,068**	**5,249,389**	**4,586,771**

Sources and notes

(1) UNICEF 2013 projections based on the National Population Council (Total population)
(2) UNICEF 2013 projections based on the National Population Council (Children 0-23 months)
(3) UNICEF 2013 projections based on the National Population Council (Children 6-59 months) , State-level vitamin A coverage estimates from MICS 2011 report and September 2012 SMART survey results for 8 states (Borno, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, Zamfara)
(4) UNICEF 2013 projections based on the National Population Council (Children 6-59 months)
(5) UNICEF 2013 projections based on the National Population Council (Children 6-23 months)
(6) UNICEF 2013 projections based on the National Population Council (Children 12-59 months), State-level deworming coverage estimates from the FMOH 2012 programmatic data from the first round of MNCH weeks in 2012 and September 2012 SMART survey results for 8 states (Borno, Jigawa, Kano, Katsina, Kebbi, Sokoto)
(7) UNICEF 2013 projections based on the National Population Council (Total population), State-level iron folic acid coverage estimates from the FMOH 2012 programmatic data from the first round of MNCH weeks in 2012
(8) UNICEF 2013 projections based on the National Population Council (Total population), Percent of households consuming iodized salt from MICS 2011
(9) UNICEF 2013 projections based on the National Population Council (Children 6-23 months), State-specific data on underweight from MICS 2011
(10) UNICEF 2013 projections based on the National Population Council (Children 6-59 months), State-specific data on severe wasting from MICS 2011, UNICEF provided coverage data for 11 states (Adamawa, Bauchi, Borno, Gombe, Yobe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Zamfara)
This represents the total population of children 6-59 months not treated for severe acute malnutrition although we expect to reach 80 percent of this population

Appendix 3: Data Sources and Relevant Assumptions

Intervention	Costed delivery platform	Cost estimate	Source	Assumptions
Behavior change interventions				
Breastfeeding promotion	Community nutrition programs	Included in community nutrition programs $ 5 per participant per year	UNICEF (2013)	Behavior change campaign interventions cost US$ 5 per child under five years of age and we assume there are two children under five years of age per participating mother. Focus is on exclusive breast feeding, infant and young child complementary food, hygiene practices among others.
Education on appropriate complementary feeding practices (excluding provision of food)	Community nutrition programs	Included in community nutrition programs	UNICEF (2013)	Assume zero additional cost as it is included in community nutrition program
Hand washing	Community nutrition programs	Included in community nutrition programs	UNICEF (2013)	Assume zero additional cost as it is included in community nutrition program
Micronutrients and deworming interventions				

Vitamin A supplementation	Maternal, New Born and Child Health Weeks	US$ 0.44 per child per year. Freight and handling costs added to the unit capsule cost of US$0.02	UNICEF (2013); Federal Republic of Nigeria (2011); Takang et al (2012); Katsina State Government (2012); Anger (2012); Federal Capital Territory (2012); Zoakah (2012); Ososanya (2013)	Supplements are distributed through biannual MNCH weeks, with overhead costs (for planning; advocacy; social mobilization; health worker and volunteer training; monitoring; supervision; and logistics support to fixed facilities and outreach stations) shared with other interventions (therapeutic zinc supplementation with ORS, deworming and iron folic acid supplementation).
Therapeutic zinc supplementation with ORS	Maternal, New Born and Child Health Weeks	US$0.86 per child per year.	UNICEF (2013); Takang et al (2012)	Each child is assumed to have 2-3 episodes of diarrhea per year with average of 12 tablets needed to treat one episode. MNCHW implementation overhead costs are shared with other interventions
Micronutrient powders	Community nutrition programs	US$1.80 per child 6-11 months of age per year and US$3.60 per year per child 12-23 months of age.	Horton et al (2010)	Global estimates are used. There is insufficient information on in-country implementation of this intervention that is just commencing in 2 of 36+1 states.

Deworming	Maternal, New Born and Child Health Weeks	US$0.44 per child 12-59 months of age per year	UNICEF (2013); Federal Republic of Nigeria (2011); Takang et al (2012); Katsina State Government (2012); Anger (2012); Federal Capital Territory (2012); Zoakah (2012); Ososanya (2013)	Assume ½ tablet of Albendazole per child 12 – 23 months of age and one tablet per child 24 – 59 months of age is given in each round of the biannual MNCHW. Overhead costs are shared with other interventions
Iron-folic acid supplementation for pregnant women	Maternal, New Born and Child Health Weeks/Community nutrition programs	US$ 1.79 per pregnancy through MNCHW; US$2.00 per pregnancy through community nutrition programs	UNICEF (2013); Federal Republic of Nigeria (2011); Takang et al (2012); Katsina State Government (2012); Anger (2012); Federal Capital Territory (2012); Zoakah (2012); Ososanya (2013); Horton et al (2010)	Assume daily IFA supplementation for last two trimesters of pregnancy (about 180 tablets) delivered through MNCHWs to 40% of target population and remaining reached through community nutrition programs and ANTE-NATAL CARE services. MNCHW overhead costs shared with other interventions. Provision made for weekly SMS reminders
Iron fortification of staple foods	Market-based delivery systems	US$0.20 per person per year (flour fortification)	Horton et al (2010); Aminu (2013); UNICEF (2013)	Global estimate is used. No specific information on Nigeria available.
Salt iodization	Market-based delivery systems	US$0.05 per person per year	Horton et al (2010); Aminu (2013)	Global estimate is used. No specific information on Nigeria available.
Complementary and therapeutic food interventions				

Treatment of severe acute malnutrition	Primary Health Care and Community Nutrition Programs	US$80.00 per child per episode	UNICEF (2013)	Food cost about US$50. Additional costs are for freight and handling; training, monitoring and supervision of health workers; and provision of equipment. Cases are managed in PHC facilities. Screening carried out at community and facility levels.
Prevention/treatment of moderate malnutrition	Community Nutrition Programs or Primary health care system	US$51.10 per child per year	Horton et al (2010); UNICEF (2013)	Global estimate is used. There is no programmatic delivery mechanism as yet in Nigeria.

Appendix 4: Methodology for Estimating Costs for Nigeria

The following steps lay out the methodology used to estimate costs for each intervention:
1. Description of each intervention;
2. Definition of target populations for each intervention;
3. Estimation of the size of the target populations for each intervention in each state/region using the most current demographic data;
4. Specification of the delivery platform or channel(s) for each intervention, based on the country context and the accepted delivery modes;
5. Data on the current coverage levels for each intervention in each state/region;
6. Estimation of unit cost per beneficiary for each intervention from program experience in Nigeria, whenever possible, and/or Africa region;
7. Calculation of additional costs of scaling up to full coverage by multiplying the unit cost for each intervention with the size of the "uncovered" target population for each intervention by state/region. The formula for calculation is:

$$x_1 = z_1(100 - z_2)$$

   where:
   x_1 = *additional costs of scaling up to full coverage*
   z_1 = *unit cost per beneficiary*
   z_2 = *current coverage level (percentage)*

8. Estimation of additional resources for: (i) capacity development for program delivery and (ii) M&E and technical support, estimated at 9% and 2% of total cost of interventions, respectively;
9. Estimation of a portion of the total cost that can be covered by private household resources. It is assumed that households above poverty line could cover the cost of iron fortification, multiple micronutrient powders, salt iodization and complementary food from private resources;
10. Calculating the annual public investment required to scale up these interventions to full coverage using the following formula:

$$Y = (x_1 + x_2) - x_3$$

   where:
   Y = annual public investment required to scale up to full coverage
   x_1= *additional total cost to scale up to full coverage*
   x_2= *additional cost for capacity development, M&E, and technical assistance*
   x_3= *cost covered by households living above poverty line for selected interventions*

Full coverage is defined as 100% of the target population for all interventions except the treatment of severe acute malnutrition, which is set to 80%. This is consistent with World Bank (2010a) methods and is based on the reality that few community-based treatment programs have successfully achieved more than 80% coverage at scale.

Appendix 5: Methodology for Estimating DALYs for Nigeria

The following steps were undertaken to estimate the impact in DALYs averted of implementing the various nutrition interventions:

1. Estimate the effectiveness of each intervention on mortality and morbidity for each targeted cause
2. Calculate the rate of YLL and YLD due to each cause-risk factor combination for the target population
3. Calculate the DALYs averted under current or counterfactual coverage scenario
4. Calculate the DALYs averted under the proposed intervention coverage scenario
5. Calculate the net DALYs averted by the proposed intervention

1. Estimate the effectiveness of each intervention on mortality and morbidity for each targeted cause

To estimate the effectiveness of the interventions, key articles by Black et al and Bhutta et al in the Lancet series on maternal and child undernutrition were first consulted. Additional literature searches for the latest evidence were conducted in the Pubmed online database and the Cochrane Library of systematic reviews and meta-analyses. Effectiveness figures that were reported as statistically significant were extracted and used for the calculations.

2. Calculate the rate of YLL and YLD

The WHO's 2012 Global Health Estimates (GHE 2012) data tables provide country-specific YLL and YLD rates for each cause of death or disease. GHE 2012 morbidity and mortality estimates were used in combination with country-specific population attributable fractions (PAF) from the 2010 GBD. This assumes that the risk factor impacts on morbidity and mortality did not differ significantly between the two estimates.

To calculate the rate of morbidity and mortality from a cause due to a specific risk factor, the first step is to calculate the PAF for the cause-risk factor combination. The PAF was extracted from the country-specific risk factor attribution table from the 2010 GBD data. This was done separately for YLL and YLD. In the second step, the country-specific YLLs and YLDs for the target population, in most cases under-fives, were extracted from the GHE 2012 estimates. To calculate the YLL rate, the country-specific YLL is multiplied by the YLL PAF and then by 100,000. The final figure is divided by country-specific population of interest (usually under-fives) to get the rate. The same final steps are followed to calculate the YLD, although instead multiplying country-specific YLDs by the YLD PAF. The population estimate for the rate calculation was extracted from GHE 2012.

YLL per 100,000 = (U-5_cause_total_YLL * YLL_PAF * 100,000)/U-5_ population
YLD per 100,000 = (U-5_cause_total_YLD * YLD_PAF * 100,000)/U-5_population

3. Calculate counterfactual DALYs averted

To calculate the DALYs averted if current intervention coverage were maintained, the following formula was used:
YLL = U-5_population_intervention_year * current_coverage * intervention_mortality_reduction * YLL_rate
YLD = U-5_population_intervention_year * current_coverage * intervention_morbidity_reduction * YLL_rate

DALY_current = YLL+YLD

4. Calculate total DALYs averted under intervention coverage

To calculate the potential DALYs averted under the intervention coverage, a similar formula as above was used:

YLL = U-5_population_intervention_year * intervention_coverage * intervention_mortality_reduction * YLL_rate
YLD = U-5_population_intervention_year * intervention_coverage * intervention_morbidity_reduction * YLL_rate

DALY_intervention = YLL+YLD

5. Calculate net DALYs averted

The potential net DALYs averted by the intervention is:
DALYs averted = DALY_intervention - DALY_current

Appendix 6: Methodology for Nigeria LiST estimates

The Lives Saved Tool (LiST) is a part of an integrated set of tools that comprise the Spectrum policy modeling system. These tools include DemProj for creating demographic projections; AIM to model and incorporate the impact of HIV/AIDS on demographic projections and child survival interventions; and FamPlan for incorporating changing fertility into the demographic projection. LiST is used to project how increasing intervention coverage would impact child and maternal survival. The table below summarizes data sources used for the Nigeria LiST estimates.

Nigeria LiST estimates - Data Sources	
Demographic data	Source
First year population	2011 MICS and provided Cost table
Sex ratio at birth	2011 MICS
Life expectancy	2008 NDHS
Family Planning	
Unmet need	2011 MICS
Total fertility rate	2011 MICS
Age-specific fertility rate	Used sub-Saharan Africa model
Health, mortality, economic status	
Vitamin A deficiency	2011 MICS
Zinc deficiency	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.
Diarrhea incidence	Diarrhea incidence in low- and middle-income countries in 1990 and 2010: a systematic review. Fisher Walker CL. BMC Public Health 2012, 12:220
Severe pneumonia incidence	Global burden of childhood pneumonia and diarrhoea. Fischer Walker C, Rudan I, Liu L, Nair H, Theodoratou W, Bhutta ZA, O'Brien KL, Campbell H, Black RE. Lancet 2013; 381: 14
Malaria exposure (women)	The Limits and Intensity of Plasmodium falciparum Transmission: Implications for Malaria Control and Elimination Worldwide. Guerra CA, Gikandi PW, Tatem AJ, Noor AM, Smith DL, et al. PLoS Medicine Vol. 5, No. 2, e38
Stunting distribution	LiST default; data has been calculated using DHS and MICS datasets.
Wasting distribution	LiST default; data has been calculated using DHS and MICS datasets.
Neonatal mortality	2008 DHS
Infant mortality	2011 MICS

Child mortality	2011 MICS
Distribution of causes of death	Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C, Black RE. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet, 379(9832):2151 - 2161
Maternal mortality ratio	2008 DHS
Household poverty status	2008 DHS
Household size	2008 DHS

Once the demographic and health data have been updated, the coverage and scale-up plan for each intervention is introduced into LiST. LiST can use either a sequential method to calculate the impact of individual interventions or LiST can calculate the simultaneous impact of a set of interventions implemented at the same time. The second, simultaneous method is like to yield slightly lower estimates because interventions may have overlapping benefits. In this analysis we present the both the individual/sequential results of the individual interventions in the "full coverage" scenario (with totals calculated using the simultaneous method) and the simultaneous impact in the various scale-up scenarios.

Note on Estimates of Cases of Stunting Averted:

In order to estimate the number of cases of under-five stunting averted attributable to the annual investment in scaling up of nutrition interventions, we use LiST to model changes in the prevalence of stunting over 5 years during which the interventions have reached 100 percent scale. Next, we model changes in the prevalence of stunting over 5 years with no scale-up of the interventions. We then take the difference between the estimated stunting prevalence in year 5 with the scale up and the prevalence in year 5 absent a scale-up, and multiply this percentage point difference by the total population of children under five.

Our 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 stunting 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. We assume that continuing investments in maintaining scale after year 5 will serve to maintain the gains in stunting prevalence reduction, and therefore we present this reduction as the benefits 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, we model this scale up directly in LiST and use the annual results over 5 years in our cost-benefit analysis. This provides a more accurate portrayal of the direct benefits attributable to a five year scale up plan, and does not assume that the scale will necessarily be maintained following the end of the period covered in the plan.

Appendix 7: Methodology for Estimating Economic Benefits

There is considerable debate in the literature regarding the methodology for monetizing the value of a life saved. In this analysis, we chose to focus solely on the economic value of a life year, which we measure as equal to GNI per capita. Other studies also attempt to estimate the social value of a life year, and therefore we acknowledge that our results may underestimate the true value of a life year saved.

Still, valuing years of life saved alone does not account for the economic benefits of reduced morbidity, which includes the long-term, non-lethal impacts of malnutrition on individuals. While there are a number of long-term impacts of nutritional deficiencies, we choose to focus on stunting given the availability of country-specific impact estimates produced by the LiST tool.[18]

In order to estimate the value of a case of childhood stunting averted, we follow the methodology used in Hoddinott et al. (2013), the authors begin by assuming that stunted individuals lose an average of 66% of lifetime earnings, based on direct estimates of the impact of stunting in early life on later life outcomes found in Hoddinott et al. (2011).[19] This point estimate for the effects of stunting on future consumption is used as a proxy for the effect of stunting on lifetime earnings. Additionally, Hoddinott et al. (2013) account for uncertainty by assuming that only 90% of the total gains will be realized, which we also include in our calculations. However, unlike the authors, we also adjust our calculations to reflect the country's labor force participation rate.

For both lives saved and cases of stunting averted, the benefits of a five year scale up plan are attributed to a group of children that is assumed to enter the labor force at age 15 and exit the labor force at age 52, which is equivalent to Nigeria's life expectancy at birth. Benefits from both stunting and lives saved are then multiplied by a lifetime discount factor (LDF) derived from three potential discount rates (3% 5% and 7%), an adjustment for age at the time of investment (for simplicity we assume an average age of two years for all children), as well as the years of lifetime productivity expected. The LDF represents the years of productivity that are "counted" in the calculation, discounted back to their present value in the year in which the investment in nutrition is made. As we assume an average age of two years for all beneficiaries, we use an LDF that assumes that these children will enter the labor force in 13 years from the time of investment. Importantly, given the time frame considered under this analysis (50 years), we do not attempt to account for projected growth in the country's GDP and per capita incomes. This downward bias contributes to the conservative nature of our estimates.

The following equations are used to estimate 1) the economic value of lives saved (reduced mortality); and 2) increased future productivity (reduced morbidity):

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[18] It should be noted that because stunting is just one of many long-term consequences of poor nutrition, actual economic benefits may be much higher than estimated here.

[19] Hoddinott et al. (2011) provided direct estimates of the impact of stunting in early life on later life outcomes, which found that an individual stunted at age 36 months had, on average, 66% lower per capita consumption over his or her productive life.

1) $(lives\ saved\ attributable\ to\ intervention\ scale\ up) * (1.5 * GDP\ per\ capita) * LDF = (present\ value\ of\ reduced\ mortality)$

2) $(cases\ of\ child\ stunting\ averted) * (coefficient\ of\ deficit) * (actual\ gains\ realized) * (per\ capita\ income) * (labor\ force\ participation\ rate) * LDF = (present\ value\ of\ reduced\ morbidity)$

Where:

- Lives saved attributable to the intervention scale up are estimated using the LiST tool.
- Cases of child stunting averted are calculated by subtracting the under five stunting prevalence (%) after the intervention calculated by LiST from the stunting prevalence in year 0 and multiplying it by the total under five population.
- The coefficient of deficit is equal to the reduction in lifetime earnings attributable to stunting.
- The lifetime discount factor (LDF) is used to discount future benefits to their value at the time of investment. It is derived from a discount rate, age at the time of investment and the estimated age of entry and exit into the workforce. The equation used to calculate the LDF is:

$$LDF = \sum_{t=13}^{n} \frac{1}{(1+r)^t}$$

Where:
  - *LDF* is the lifetime discount factor
  - *r* is the discount rate
  - *t* is the number of years since the initial investment in scaling up the interventions (we assume that children enter the labor force at 15 years old, which is reflected in the starting value for *t*)
  - *n* is the life expectancy at birth

The following values and sources are used in our calculations:

Indicator	Value	Source
GNI per capita	$2,710	World Bank 2013
Life expectancy at birth	52 years	World Bank 2011
Labor force participation rate	56%	World Bank 2012
Coefficient of deficit (stunting)	0.66	Hoddinott 2011
Actual gains realized	90%	Hoddinott 2013

To arrive at a Net Present Value (NPV), we use the following equation:

$$NPV = \sum_{t=1}^{5} (PV\ of\ reduced\ mortality)_t + (PV\ of\ reduced\ morbidity)_t - (PV\ of\ Investment\ cost)_t$$

Finally, the annual addition to economic productivity is measured by taking the total economic benefits for a year in which all beneficiaries of the initial one-year investment have reached productive age (i.e. in year 13). These benefits are not discounted back to their present value, as they are considered the annual opportunity cost of not investing in scaling up nutrition interventions. It should be noted that these benefits are derived from a progressive, 5-year scale up plan, and therefore subsequent investments that maintain the target scale will increase the total annual benefits as new beneficiaries are reached.

Appendix 8: Scenario 5a Costs and Benefits by Intervention and by State

Interventions	Annual Public Investment (US$ million)	Annual Benefits		
		DALYs Saved	Lives Saved	Cases of Stunting Averted
Community programs for growth promotion	$34.9	2,897,931	8,974	1,859,167
Vitamin A supplementation	$3.3	112,190	1,485	303,844
Therapeutic zinc Supplementation with ORS	$21.6	100,216	4,278	n/a
Micronutrient powders	$17.5	383,927	n/a	n/a
Deworming	$15.1	57,125	n/a	n/a
Iron-folic acid supplementation	$10.2	232,146	321	12,033
Iron fortification of staple foods	$34.9	n/a	n/a	n/a
Salt Iodization	$1.9	n/a	n/a	n/a
Comp. Food for Prevention of MAM	$119.4	44,337	998	2,006,577
CMAM for Severe Malnutrition	$112.7	560,544	5,859	n/a
TOTAL (WHEN IMPLEMENTED SIMULTANEOUSLY)	**$371.3**	**4,388,415**	**96,463**	**1,434,988**
Capacity development for program delivery	$33.5			
M&E, operations research	$7.5			
Household contributions	($59.3)			

		Intervention Costs						
Region	State	CNPs for BCC (children U2)	Vitamin A Supp	Therapeutic Zn Supp	Multiple Micronutrient Powders (if comp food for prevention of MM provided)	Deworming	Iron Folic-Acid Supp	Salt Iodization
North-Central	FCT Abuja	$1,047,465	$37,539	$405,369	$423,092	$191,728	$150,521	$12,439
North-Central	Benue	$2,075,655	$207,545	$803,279	$867,541	$723,324	$34,798	$44,108
North-Central	Kogi	$1,612,850	$111,771	$624,173	$616,625	$289,539	$274,257	$44,757
North-Central	Kwara	$1,166,456	$37,184	$451,419	$456,038	$410,593	$279,366	$25,662
North-Central	Nasarawa	$916,637	$74,594	$354,739	$288,081	$193,594	$219,535	$27,270
North-Central	Niger	$1,996,771	$155,772	$772,750	$517,563	$302,231	$57,387	$126,545
North-Central	Plateau	$1,532,161	$112,246	$592,946	$498,075	$447,636	$348,605	$39,453
North Central Subtotal		**$10,347,995**	**$736,651**	**$4,004,674**	**$3,667,014**	**$2,558,645**	**$1,364,469**	**$320,233**
North-Eastern	Adamawa	$1,547,985	$98,693	$599,070	$449,720	$435,912	$285,472	$45,279
North-Eastern	Bauchi	$2,363,858	$254,148	$914,813	$239,979	$141,453	$413,285	$93,372
North-Eastern	Borno	$2,098,344	$277,535	$812,059	$605,078	$258,516	$487,477	$25,705
North-Eastern	Gombe	$1,173,821	$71,119	$454,269	$228,191	$400,790	$258,640	$59,571
North-Eastern	Taraba	$1,114,280	$110,976	$431,226	$306,873	$341,237	$266,870	$68,110
North-Eastern	Yobe	$1,181,485	$114,862	$457,235	$170,984	$262,422	$206,565	$29,389
North Eastern Subtotal		**$9,479,773**	**$927,333**	**$3,668,672**	**$2,000,826**	**$1,840,330**	**$1,918,308**	**$321,427**
North-Western	Jigawa	$2,124,819	$148,933	$822,305	$135,393	$320,117	$0	$112,350
North-Western	Kaduna	$2,984,442	$200,913	$1,154,979	-$244,963	$724,861	$157,250	$93,264
North-Western	Kano	$4,711,243	$504,659	$1,823,251	-$407,051	$1,111,100	$1,128,343	$159,593
North-Western	Katsina	$2,849,656	$158,549	$1,102,817	$123,105	$902,771	$252,522	$113,274
North-Western	Kebbi	$1,604,101	$100,365	$620,787	$190,567	$564,644	$384,182	$83,614
North-Western	Sokoto	$1,818,737	$257,118	$703,851	$241,601	$249,676	$34,847	$150,046
North-Western	Zamfara	$1,625,605	$187,328	$629,109	$228,235	$74,388	$105,120	$113,386
North Western Subtotal		**$17,718,604**	**$1,557,866**	**$6,857,100**	**$266,887**	**$3,947,556**	**$2,062,264**	**$825,526**
South-Eastern	Abia	$1,366,007	$52,471	$528,645	$566,510	$384,667	$235,554	$21,856
South-Eastern	Anambra	$2,029,547	$79,968	$785,435	$786,896	$700,113	$369,418	$19,534
South-Eastern	Ebonyi	$1,054,804	$67,250	$408,209	$428,335	$293,320	$217,258	$15,427
South-Eastern	Enugu	$1,602,426	$51,082	$620,139	$742,436	$507,649	$341,565	$25,238
South-Eastern	Imo	$1,962,237	$81,590	$759,386	$813,779	$669,986	$460,557	$20,603
South Eastern Subtotal		**$8,015,021**	**$332,361**	**$3,101,813**	**$3,337,956**	**$2,555,735**	**$1,624,352**	**$102,659**
South-South	Akwa-Ibom	$1,981,586	$56,107	$766,874	$746,899	$488,263	$199,328	$15,853
South-South	Bayelsa	$832,288	$46,307	$322,095	$346,964	$284,176	$199,333	$21,848
South-South	Cross-River	$1,411,595	$69,315	$546,287	$536,632	$0	$202,846	$19,409
South-South	Delta	$2,043,766	$154,582	$790,938	$763,715	$625,883	$440,534	$42,919
South-South	Edo	$1,551,258	$85,080	$600,337	$710,352	$507,820	$352,950	$21,330
South-South	Rivers	$2,621,115	$89,265	$1,014,371	$1,092,690	$885,727	$514,761	$25,884
South South Subtotal		**$10,441,607**	**$500,656**	**$4,040,902**	**$4,197,252**	**$2,791,869**	**$1,909,751**	**$147,242**
South-Western	Ekiti	$1,180,907	$26,655	$457,011	$505,050	$307,603	$135,757	$18,747
South-Western	Lagos	$4,494,827	$200,245	$1,739,498	$1,800,987	$1,423,961	$1,022,685	$61,804
South-Western	Ogun	$1,871,757	$120,077	$724,370	$640,815	$632,504	$443,803	$58,258
South-Western	Ondo	$1,692,810	$61,672	$655,118	$669,134	$494,571	$381,102	$11,426
South-Western	Osun	$1,707,232	$29,747	$660,699	$709,867	$492,776	$408,882	$22,834
South-Western	Oyo	$2,826,435	$146,624	$1,093,830	$985,974	$507,402	$453,544	$47,696
South Western Subtotal		**$13,773,968**	**$585,020**	**$5,330,526**	**$5,311,827**	**$3,858,817**	**$2,845,774**	**$220,766**
GRAND TOTAL		**$69,776,969**	**$4,639,887**	**$27,003,687**	**$18,781,763**	**$17,552,952**	**$11,724,919**	**$1,937,853**

		Intervention Costs						
Region	State	CMAM for SAM	Comp Food for Prevention of Moderate Malnutrition	TOTAL COST OF ALL INTERVENTIONS Comp Food for Prevention of MM and BCC for U2s	Cost of capacity development (9% of total cost of interventions)	Cost of M&E and Operations Research (2% of total cost of interventions divided into three steps)	GRAND TOTAL including CD and M&E	Household Contributions
North-Central	FCT Abuja	$3,016,700	$2,023,263	$7,831,848	**$704,866**	**$156,637**	**$8,693,351**	**$1,625,477**
North-Central	Benue	$1,673,808	$3,595,637	$11,063,522	**$995,717**	**$221,270**	**$12,280,510**	**$1,463,910**
North-Central	Kogi	$2,601,205	$3,609,849	$10,591,450	**$953,231**	**$211,829**	**$11,756,510**	**$1,655,316**
North-Central	Kwara	$940,630	$4,935,369	$9,285,945	**$835,735**	**$185,719**	**$10,307,399**	**$1,674,083**
North-Central	Nasarawa	$1,847,941	$2,936,878	$7,317,587	**$658,583**	**$146,352**	**$8,122,522**	**$801,478**
North-Central	Niger	$9,201,120	$15,917,459	$30,045,985	**$2,704,139**	**$600,920**	**$33,351,043**	**$8,604,377**
North-Central	Plateau	$3,883,108	$4,674,116	$12,894,426	**$1,160,498**	**$257,889**	**$14,312,813**	**$1,649,852**
North Central Subtotal		**$23,164,512**	**$37,692,571**	**$89,030,762**			**$98,824,146**	
North-Eastern	Adamawa	$4,026,667	$5,481,769	$13,744,560	**$1,237,010**	**$274,891**	**$15,256,462**	**$1,498,669**
North-Eastern	Bauchi	$10,882,921	$14,712,607	$31,198,366	**$2,807,853**	**$623,967**	**$34,630,187**	**$2,596,462**
North-Eastern	Borno	$19,402,638	$14,990,108	$40,006,632	**$3,600,597**	**$800,133**	**$44,407,362**	**$6,568,005**
North-Eastern	Gombe	$3,057,786	$11,516,596	$17,807,695	**$1,602,693**	**$356,154**	**$19,766,541**	**$2,279,994**
North-Eastern	Taraba	$1,540,381	$4,185,070	$8,922,164	**$802,995**	**$178,443**	**$9,903,602**	**$1,622,150**
North-Eastern	Yobe	$8,027,055	$13,258,103	$24,298,842	**$2,186,896**	**$485,977**	**$26,971,715**	**$2,571,007**
North Eastern Subtotal		**$46,937,449**	**$64,144,253**	**$135,978,260**			**$150,935,868**	
North-Western	Jigawa	$7,369,811	$28,729,807	$40,825,945	**$3,674,335**	**$816,519**	**$45,316,799**	**$3,454,595**
North-Western	Kaduna	$47,445,472	$52,705,731	$106,714,171	**$9,604,275**	**$2,134,283**	**$118,452,729**	**$19,456,651**
North-Western	Kano	$63,844,086	$41,889,548	$117,120,393	**$10,540,835**	**$2,342,408**	**$130,003,636**	**$13,023,323**
North-Western	Katsina	$17,900,471	$40,190,410	$65,018,404	**$5,851,656**	**$1,300,368**	**$72,170,428**	**$9,374,762**
North-Western	Kebbi	$7,421,245	$19,180,878	$30,952,433	**$2,785,719**	**$619,049**	**$34,357,200**	**$5,570,705**
North-Western	Sokoto	$6,065,982	$21,022,453	$31,453,681	**$2,830,831**	**$629,074**	**$34,913,585**	**$3,102,962**
North-Western	Zamfara	$4,622,957	$18,441,185	$26,840,115	**$2,415,610**	**$536,802**	**$29,792,527**	**$6,368,573**
North Western Subtotal		**$154,670,023**	**$222,160,012**	**$418,925,140**				
South-Eastern	Abia	$3,776,735	$4,858,284	$12,473,733	**$1,122,636**	**$249,475**	**$13,845,843**	**$3,052,568**
South-Eastern	Anambra	$10,754,976	$4,386,927	$20,927,588	**$1,883,483**	**$418,552**	**$23,229,623**	**$2,874,365**
South-Eastern	Ebonyi	$1,944,214	$2,005,097	$6,961,315	**$626,518**	**$139,226**	**$7,727,060**	**$508,941**
South-Eastern	Enugu	$1,845,995	$1,744,129	$8,281,873	**$745,369**	**$165,637**	**$9,192,879**	**$1,305,328**
South-Eastern	Imo	$3,955,870	$3,489,407	$13,194,533	**$1,187,508**	**$263,891**	**$14,645,932**	**$3,214,774**
South Eastern Subtotal		**$22,277,790**	**$16,483,844**	**$61,839,042**			**$68,641,336**	
South-South	Akwa-Ibom	$3,081,762	$4,587,034	$12,914,498	**$1,162,305**	**$258,290**	**$14,335,092**	**$3,106,884**
South-South	Bayelsa	$623,217	$1,454,523	$4,546,895	**$409,221**	**$90,938**	**$5,047,053**	**$1,254,108**
South-South	Cross-River	$2,520,544	$3,202,683	$9,215,108	**$829,360**	**$184,302**	**$10,228,770**	**$1,767,950**
South-South	Delta	$8,475,908	$9,649,929	$24,010,058	**$2,160,905**	**$480,201**	**$26,651,164**	**$5,303,042**
South-South	Edo	$3,216,688	$1,807,339	$9,628,782	**$866,590**	**$192,576**	**$10,687,948**	**$1,189,959**
South-South	Rivers	$4,227,334	$4,580,712	$16,362,416	**$1,472,617**	**$327,248**	**$18,162,282**	**$3,701,197**
South South Subtotal		**$22,145,453**	**$25,282,221**	**$76,677,756**			**$85,112,310**	
South-Western	Ekiti	$1,564,465	$1,882,743	$6,669,390	**$600,245**	**$133,388**	**$7,403,023**	**$1,321,674**
South-Western	Lagos	$9,838,277	$17,777,670	$40,607,368	**$3,654,663**	**$812,147**	**$45,074,178**	**$13,067,061**
South-Western	Ogun	$4,959,408	$5,251,010	$15,637,882	**$1,407,409**	**$312,758**	**$17,358,049**	**$2,919,648**
South-Western	Ondo	$1,657,600	$3,477,405	$9,947,244	**$895,252**	**$198,945**	**$11,041,441**	**$2,116,849**
South-Western	Osun	$3,245,107	$3,009,765	$11,140,526	**$1,002,647**	**$222,811**	**$12,365,984**	**$2,872,552**
South-Western	Oyo	$3,093,250	$15,338,554	$25,906,527	**$2,331,587**	**$518,131**	**$28,756,245**	**$8,750,437**
South Western Subtotal		**$24,358,108**	**$46,737,146**	**$109,908,937**			**$121,998,920**	
GRAND TOTAL		**$293,553,335**	**$412,500,048**	**$892,359,897**	**$80,312,391**	**$17,847,198**	**$990,519,485**	**$153,289,686**

Region	State	Annual Public Investment Required	DALYs Saved	Lives Saved	Cases of Stunting Averted
			BENEFITS		
North-Central	FCT Abuja	$ 4,054,345.00	61,134	1,042	36,843
North-Central	Benue	$ 6,225,220.00	139,869	2,536	94,717
North-Central	Kogi	$ 5,414,105.00	95,843	1,843	71,360
North-Central	Kwara	$ 3,774,728.00	72,240	1,704	78,638
North-Central	Nasarawa	$ 3,767,046.00	52,536	1,099	44,765
North-Central	Niger	$ 11,100,147.00	147,505	3,431	157,508
North-Central	Plateau	$ 7,911,189.00	86,306	1,755	69,495
North Central Subtotal		**$ 42,246,780.00**	**655,433**	**13,409**	**553,327**
North-Eastern	Adamawa	$ 8,065,568.00	86,554	1,702	64,804
North-Eastern	Bauchi	$ 13,663,113.00	142,287	3,262	138,613
North-Eastern	Borno	$ 13,285,009.00	141,535	3,924	190,676
North-Eastern	Gombe	$ 5,062,981.00	72,219	1,807	83,725
North-Eastern	Taraba	$ 4,326,340.00	66,854	1,519	65,693
North-Eastern	Yobe	$ 9,599,948.00	76,926	2,044	96,610
North Eastern Subtotal		**$ 54,002,959.00**	**586,374**	**14,258**	**640,122**
North-Western	Jigawa	$ 15,211,657.00	166,531	4,260	206,699
North-Western	Kaduna	$ 33,857,310.00	200,701	4,195	176,909
North-Western	Kano	$ 46,356,488.00	272,406	6,616	289,423
North-Western	Katsina	$ 18,534,774.00	197,333	4,921	231,504
North-Western	Kebbi	$ 8,615,081.00	103,333	2,855	140,007
North-Western	Sokoto	$ 10,572,566.00	146,591	3,771	181,721
North-Western	Zamfara	$ 8,943,700.00	123,773	3,359	164,301
North Western Subtotal		**$ 142,091,577.00**	**1,210,668**	**29,977**	**1,390,564**
South-Eastern	Abia	$ 5,472,679.00	85,312	1,747	73,927
South-Eastern	Anambra	$ 10,265,662.00	119,018	2,098	77,712
South-Eastern	Ebonyi	$ 3,971,693.00	62,020	1,265	51,427
South-Eastern	Enugu	$ 4,702,636.00	98,171	2,037	87,469
South-Eastern	Imo	$ 6,347,482.00	106,873	1,942	71,273
South Eastern Subtotal		**$ 30,760,152.00**	**471,393**	**9,089**	**361,808**
South-South	Akwa-Ibom	$ 6,960,856.00	119,005	2,007	70,895
South-South	Bayelsa	$ 2,258,387.00	45,746	865	32,638
South-South	Cross-River	$ 4,333,959.00	85,324	1,583	60,679
South-South	Delta	$ 9,358,653.00	125,650	2,760	119,431
South-South	Edo	$ 5,423,803.00	89,706	1,734	68,490
South-South	Rivers	$ 9,048,647.00	162,807	3,355	143,554
South South Subtotal		**$ 37,384,305.00**	**628,238**	**12,304**	**495,688**
South-Western	Ekiti	$ 3,832,535.00	70,221	1,145	39,422
South-Western	Lagos	$ 14,973,298.00	272,248	5,778	248,925
South-Western	Ogun	$ 7,592,819.00	116,066	2,625	117,158
South-Western	Ondo	$ 5,057,529.00	104,722	2,286	101,254
South-Western	Osun	$ 5,240,210.00	92,287	1,652	60,984
South-Western	Oyo	$ 9,792,834.00	180,754	3,940	172,359
South Western Subtotal		**$ 46,489,225.00**	**836,298**	**17,426**	**740,100**
GRAND TOTAL		**$ 352,974,998.00**	**4,388,404**	**96,463**	**4,181,609**

Appendix 9: Sensitivity Analysis

Full National coverage

Assumption Changed	Effect on Total Cost
Iron fortification of staple foods costs double	Increase from $837.2 million to $862.9 million
All micronutrient and deworming unit cost doubles	Increase from $837.2 million to $944.9 million
Community nutrition program unit cost doubles	Increase from $837.2 million to $914.7 million
Complementary food unit cost doubles	Increase from $837.2 million to $1,163.5 million
CMAM for SAM unit cost doubles	Increase from $837.2 million to $1,163.1 million
Iron fortification of staple foods costs reduced by 50%	Decrease from $837.2 million to $824.4 million
All micronutrient and deworming unit cost reduced by 50%	Decrease from $837.2 million to $783.4 million
Community nutrition program unit cost reduced by 50%	Decrease from $837.2 million to $798.5 million
Complementary food unit cost reduced by 50%	Decrease from $837.2 million to $674.1 million
CMAM for SAM unit cost reduced by 50%	Decrease from $837.2 million to $674.3 million

Scenario 5a

Assumption Changed	Effect on Total Cost
Iron fortification of staple foods costs double	Increase from $352.98 million to $391.7 million
All micronutrient and deworming unit cost doubles	Increase from $352.98 million to $447.8 million
Community nutrition program unit cost doubles	Increase from $352.98 million to $378.6 million
Complementary food unit cost doubles	Increase from $352.98 million to $447.4 million
CMAM for SAM unit cost doubles	Increase from $352.98 million to $478.1 million
Iron fortification of staple foods costs reduced by 50%	Decrease from $352.98 million to $340.1 million
All micronutrient and deworming unit cost reduced by 50%	Decrease from $352.98 million to $305.6 million
Community nutrition program unit cost reduced by 50%	Decrease from $352.98 million to $333.6 million

Complementary food unit cost reduced by 50%	Decrease from $352.98 million to $305.8 million
CMAM for SAM unit cost reduced by 50%	Decrease from $352.98 million to $290.4 million

REFERENCES

Abt Associates. 2014. *Country Assessment for Aflatoxin Contamination and Control in Nigeria*. January 8. Bethesda, MD: Abt Associates.

Arimond M, C. Hawkes, M.T. Ruel et al. 2011. "Agricultural interventions and nutrition: Lessons from the past and new evidence". In *Combating Micronutrient Deficiencies: Food-based Approaches.* Rome: FAO.

Asare-Marfo, D,, E. Birol, C. Gonzalez, M. Moursi, S. Perez, J. Schwarz and M. Zeller. 2013. "Prioritizing Countries for Biofortification Interventions Using Country-Level Data." HarvestPlus Working Paper No. 11(October 2013). Washington, DC: HarvestPlus.

Awasthi, S. et al. 2013. "Population deworming every 6 months with albendazole in 1 million pre-school children in north India: DEVTA, a cluster-randomized trial." *Lancet*. 381(9876):1478-86.

Baird, S., J.H. Hicks, M. Kremer and E. Miguel. 2011. *Worms at work: long run impacts of child health gains.* Working paper. Harvard University

Bandyopadhyay, R. (IITA plant pathologist). 2013. Personal communication (Nigeria).

Bandyopadhyay, R. and J. Cotty. 2013. "Biological Controls for Aflatoxin Reduction." in Unnevehr, L. and D. Grace, eds. "Aflatoxins: Finding Solutions for Improved Food Safety." *2020 Focus Brief #20 (16)*. Washington, DC: International Food Policy Research Institute.

Behrman, J.R., M.C. Calderon, S.H. Preston, J. Hoddinott, R. Martorell and A.D. Stein. 2009. "Nutritional supplementation in girls influences the growth of their children: Prospective study in Guatemala." *American Journal of Clinical Nutrition* 90(1):1372-9.

Bhutta, Z., T. Ahmed, R. Black, S. Cousens, K. Dewey, E. Giugliani, B. Haider, B. Kirkwood, S. Morris, H. Sachdev and M. Shekar. 2008. "What works? Interventions for maternal and child undernutrition and survival." *The Lancet* 371:417-440.

Bhutta Z.A., et al., 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*; Maternal and Child Nutrition series.

Birol et al. 2014. *Cost-effectiveness of biofortification revisited*. Washington, DC: HarvestPlus, Preliminary results as cited in HarvestPlus Biofortification Progress Brief #25. Washington, DC:HarvestPlus.
http://www.harvestplus.org/sites/default/files/Biofortification_Progress_Briefs_August2014_WEB_0.pdf

Black R.E., et al., for the Maternal and Child Undernutrition Study Group. 2008. "Maternal and child undernutrition: global and regional exposures and health consequences." *Lancet*; 371: 243-60

Black R.E., et al., for the Maternal and Child Under nutrition Study Group. 2013. "Maternal and child undernutrition and overweight in low-income and middle-income countries." *Lancet*; 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

Bloom D., J. Finlay, S. Humair et al. 2010. "Prospects for economic growth in Nigeria: A demographic perspective." Paper presented at the IUSSP Seminar on Demographics and Macroeconomic Performance held at Novotel, Gare de Lyon, Paris, France 4-5 June 2010.

Bolt, E. and S. Cairncross. 2004. "Sustainability of Hygiene Behaviour and the Effectiveness of Change Interventions: Lessons learned on research methodologies and research implementation from a multi-country research study." IRC International Water and Sanitation Centre, Delft, the Netherlands.

Caulfield, L.E., M. de Onis, M. Blossner, and R.E. Black. 2004. "Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles." *American Journal of Clinical Nutrition*. 80(1): 193-198.

DCP2 (Disease Control Priorities Project). 2008. Deworming Children Brings Huge Health and Development Gains in Low-Income Countries. Seattle, WA: University of Washington.

Ejemot, R, et al. 2008. "Hand-washing for Preventing Diarrhoea," *Cochrane Database of Systematic Reviews.* Issue 1.

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

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.

Fiedler, J. 2010. *The Cost of Micronutrient Interventions*. Washington DC: HarvestPlus.

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

Goodman C., P. Coleman and A. Mills. 2000. *Economic analysis of malaria control in Sub-Saharan Africa*. Geneva: Global Forum for Health Research.

Government of Nigeria. 2013. *National Strategic Plan of Action for Nutrition (2014-2018)*. Abuja, Nigeria.

Guyatt, H.L. 2003 "The Cost of delivering and sustaining a control programme for schistosomiasis and soil-transmitted helmithiasis." *Acta Tropica* 86:267-74.

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., 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.

Hoddinott, J. M. Rosegrant, M. Torero. 2012. "Investments to reduce hunger and undernutrition." Challenge Paper prepared for the 2012 Copenhagen Consensus.

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(Suppl. 2):69-82.

Horton S. 1999. "Opportunities for Investment in nutrition in low-income Asia.' *Asia Development Review*, 17:246-73.

Horton S. and J. Ross. 2003. "The economics of iron deficiency." *Food Policy*. 28(1)51-75.

*Horton S. and R. Steckel. 2013. "*Global economic losses attributable to malnutrition 1900–2000 and projections to 2050." *In The Economics of Human Challenges, ed B. Lomborg Cambridge, U.K.: Cambridge University Press.*

Hotez, P. P.J. Brindley, J.M. Bethony et al. 2008. "Helminth infections: the great neglected tropical disease." *The Journal of Clinical Investigation* 118 (4): 1312

Hotz C, Loechl C, De Brauw A, et al. 2012a. « A large scale intervention to introduce orange sweet potato in Mozambique increases vitamin A intakes among child and women*." British Journal of Nutrition*. 108: 163-76.

Hotz C, Loechl C, Lubowa A, et al. 2012b. « Introduction of B carotene-rich orange sweet potato in rural Uganda resulted in creased vitamin A intakes among children and women and improved vitamin A status among children." *Journal of Nutrition*. 142: 1871-80

J-PAL (Abdul Latif Jameel Poverty Action Lab). 2012. *Deworming: A Best Buy For Development*. J-PAL Policy Bulletin. March, 2012. Boston, MA: Massachusetts Institute of Technology.

Khlangwiset, P. 2011. “Reducing the Risks of Aflatoxin Through Public Health Interventions.” Doctoral dissertation. University of Pittsburg.

Khlangwiset, P and Wu F. 2011. “Cost and efficacy of public health interventions to reduce aflatoxin-induced human diseases.” Food Addit Contam Part A Chem Anal Control Expo Risk Assess. July; 27 (7): 998-1014

Kuniholm, M. H., O.A. Lesi, M. Mendy, et al. 2008. “Aflatoxin exposure and viral hepatitis in the etiology of liver cirrhosis in the Gambia, West Africa.” *Environ Health Perspect,* 116(11), 1553-1557.

Liu Y., and F. Wu. 2010. “Global Burden of Aflatoxin-Induced Hepatocellular Carcinoma: A Risk Assessment.” *Environmental Health Perspectives* 118:818-824.

Lorntz B. et al. 2006. “Early Childhood Diarrhea Predicts Impaired School Performance.” *The Pediatric Infectious Disease Journal*, vol. 25, no. 6, June 2006, pp. 513–520.

Masset E, L. Haddad, A. Cornelius and J. Isaza-Castro. 2011, “A systematic review of agricultural interventions that aim to improve nutritional status of children.” London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Maziya-Dixon B.B. et al. 2006. “Vitamin A deficiency is prevalence in children less than 5 years-old.” *Journal of Nutrition.* Aug 136 (8): 2255-61

Menakshi J. et.al. 2010. “How cost-effective is biofortification in combating micronutrient malnutrition? An ex-ante assessment.” *World Development* 38(1): 64-75.

Miguel, E and M. Kremer. 2004. “Worms: identifying impacts on education and health in the presence of treatment externalities.” *Econometrica* 72(1): 159-217

Murray C.J. et al. 2013. “Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study.” *Lancet* 380 (9859): 2197–223.

Nigeria Multiple Indicators Cluster Survey (MICS). 2011. National Bureau of Statistics (NBS).

Nigeria Demographic and Health Survey (NDHS). 2008. http://microdata.worldbank.org/index.php/catalog/1459

Results for Development (R4D). 2014. *Saving One Million Lives Fiscal Space Analysis*. (Preliminary Results March 2014).

Ruel M., et al., for the Maternal and Child Undernutrition Study Group. 2013: Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? *Lancet*; Maternal and Child Nutrition series.

Seddoh, A. et al. 2013. "Towards Investment Case for Neglected Tropical Diseases." Working paper for Lancet Commission on Investing in Health. *Draft*

Shephard GS, P. Khlangsiwet and Wu F. 2011. "Aflotoxin and growth impairment: A review." *Critical Review of Toxicology.* October. 41(9):740-55.

Spears, D. 2013. "How much international variation in child height can sanitation explain?" World Bank Policy Research Working Paper 6351. Washington, DC: World Bank

Stenberg K. et al. 2013. "Advancing social and economic development by investing in women's and children's health: a new Global Investment Framework." *The Lancet Health Policy*, Published Online November 19, 2013 http://dx.doi.org/10.1016/50140-6736(13)62231-x. p.8.

Strauss, J. and D. Thomas. 1998. "Heath, Nutrition and Economic Development." *Journal of Economic Literature*. 36(1):766-817.

UNICEF. 2012. *Water, sanitation and hygiene (WASH) in schools.* New York: UNICEF.

Unnevehr, L. and D. Grace, eds. 2013. "Aflatoxins: Finding Solutions for Improved Food Safety." *2020 Focus Brief #20*. Washington, DC: International Food Policy Research Institute.

World Bank. 2006. *Repositioning nutrition as central to development: A strategy for large-scale action.* Washington, DC: World Bank.

World Bank. 2010a. *Scaling Up Nutrition. What Will It Cost?* Washington, DC: The World Bank.

World Bank. 2010b. *Nigeria: Country Nutrition Profiles*. Washington, DC: World Bank.

World Bank. 2012. *Nigeria: economic impacts of poor sanitation*. Water and Sanitation Program. Washington, DC: World Bank.

World Bank. 2013a. *Where has all the growth gone? A poverty update for Nigeria*. Washington, DC: World Bank

World Bank. 2013b. *Improving Nutrition Through Multisectoral Approaches*. Washington, DC: World Bank.

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

WHO. 2014. Cost-effectiveness and strategic planning: threshold values for intervention cost-effectiveness by region. Geneva, Switzerland: WHO-CHOICE (Choosing Interventions that are cost-effective) Program. http://www.who.int/choice/costs/CER_levels/en/

COSTED PLAN FOR SCALING UP NUTRITION:

Nigeria

Meera Shekar, Christine McDonald, Ali Subandoro, Julia Dayton Eberwein, Max Mattern and Jonathan Kweku Akuoku

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Health, Nutrition and Population (HNP) Discussion Paper

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Health, Nutrition and Population (HNP) Discussion Paper

Costed Plans for Scaling Up Nutrition: *Nigeria*

The World Bank Group
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Abstract: This paper estimates country-specific costs and benefits of scaling up key nutrition investments in Nigeria. Building on the methodology established in the global report *Scaling Up Nutrition: What will it cost?,* we first estimate the costs and benefits of a nationwide scale up of ten effective nutrition-specific interventions. This would require an annual public investment of $837 million and would yield enormous benefits: over 8.7 million DALYs and 183,000 lives would be saved annually, while more than 3 million cases of stunting among children under five would be averted. As it is unlikely that the Government of Nigeria or its partners will find the $837 million necessary to reach full national coverage, we also considers five potential scale-up scenarios based on considerations of burden of stunting, potential for impact, resource requirements and capacity for implementation in Nigeria. Using cost-benefit analyses we propose scale-up scenarios that represent a compromise between the need to move to full coverage and the constraints imposed by limited resources. This analysis takes an innovative approach to nutrition costing by not only estimating the costs and benefits of nutrition-specific interventions, but also exploring costs for a selected number of nutrition-sensitive interventions implemented outside of the health sector. We identify and cost four candidate nutrition-sensitive interventions with high impact potential for Nigeria, including biofortification of cassava, aflatoxin control, school-based deworming, and school-based promotion of good hygiene. Overall, these findings point to a selection of nutrition-specific interventions and a candidate list of nutrition-sensitive approaches that represent a cost-effective approach to reducing child malnutrition in Nigeria. Moving forward, these results are intended to help guide decision makers as they plan future efforts to scale-up action against malnutrition in Nigeria and develop nutrition financing plans that bring together the health, education and agriculture sectors.

Keywords: nutrition-specific interventions, nutrition-sensitive interventions, cost of nutrition interventions, cost-benefit analysis, nutrition financing.

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GLOSSERY OF TERMS

ANC	antenatal clinics
ARI	acute respiratory infections
BMGF	Bill and Melinda Gates Foundation
CCT	conditional cash transfers
CIDA	Canadian International Development Agency
C-IMCI	community-based approach to integrated management of childhood illnesses
CHAI	Clinton Health Access Initiative
CMAM	community-based management of acute malnutrition
CNPs	community nutrition programs
CIFF	Children's Investment Fund Foundation
DALYs	disability adjusted life years
EU	European Union
FGoN	Federal Government of Nigeria
GAIN	Global Alliance for Improved Nutrition
GMP	growth monitoring and promotion
GNI	gross national income
GNP	gross national product
HKI	Helen Keller International
IFA	iron folic acid
IITA	International Institute for Tropical Agriculture
LiST	Lives Saved Tool
M&E	monitoring and evaluation
MAM	management of acute malnutrition
MI	Micronutrient Initiative
MICS	Multiple Indicator Cluster Survey
MoH	Ministry of Health
NAFDAC	National Agency for Food and Drug Administration
NDHS	Nigeria Demographic and Health Survey
NPV	net present value
NTD	neglected tropical disease
ORS	oral rehydration solution
R4D	Results For Development
SAM	severe acute malnutrition
SMART	Standardized Monitoring and Assessment of Relief and Transitions
SOML	Saving One Million Lives
UNICEF	United Nations Children's Fund
UHC	Universal Health Coverage
USAID	United States Agency for International Development
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WINNN	Working to Improve Nutrition in Northern Nigeria

GLOSSARY OF TECHNICAL TERMS

Aflatoxins are a group of toxic compounds produced by certain molds, especially *aspergillus flavus*, which contaminate stored food supplies such as animal feed, maize and peanuts. Research shows that human consumption of high levels of aflatoxins can lead to liver cirrhosis (Kuniholm et al., 2008) and liver cancer in adults (Abt Associates 2014). It is widely understood that there is a relationship between aflatoxin exposure and child stunting but this relationship has not yet been adequately quantified in the published literature (Unnevehr and Grace 2013, Abt Associates 2014).

Biocontrol (also called biological control) is the use of an invasive agent to reduce pest or mold population below a desired level. Aflatoxins can be reduced through biocontrol and the most effective method involves a single application of a product (such as AflaSafeTM) containing strains unique to the specific country or location.

Biofortification is the idea of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding, or through genetic engineering.

A **DALY** is a **Disability Adjusted Life Year**, and 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 advantages of the DALY is that it is a metric that is recognized and understood by external audiences such as the WHO and the NIH. It helps to gauge the contribution of individual diseases relative to 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.

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 a part of an integrated set of tools that comprise the Spectrum policy modeling system.

Stunting is an anthropometric measure of low height-for-age. It is an indicator of chronic undernutrition and is the result of prolonged food deprivation and/or disease or illness. It is measured in terms of Z-score (or standard deviation score; see definition below) and a child is considered stunted with a height-for-age Z-score of -2 or lower.

Underweight is an anthropometric measure of low weight-for-age. It is used as a composite indicator to reflect both acute and chronic undernutrition, although it cannot distinguish between them. It is measured in terms of Z-score (or standard deviation score; see definition below) and a child is considered underweight with a Z-score of -2 or lower.

Wasting is an anthropometric indicator of low weight-for-height. It is an indicator of acute undernutrition and the result of more recent food deprivation or illness. It is measured in terms of Z-score (or standard deviation score; see definition below) and a child is considered stunted with a Z-score of -2 or lower.

A **Z-score** or standard deviation score is calculated with the following formula:

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

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EXECUTIVE SUMMARY

1. **The overall objective of this programmatic Knowledge Product is to support the Federal Ministry of Health in the Government of Nigeria to develop a costed scale-up plan for nutrition. This scale-up plan will be complemented with a health-sector fiscal space analysis financed by the Children's Investment Fund Foundation (CIFF) and conducted by Results For Development (R4D).** The executive summary is written for policy makers; it highlights the main findings and discusses the implications for nutrition policy in Nigeria. The paper itself is more technical in nature and is written for planners and programmers. The analysis seeks to estimate the potential impact and allocative efficiency of investments in nutrition, with the goal of guiding Nigeria's ongoing nutrition strategic planning process. The report has benefitted tremendously from a strong partnership with the FMOH and SOML, as well as extensive consultation with partners such as DFID, UNICEF, USAID, Save the Children, CIFF, CHAI and other stakeholders in Nigeria.

2. **Nigeria is home to the third largest population of chronically undernourished (stunted) children in the world.** Within Nigeria, there is enormous geographic variation in nutrition outcomes, with the worst malnutrition concentrated in the North-Eastern and North-Western regions. Vitamin and mineral deficiencies (*hidden hunger*) are also pervasive, of which anemia and vitamin A deficiencies are the most prevalent.

3. **Malnutrition, particularly in very young children, leads to increased mortality, greater susceptibility to illness, and long-term effects on cognitive abilities, resulting in irreversible losses in human capital that contribute to future losses in economic productivity.** Undernutrition is responsible for approximately half of under-five child mortality and one-fifth of maternal mortality in developing countries, and children who have been malnourished early in life are more likely to experience cognitive deficiencies and poor schooling outcomes. Over the long-term, stunting results in 10-17 percent loss of wages, and it is estimated that Nigeria loses over US$1.5 billion in GDP annually to vitamin and mineral deficiencies alone (Government of Nigeria 2014; World Bank 2009).

4. **At the same time, nutrition interventions are consistently identified as among the most cost effective development actions, and the costs of scaling up nutrition interventions are modest.** Cost-benefit analysis shows that nutrition interventions are highly effective (Hoddinott et al 2013; World Bank 2010a). It is estimated that investing in nutrition can increase a country's gross domestic product (GDP) by at least 3 percent annually (Horton and Steckel 2013). Globally, the cost of scaling up key nutrition interventions across 68 countries is estimated at $10.3 billion per annum, and would provide preventive nutrition services to about 356 million children, save at least 1.1 million lives and 30 million DALYs, and reduce the number of stunted children by about 30 million worldwide (World Bank 2010a).

5. **This report builds on the global costing exercise to identify country-specific estimates of the costs and benefits of scaling up key nutrition investments in Nigeria. It is intended to help guide the development of the National Strategic Plan of Action for Nutrition, and aims to maximize allocative efficiencies by identifying the most cost effective package of interventions.** The methodology is based on the costing framework established by *Scaling Up Nutrition: What will it cost?* (World Bank 2010a), which is adapted to the country-specific context of Nigeria. By combining costing with estimates of impact (in terms of DALYs saved, lives saved, and cases of childhood stunting averted) this report strengthens the "case for nutrition" and guides policy makers in prioritizing investments in situations where financial and human resources are constrained. Furthermore, this analysis takes an innovative approach by also exploring the costs and benefits of selected (albeit not exhaustive) nutrition-sensitive interventions implemented outside of the health sector.

6. **We first estimate the costs and benefits of a nationwide scale up of all ten nutrition-specific interventions.** These ten interventions were selected as a starting point because they have demonstrated effectiveness in improving child nutrition and have clear delivery scenarios that allow them to achieve scale. We refer to this as the "full coverage" scenario, [1] and estimate that it would require an annual public investment of $837 million. The expected benefits are enormous: over 8.7 million DALYs and 183,000 lives would be saved annually, while more than 3 million cases of stunting among children under five would be averted.

7. **Given resource constraints, few countries are able to effectively scale-up all ten nutrition-specific interventions to full national coverage simultaneously. We therefore consider 5 potential scale-up scenarios based on considerations of burden of stunting, potential for impact, resource requirements and capacity for implementation in Nigeria.**

- **Scenario 1**: Scale up by region
- **Scenario 2**: Scale up by intervention
- **Scenario 3**: Scale up by state
- **Scenario 4**: Scale up by state and by intervention
- **Scenario 5**: Scale up by levels of program coverage

8. **Scenarios 4 and 5 represent the most cost effective means of scaling up, when measured in terms of cost per DALY saved, cost per life saved and cost per case of childhood stunting averted. We further refine our analysis by comparing variations of these scenarios:**

- **Scenario 4a:** scale up critical interventions, including community nutrition programs, micronutrient supplementation, deworming and community-based management of

[1] "Full" program coverage levels are 100 percent coverage for all interventions except for the public provision of complementary food for prevention of moderate acute malnutrition and community-based management of severe acute malnutrition for which "full" coverage is 80 percent.

severe acute malnutrition to full program coverage levels in states where stunting prevalence exceeds 25 percent**.**

- **Scenario 4b**: scale up critical interventions, including community nutrition programs, micronutrient supplementation, deworming and community-based management of severe acute malnutrition in states where stunting prevalence exceeds 35 percent.
- **Scenario 5a:** scale up all 10 interventions to partial coverage levels.[2]
- **Scenario 5b**: scale up micronutrient and deworming interventions[3] to partial coverage levels in all 36 states, and scale up community nutrition programs and community-based management of severe acute malnutrition to partial coverage levels in states where stunting prevalence exceeds 35 percent.

The table below presents estimated costs and benefits for each of these scenarios.

Estimated Costs and Benefits of 5 Scenarios

Recommended Scenarios	**Annual Public Investment (US$ million)**	**Annual Benefits**			**Cost per Benefit Unit**		
		DALYs Saved	**Lives Saved**	**No. of Cases of Stunting Averted**	**DALY Saved**	**Lives Saved**	**Cases of Stunting Averted**
Scenario 4a	$337	4,694,076	96,092	n/a	66	3,229	n/a
Scenario 4b	$271	3,439,969	70,911	n/a	72	3,496	n/a
Scenario 5a	$353	4,388,415	96,463	1,434,988	85	3,849	259
Scenario 5b	$184	2,256,091	58,519	n/a	82	3,152	n/a

Source: Authors' calculations.

9. **The analysis further identifies three scenarios (4a, 4b and 5a) that have the potential to significantly improve nutrition outcomes in a highly cost-effective manner, while also prioritizing the use of scarce resources.** Scenario 4b represents the lowest-cost option, and would scale up critical interventions, including community nutrition programs, micronutrient supplementation, deworming and community-based management of severe acute malnutrition in states where the prevalence of stunting among children under five exceeds 35 percent. Scenario 4a is slightly more expensive,

[2] "Partial" program coverage is as follows: 35 percent coverage for public provision of complementary food for prevention of moderate acute malnutrition and community-based management of severe acute malnutrition; 50 percent coverage for community programs for growth promotion; 80 percent coverage for therapeutic zinc supplements with ORS; 90 percent for vitamin A supplements, micronutrient powders, deworming, iron folic-acid supplements for pregnant women; and 100 percent for iron fortification of staple foods and salt iodization.

[3] This includes deworming, vitamin A supplementation, zinc supplementation, multi micronutrient powders, iron fortification of staple foods and salt iodization

but increases the coverage of these interventions to all states with stunting rates higher than 25 percent. Scenario 5a is the most expensive of the three proposed scenarios but is also the most politically attractive: it scales up all interventions in all 36 states, while focusing primarily on increasing the coverage of low-cost, high-impact interventions such as micronutrient supplementation.

10. **Recognizing the difficulty of scaling up to full coverage in one year, and following the five-year time frame of the Federal Government's National Strategic Plan of Action for Nutrition, we estimate the cost of scaling up these interventions over five years to be $769 million for scenario 4b, $987 million for scenario 4a, and $912 million for scenario 5a.**[4] This is significantly less than the $2.4 billion needed for the five year scale up of the "full coverage" scenario, but still represents a significant increase over current spending on nutrition in Nigeria.

11. **Scenario 5a is considered a highly attractive investments, with positive returns on investment and significant additions to economic productivity.** [5] When scaled up gradually over 5 years, this scenarios has the potential to add over US$1 billion annually to the Nigerian economy over the productive lives of children who would otherwise have died or become stunted. Moreover, these investments in Nigeria's human capital result in a positive net present value (NPV) and internal rates of return (IRR) exceeding 18 percent.

12. **The costs discussed thus far relate to the scale up from current coverage, and therefore do not take into account the financing necessary to maintain existing coverage levels, which R4D estimates at approximately US$49 million annually in a draft fiscal space analysis of nutrition in Nigeria (2014).** The R4D analysis also identifies several sources of "planned" investments for nutrition estimated at about $175 million over the next 4 years. This suggests a planned increase in funding for nutrition of approximately $126 million over four years. Our analysis predicts financing needs over five years of between $769 million and $987 million for scaling up under the three proposed scenarios, resulting in an estimated financing gap of between $543 and $861 million over five years. Therefore, any scale up of nutrition interventions will not only require additional financing, but also the prioritization of interventions based on need, cost-effectiveness and allocative efficiencies.

13. **While every attempt has been made to use actual program costs in these estimates, in reality the estimates likely overestimate the costs and underestimate the benefits.** In many cases, actual program costs will be lower than estimated because they

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[4] For scenarios 4a and 4b we assume that coverage scales up progressively over 5 years, with 20% achieved in year 1, 40% in year 2, 60% in year 3, 80% in year 4 and 100% in year 5. The scale up of Scenario 5a matches the assumptions in Nigeria's National Strategic Plan of Action for Nutrition (NSPAN), and therefore does not follow the same scale up pattern. For more information on the scale up of Scenario 5a, please see Chapter IV-B

[5] Scenario 5a is the only one for which we were able to calculate NPV and IRR.

can be added to existing programs. Program experience shows that the incremental costs of adding to an existing program are lower, as existing implementation arrangements can be used, thereby containing costs for staffing, operations and training. Moreover, we do not account for potential savings achieved through expected economies of scale. With respect to the benefits, given the limitations of the LiST tool, it is only possible to estimate the benefits of some of the interventions. As a result, we likely underestimate the potential benefits of scaling up the ten proven nutrition specific interventions.

14. **This analysis takes an innovative approach by not only estimating the costs and benefits of nutrition-specific interventions, but also exploring those of selected nutrition-sensitive interventions implemented outside of the health sector**. While recognizing that the evidence base for impact of nutrition-sensitive interventions is less conclusive, we consider four nutrition-sensitive interventions in the agriculture and education sectors that have shown some potential for improving nutrition outcomes. In Nigeria, these include biofortification of cassava, aflatoxin control, school-based deworming, and school-based promotion of good hygiene. The first two of these interventions would be implemented through the agriculture sector, and the second two through the education sector. The estimated annual costs are modest: US$25 million for biofortification of cassava, US$65 million for aflatoxin control, US$8 million for school-based deworming and US$60 million for school-based promotion of good hygiene. However, these must be considered rough approximations, as there are significant limitations in the available data and in the methodological approaches, especially in contextualizing these global costs to the Nigerian situation. In addition we were not able to estimate the benefits of these interventions due to data and methodological shortcomings, although we do report benefits estimated by other reports.

15. **Overall, these findings point to a selection of nutrition-specific interventions and a candidate list of nutrition-sensitive approaches that represent a cost-effective approach to reducing child malnutrition in Nigeria. Most of the malnutrition that occurs in the first 1000 days of a child's life is essentially irreversible.** Therefore, investing in early childhood nutrition interventions offers a window of opportunity to permanently lock-in human capital and to super-charge the potential demographic dividend in Nigeria. This fits into the President's Transformational Agenda for Nigeria and the government's flagship Saving One Million Lives (SOML) initiative, which focus on six pillars, one of which is nutrition. However, despite strong commitments to address malnutrition, there are currently no financial allocations for nutrition in FGoN's 2014 budget.

16. **Moving forward, these results will be useful to decision makers as they plan future efforts to scale-up action against malnutrition in Nigeria and develop nutrition financing plans that bring together the health, education and agriculture sectors**. In the health sector, plans for financing Universal Health Coverage (UHC) and SOML must include these costs under the nutrition pillar of SOML. There also exist several opportunities to incorporate these highly cost-effective interventions into the World Bank's existing and pipeline investments in Health (e.g. the State Health Project

and planned support for SOML), agriculture (such as FADAMA III) and education (e.g. the State Education Project and the Global Partnership on Education).

PART I – BACKGROUND

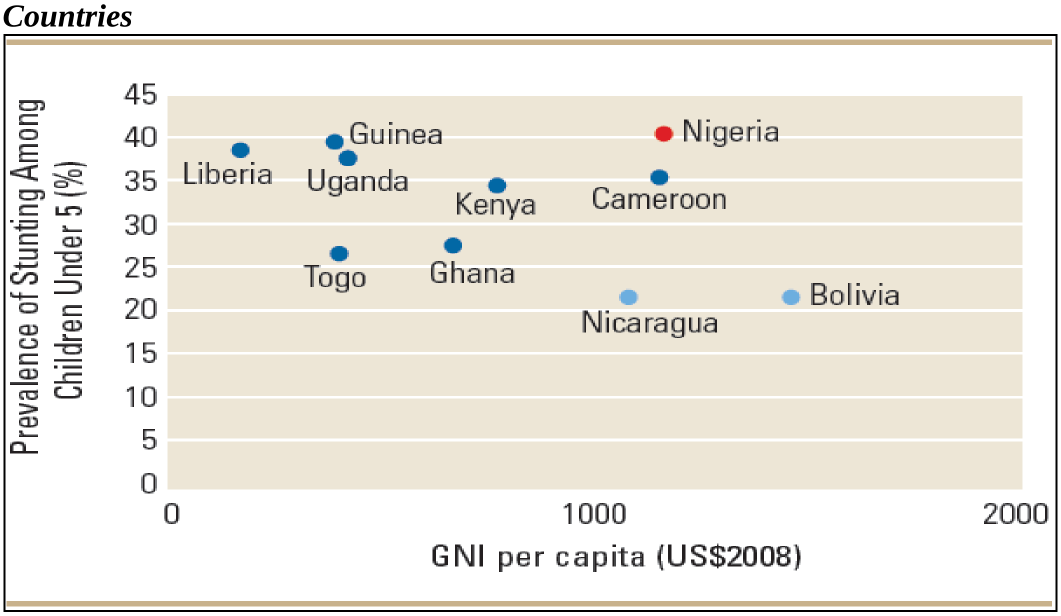
A. COUNTRY CONTEXT

1. **With an estimated 163 million inhabitants, Nigeria is the most populous country in Africa, and despite strong GDP growth that averaged more than 8 percent over the past decade, Nigeria's poverty rate remains persistently high (World Bank 2013a).** Nigeria currently ranks 156th out of 187 countries on the Human Development Index, and the estimated life expectancy is 52 years. In 2010, 46 percent of the population lived below the poverty line, a prevalence which represents a decline of less than three percentage points since 2004. A recent World Bank poverty analysis highlighted a combination of two economic patterns at the sub-national level: i) increased poverty and decreased urbanization in Northern States with most important economic activities taking place in Southern States; and ii) within the North and South, Western States perform relatively better than Eastern States (World Bank, 2013a). The same analysis also showed that the degree of inequality in Nigeria has increased: from 2004 to 2010 the Gini index increased from 0.38 to 0.41.

B. HEALTH AND NUTRITIONAL STATUS IN NIGERIA

2. **Nigeria is home to the third largest population of chronically undernourished children in the world**, with an under-five mortality rate of 157 deaths per 1,000 live births, and an infant mortality rate of 75 per 1,000 (NDHS 2008). These rates remain stubbornly above sub-Saharan Africa's regional average. In 2013, the prevalence of stunting among children under five years of age was 37 percent, which is a very modest decline from 43 percent in 2003 (NDHS 2003 and 2013). The stunting rate is higher than in several other countries in the region with similar incomes (**Figure 1**). Nigeria's failure to make substantial headway in reducing poverty has translated into limited progress in improving health and nutrition indicators, and vice versa.

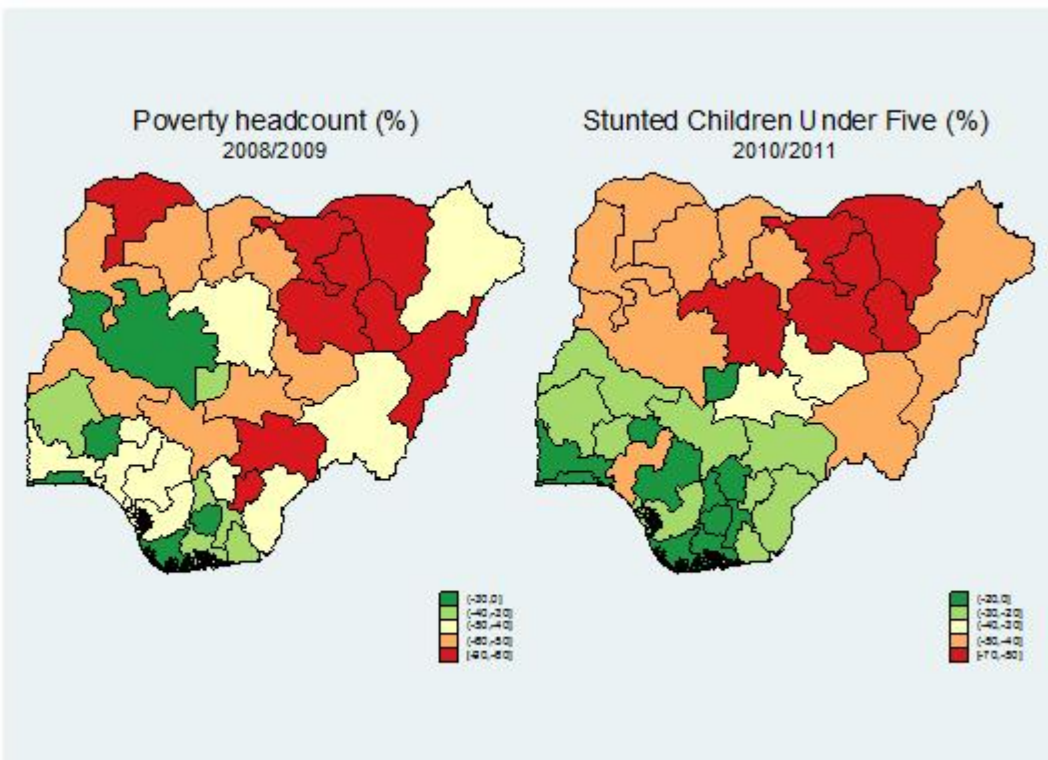
Figure 1: Prevalence of Stunting and GNI per capita in Nigeria and Selected Peer Countries



Data Sources: WHO Global Database on Child Growth and Malnutrition; World Bank World Development Indicators, Nigeria MICS 2011.

3. **There is great regional variation in child stunting and the prevalence of stunting actually increased in 5 of the 6 regions between 2003 and 2008.** The national average masks dramatic geographical disparities within the country. **Figure 2** demonstrates striking disparities between northern and southern regions, in which *all* states in North-Eastern and North-Western have stunting prevalence above 40 percent, whereas the majority of states in the southern regions have stunting prevalence below 25 percent (Nigeria MICS 2011). The prevalence of stunting in the North West region is 2.5 times the prevalence in the South East region. In Lagos, only 8.9 percent of children under five are stunted, whereas in the state of Katsina, the prevalence is 61.9 percent. The same figure also shows that the disparities in poverty closely mirror the disparities in malnutrition, but the patterns are not identical. Many states with relatively lower poverty rates (i.e. Niger, Ondo, and Oyo) still have high rates of stunting. Child wasting (low weight-for-height) rates, which reflect acute nutritional deficits that are often compounded by infection or disease, are also highly variable by state: in FCT (Abuja) the prevalence is 3.4 percent, whereas in Borno, it is 18.7 percent.

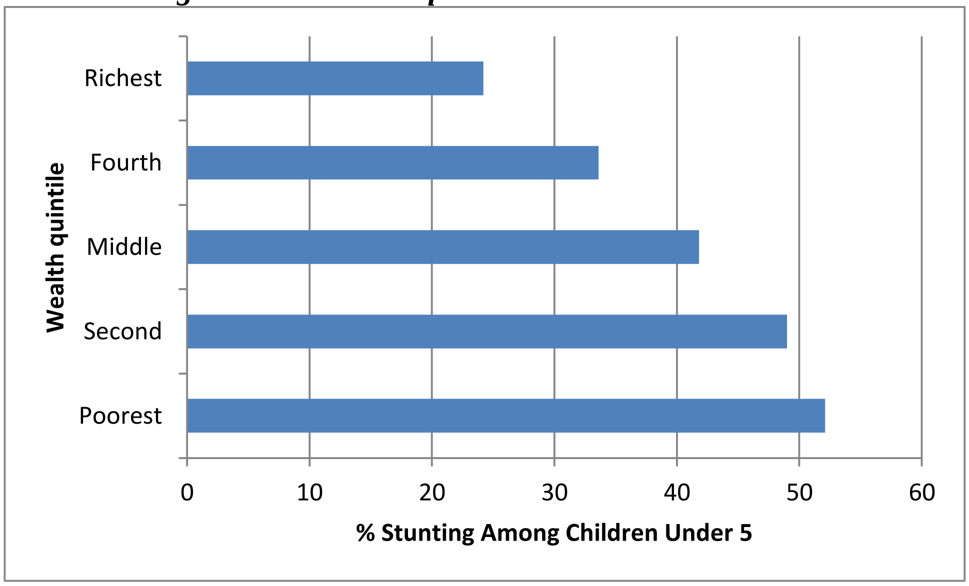
Figure 2. State-level prevalence of stunting (2011) and poverty estimates (2009)



Source: Poverty map from World Bank, 2013; Stunting map created from sub-national stunting data from Nigeria MICS 2011.

4. **Inequities in child undernutrition across wealth quintiles are also pronounced in Nigeria. Stunting rates in the poorest households (52 percent) are more than twice those in the richest households (24 percent) (Figure 3).** However, while stunting rates are highest among the poorest quintile, somewhat surprisingly even in the richest households, nearly one-quarter of children are stunted. This shows that while poverty is associated with stunting, other factors are also involved. Non-food influences, such as informational asymmetries, disease and optimal feeding and caregiving practices have a major role to play in causing malnutrition.

Figure 3. Wealth inequities in child undernutrition



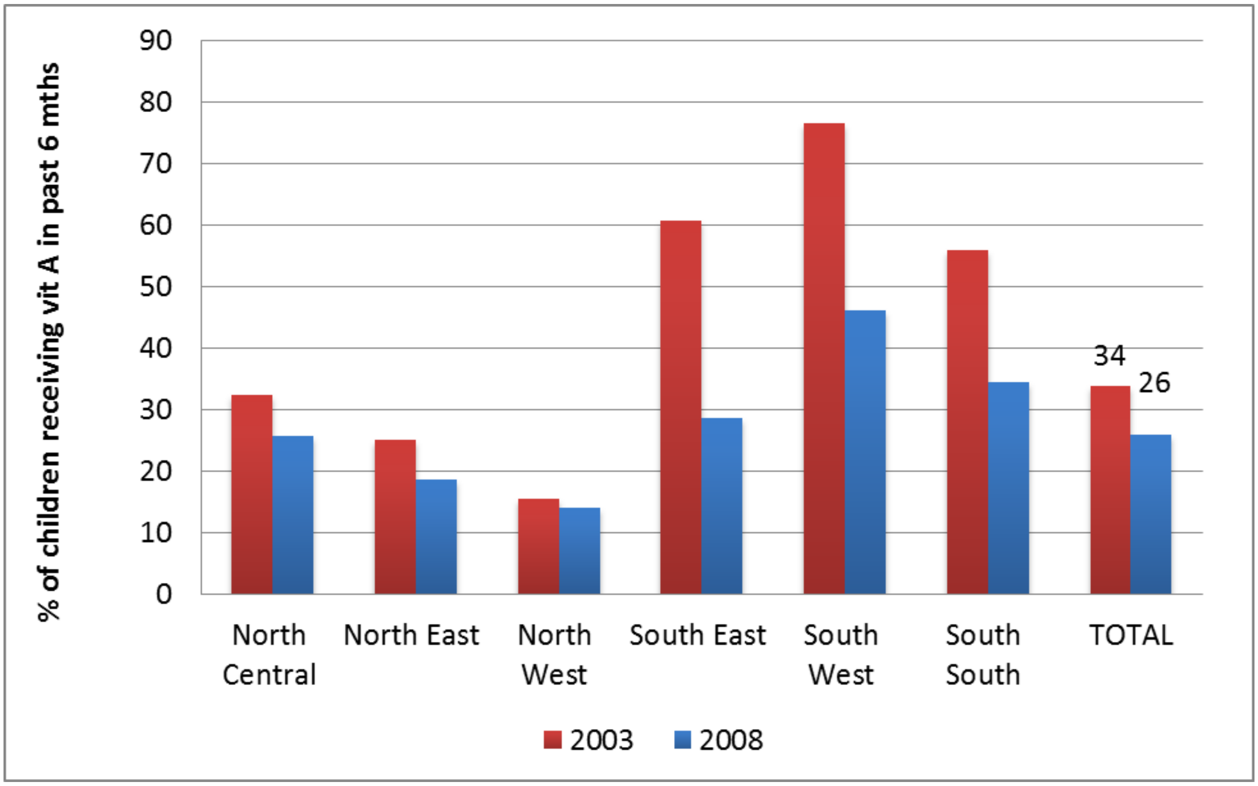
Source: NDHS 2008

5. **Vitamin and mineral deficiencies (*hidden hunger*) and are also pervasive in Nigeria.** It is estimated that 30 percent of Nigerian children under five and 20 percent of pregnant women are vitamin A deficient (Maziya-Dixon *et al*. 2006). Vitamin A deficiency increases child mortality, increases vulnerability to infectious diseases such as measles and leads of blindness among children under five years-old. Coverage of vitamin A supplementation is low in Nigeria, with only 65.2 percent of children 6-59 months of age receiving a supplement in the past six months (Nigeria MICS 2011).[6] Data from DHS 2008 indicates even lower vitamin A coverage (26 percent) and the coverage actually decreased from 34 percent in 2003 (**Figure 4**).[7] Given the strong evidence that high coverage with twice-annual doses of Vitamin A supplementation has the potential to reduce child mortality by 23 percent on average, this is a lost opportunity. The most recent data available indicate that 76 percent of preschool-aged children and 67 percent of pregnant women are anemic, with approximately half of all anemia caused by inadequate dietary intake of iron, and the rest due to infections and parasites. One in five households does not consume adequately iodized salt (), thereby predisposing these children to IQ losses of up to 13 points, increasing the risk of still births, and wasted pregnancies.

[6] There is a discrepancy between the DHS (2008) and the MICS (2011).

[7] No data available on children who received twice-annual doses so this indicator is used as a proxy.

Figure 4: Vitamin A supplementation in Nigeria by region, 2003 and 2008.



Source: Nigeria DHS, 2008

6. **Another health burden in Nigeria is the high levels of aflatoxins, which are naturally occurring carcinogenic (cancerous) by-products of common fungi that grow on crops such as maize and peanuts**. A recent review of published articles shows that the mean level of aflatoxin contamination in maize and groundnuts in Nigeria is well above safe levels (Abt Associates 2014) and well above levels in other African countries (Liu and Wu, 2010). Groundnut contamination is generally higher in the south and maize contamination is higher in the north and west. Evidence shows that consumption of high levels of aflatoxins can lead to liver cirrhosis (Kuniholm et al., 2008) and liver cancer in adults (Abt Associates 2014). Further, it is widely understood that there is a relationship between aflatoxin exposure and child stunting, albeit the evidence base is more tentative, and this relationship has not yet been adequately quantified in the published literature (Unnevehr and Grace 2013, Abt Associates 2014). Using data on aflatoxin exposure and growth from other countries, one study estimated that up to 4.4 million children in Nigeria become stunted from consuming maize and groundnuts that are contaminated with aflatoxin (Khlangwiset 2011). Almost 8,000 deaths/year from liver cancer in Nigeria are attributed to aflatoxin exposure, resulting in over 100,000 lost DALYs. This translates into a monetized impact of between 0.2 percent and 1.6 percent of Nigeria's GDP (Abt Associates 2014). While the evidence on the links between aflatoxins and child stunting is still tentative, the links with liver cancer are well established, and provide sufficient impetus for actions to control aflatoxin exposure in Nigeria.

7. **Approximately 87,100 children under five die each year in Nigeria from diarrhea. Nearly 90 percent is directly attributed to poor water, sanitation and hygiene** (World Bank 2012)**.** Diarrheal episodes exacerbate the relationship between malnutrition and infection, as

children tend to eat less, absorb fewer nutrients and reduced resistance to infections. Prolonged diarrheal episodes lead to impaired growth and development (Ejemot et al. 2006). 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.

8. **In Nigeria, 45 percent of school-age children, totaling nearly 12 million, are estimated to be infected with parasitic intestinal worms (helminthic infections).** In the short term, helminthic infections potentially cause anemia, increase morbidity, undernutrition and 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 grow up free of worms (Bleakley 2007).

C. THE IMPORTANCE OF INVESTING IN NUTRITION

9. **Undernutrition is an underlying cause of approximately half of deaths (3.1 million) in children under five and one-fifth of maternal deaths in developing countries.** The joint effect of suboptimum breastfeeding and fetal growth restriction in neonatal period alone contributes 1.3 million deaths or 19 percent of all deaths of children under five (Black et al. 2013). Undernourished children are more likely to die from common childhood illnesses such as diarrhea, measles, pneumonia, malaria or HIV/AIDS.

10. **For those malnourished children who survive, there are long-lasting health and schooling consequences, including cognitive deficits and poorer schooling outcomes.** Children with impaired cognitive skills have lower school enrollment, attendance and graduation, which in turn results in lower productivity, earnings and economic well-being. Stunted children lose 0.7 grades of schooling, and are more likely to drop out of school. Iodine deficient children lose on average 13 IQ points and iron deficiency anemia reduces performance on tests by 8 IQ points, making them less educable (World Bank 2006). Behrman and colleagues (2009) showed improved schooling and test scores from participation in nutrition programs in early childhood.

11. **In Nigeria, being underweight in the early years of life accounts for 8 percent of Disability-Adjusted-Life-Years (DALYs).** This was the biggest risk factor affecting DALYs, with micronutrient deficiencies and suboptimal breastfeeding also among the 15 highest risk factors (Murray *et al.* 2013). The DALYs lost from Vitamin A deficiency in Nigeria is nearly 800,000 annually, with virtually all losses occurring in children under five years of age (Menakshi et al. 2010).

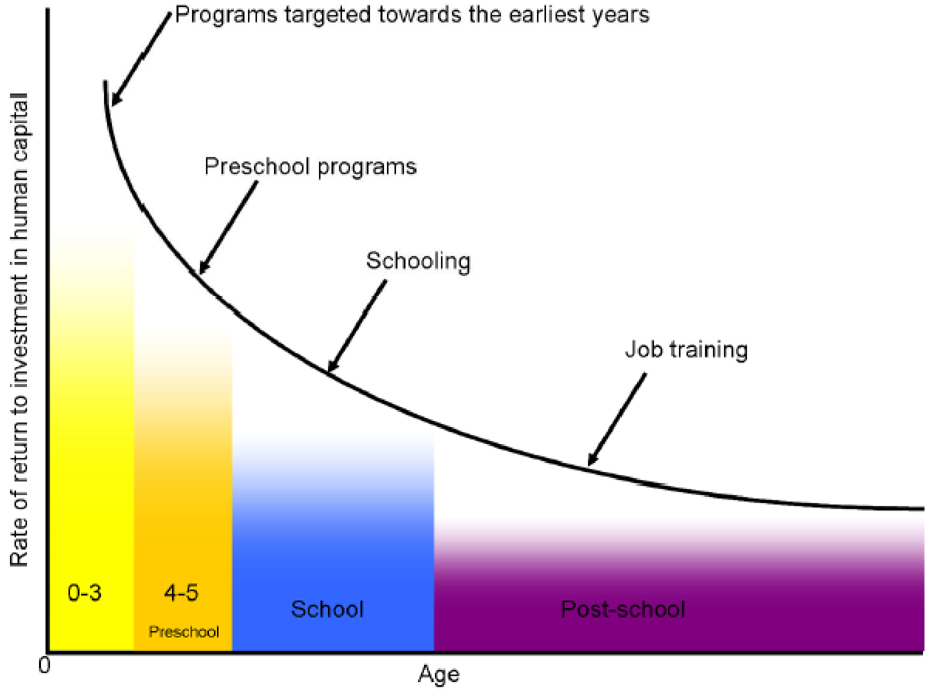
12. **Malnutrition costs developing countries billions in lost revenue through reduced economic productivity, particularly through lower wages, lower physical and mental capabilities and more days away from work as a result of illness.** Childhood stunting is estimated to reduce at least 10 percent of potential lifetime earnings (World Bank 2006). Other studies have shown that a 1 percent loss in adult height results in a 2–2.4 percent loss in productivity (Caulfield et al. 2004, Strauss and Thomas 1998). In addition, micronutrient deficiencies in childhood and adulthood have tremendous economic cost. Childhood anemia alone is associated with a 2.5 percent drop in adult wages. Anemia in adults has been estimated to be equivalent to 0.6 percent of GDP, and goes up to 3.4 percent when including the secondary effects of retarded cognitive development in children (Horton 1999). Horton and Ross (2003) estimate that eliminating iron-deficiency anemia would result in a 5–17 percent increase in adult

productivity. Collectively, micronutrient deficiencies alone in Nigeria add up to an estimated loss of over US$1.5 billion in GDP every year (World Bank 2010b). The economic costs of undernutrition affect the most vulnerable and the poorest in the developing world. A recent analysis estimates these losses at 11 percent of GDP in Africa and Asia each year (Horton and Steckel 2013). This equals about $149 billion of productivity losses.

13. **Investing in early childhood nutrition interventions has the potential to super-charge the potential demographic dividend in Nigeria**. Demographic dividend refers to the growth in a country's economy resulting from changes in the age structure leading to a youth bulge and reduced dependency ratios in the population. This dividend is more likely to be realized if these cohorts are better nourished and productive. By increasing investment in human capital as fertility rates decline, Nigeria could potentially harness the demographic dividend by: (i) increasing GDP by nearly 50 percent and sustain that gain indefinitely; (ii) raise per capita incomes by 30 percent or more by 2030, and (iii) lift around 32 million additional people out of poverty by 2030 (Bloom et al. 2010).

14. **Most of the malnutrition that occurs in the first 1000 days of a child's life is essentially irreversible. Therefore, the window of opportunity for preventing malnutrition is the first 1000 days between pregnancy and two years of age**. After that age, most actions are too little, too late and too expensive (World Bank 2006; Black *et al*. 2008, 2013). **Figure 5** shows that the rates of return from nutrition investments are highest for programs targeting towards the earliest years since these investments build a foundation for future learning and productivity, prevent irreversible losses, and lock-in human capital for life (Heckman and Masterov 2004).

Figure 5. Rates of return to investment in human capital



Source: Heckman and Masterov (2004)

15. **Malnutrition and poverty are interrelated and exacerbate each other.** A recent study (Hoddinott et al. 2011) concludes that individuals who are not stunted at 36 months are one-third less likely to live in poor households as adults. Poverty increases the risk of malnutrition by lowering poor households' purchasing power, reducing access to basic health services, and exposing them to unhealthy environments, thereby compromising food intakes (both quality and quantity), and increasing infections. Poor households are also more likely to have frequent pregnancies, larger family sizes with high dependency ratios, more infections and increased health-care costs. Conversely, malnutrition causes poor health status, poor cognitive development and less schooling, resulting in in poor human capital and long-term productivity losses. However, as Figure 2 shows, *while child stunting rates are highest among the poorest two quintiles in Nigeria, even among the richest quintile nearly 25 percent children are stunted.* This suggests a need to design somewhat different strategies to address undernutrition among the poorest, vs those among the non-poor.

16. **Nutrition interventions are consistently identified as cost effective development actions and the costs of scaling up nutrition interventions are modest.** Hoddinott and colleagues (2013) estimated that for every dollar invested in programs to reduce stunting would generate between $24.4 and $26.6 in economic returns. Others have estimated global benefit-cost ratios for integrated child care programs to be between 9 and 16; for iodine supplementation for women, between 15 and 520; for vitamin A supplementation for children under 6 years, between 4 and 43; for iron supplementation for pregnant women, between 6 and 14; and for iron fortification per capita, between 176 and 200 (World Bank 2010). A recent World Bank publication estimated that investing in nutrition can increase a country's gross domestic product (GDP) by at least 3 percent annually. The same study estimated these investment costs at $10.3 billion per annum globally, to be financed through domestic public and private sector and donor resources (World Bank 2010a). These investments would provide preventive nutrition services to

about 356 million children, save at least 1.1 million lives and 30 million DALYs, and reduce the number of stunted children by about 30 million worldwide. Bhutta et al. (2013) came up with very similar estimates. In another study, Hoddinott, Rosegrant and Torero (2012) estimate that, for just $100 per child, interventions including micronutrient provision, complementary foods, treatments for worms and diarrheal diseases, and behavior change programs, could reduce chronic under-nutrition by 36 percent in developing countries. Clearly there is huge potential pay-off from dedicating more resources to the scale-up of evidence-based, cost-effective nutrition interventions.

D. A MULTI-SECTORIAL APPROACH FOR IMPROVING NUTRITION

17. **The determinants of malnutrition are multi-sectorial. Therefore, to successfully and sustainably improve nutrition outcomes, a multi-sectorial approach is needed.** At a proximate level, access to food, health, hygiene and adequate child care practices are key to reducing malnutrition. At a more distal level, poverty, women's status and other social factors play an important role. It has been demonstrated that direct actions to address the proximate determinants of malnutrition can be further enhanced by action on some of the more distal levels. For example, programs supporting improved infant and young child feeding practices will be more effective if they are complemented with programs to address gender issues through, for example, the reduction of women's workloads, thus allowing women more time for childcare. Similarly, conditional cash transfer programs that target the poor, if designed appropriately, have the potential not just to address poverty, but also to increase demand for nutrition services and good nutrition behaviors.

18. **While the health sector is key in delivering "nutrition-specific" interventions to the poor (such as Vitamin A supplementation or deworming), multisectoral "nutrition-sensitive" actions through agriculture sector, social protection, water and sanitation and poverty reduction programs have the potential to strengthen nutritional outcomes in several ways.** Examples of these include**:** (a) improving the context within which the nutrition-specific interventions are delivered, for example through investment in food systems, empowerment of women and equitable education; (b) integrating nutrition considerations into programs in other sectors as delivery platforms (such as conditional cash transfer programs) that will potentially increase the scale and coverage of nutrition-specific interventions,; and (c) by increasing "policy coherence" through government-wide attention to policies or strategies and trade-offs, which may have positive or unintended negative consequences on nutrition. The synergy with other sectors is critical to break the cycle of malnutrition and sustain the gains from direct nutrition-specific interventions (World Bank 2013b).

19. **There is currently very limited guidance on costing for nutrition-sensitive interventions for at least two reasons.** First, evidence on effectiveness of "nutrition-sensitive" interventions with respect to nutritional outcomes is limited. Second, compared with nutrition-specific interventions, estimating and attributing the costs of nutrition-sensitive interventions is more complex since these interventions have multiple objectives, improved nutrition outcomes being only one of them. Notwithstanding these limitations, the availability of costing information is crucial to assess cost effectiveness of these interventions, and this paper makes a first-ever attempt to address these issues.

20. **We identify and cost four selected nutrition-sensitive interventions that are relevant for scale-up in the Nigerian context, for which there is evidence of the positive impact on nutrition outcomes, and for which there is some cost information.** These include two interventions delivered through the agriculture sector—biofortification of cassava and aflatoxin reduction through biocontrol intervention—and two delivered through the education sector—school-based deworming and school-based promotion of good hygiene. Other potential nutrition-sensitive interventions include the reduction of women's work-loads through appropriate technologies in agriculture, social safety nets and conditional cash transfers targeted to the poor and designed to have an impact on nutrition outcomes, and water and sanitation programs that reduce the exposure to infections and childhood diseases.

21. **Biofortification has the potential to reduce micronutrient deficiencies in a highly cost-effective manner.** Biofortification uses plant breeding techniques to enhance the micronutrient content of staple foods. Evaluation of the orange-flesh sweet potato biofortification program in Uganda and Mozambique showed high farmer adoption, significant increase in vitamin A intakes and improvement of child vitamin A status (Arimond et al, 2011; Hotz et al. 2010). An ex-ante cost study of biofortification in 14 countries suggests that most cost per DALY averted fall in the "highly" cost-effective category, particularly in South Asia and Africa (Menakshi et al. 2010). A recent study by HarvestPlus that ranked countries using country-level data according to their suitability for investment in biofortification interventions identified Nigeria as "top priority" country for benefiting from biofortification (Asare-Marfo et al. 2013).

22. **Nigeria formally launched biofortified cassava to address vitamin A deficiency in 2012.** Cassava is one of the four most important staple foods (along with rice, maize and wheat) in the country. In 2013, three new cassava varieties are being introduced to 50,000 farmers household in Nigeria and could reach as many as 2 million farmers in the next three years. The three launched varieties have the potential to meet 25 percent of the daily vitamin A needs of consumers. Collaborating with HarvestPlus, the government will continue to work with farmers and the private sector to significantly scale up vitamin A-biofortified cassava dissemination.

23. **Biocontrol of aflatoxins has the potential to reduce aflatoxins in maize and groundnuts by at least 80-90 percent (Bandyopadhyay and Cotty 2013).** Field testing of biocontrol products in Burkina Faso, Kenya, Nigeria and Senegal, although not formally published, is producing extremely positive results. The method involves a single application of a product (AflaSafeTM) containing strains unique to that country. Efforts are already underway in Nigeria to build on this experience and expand the use of biocontrol products to control aflatoxins (Abt Associates 2014).

24. **School-based deworming has been proven to be an efficient and cost-effective intervention to address health and nutrition outcomes, with cost per DALY saved estimated at US$4.55 (J-PAL 2012)**. The cost of delivering deworming tablets through schools is inexpensive because it uses the existing infrastructure and delivery platforms in schools and community links with teachers. Teachers only need minimal training to safely administer the delivery, thus it does not add significantly to teachers' workloads. The delivery costs of school-based deworming in schools are about $0.04 per treatment (Guyatt 2003), yet the benefits are enormous. Bi-annual deworming significantly increased school attendance and reduced self-reported illness and anemia, while providing modest gains in height-for-age Z-scores in Kenya

(J-PAL 2012). Evidence from India also suggests that deworming has the potential to reduce cases of childhood stunting and underweight (Awasthi et al, 2013). In the long term, deworming improved self-reported health, increased total schooling years, and increased earnings by 20 percent (Baird et al 2011).

25. **School-based deworming in Nigeria is included in integrated Neglected Tropical Diseases (NTD) control policy and plan, a school health policy and school feeding guidelines.** In early 2013, Nigeria launched a multi-year national plan for the control and elimination of NTDs (NTD Master Plan). The NTD Master Plan provides a platform for Nigeria to stimulate global efforts to reach elimination and control of diseases under the London Declaration and the Millennium Development Goal 6. Nigeria's NTD plan, worth $332 million, will provide treatment for more than 60 million people annually over the next five years. In late 2012, Nigeria received a donation of 23,025 million tablets to support the scale-up of treatment to combat NTDs. The donated tables will be sufficient to treat nearly eight million school children and adults in 12 states.

26. **Improved hygiene behaviors through promotion of hand-washing and good hygiene behavior would decrease the risk of stunting in one in three children**. Correct hand washing at critical times can reduce diarrhea by 42 -47 percent and lower the incidence of diarrhea for children by 53 percent and reduce the incidence of acute respiratory infections (ARI's) by 44 percent (World Bank 2012). A recent campaign promoting hand washing with soap in primary schools in Egypt, China and Colombia demonstrated significant reduction in absenteeism related to diarrhea and respiratory-illness (UNICEF 2012). A study in Brazil showed a relationship between the effects of early childhood diarrhea on later school readiness and school performance, revealing the potential long-term human and economic costs of early childhood diarrhea (Lorntz et al. 2006).

27. **Effectiveness of promoting good hygiene behavior in schools is demonstrated by its long terms impact and broad effect on communities.** Schools are ideal settings for hygiene education, where children can learn and sustain lifelong proper hygiene practices through peer-to-peer teaching, classroom sessions with focused training materials and role-playing or interactive songs. A study on the long-term effect of hygiene education program for both adults and children found that hygiene behaviors are sustained beyond the end of an intervention. The study also found that educated students can also influence family members by sharing this information, which may in turn affect behavior change at the community level (Bolt and Cairncross 2004).

E. PARTNER EFFORTS TO ADDRESS MALNUTRITION IN NIGERIA

28. **Many partners are supporting the Federal Ministry of Health to address malnutrition in Nigeria and most of the interventions are in the north where malnutrition is most severe.** Partners include UNICEF, DFID, Helen Keller International (HKI), Micronutrient Initiative, Save the Children UK, Global Alliance for Improved Nutrition (GAIN), Action Against Hunger, Valid International and Food Basket International (Government of Nigeria 2014). UNICEF implements nutrition programs in 36 states and mainly provides support for Infant and young child feeding, micronutrient deficiency control and treatment of severe acute malnutrition through Community Management of Acute Malnutrition (CMAM). DFID supports the Working to Improve Nutrition in Northern Nigeria (WINNN) program which provides key

services to children under five in five states in Northern Nigeria. Interventions include community-based management of acute malnutrition, vitamin A supplementation and deworming, and promotion of improved infant and young child feeding practices. Nigeria is a priority country for Save the Children's *Global Child Survival Campaign* and Save the Children UK supports the Katsina State Ministry of health. GAIN works with the National Agency for Food and Drug Administration (NAFDAC) to fortify wheat and maize flour with iron, vegetable oil with vitamins A and B and sugar with vitamin A. (**Appendix 1** provides a list of region- and state-specific partner interventions.)

PART II – RATIONALE AND OBJECTIVES FOR DEVELOPING A SET OF COSTED SCALE-UP SCENARIOS FOR NIGERIA

29. **The overall objective of this programmatic Knowledge Product (KP) is to support the Government of Nigeria to develop a costed scale-up plan for nutrition. This scale-up plan will be complemented with a health-sector fiscal space analysis financed by the Children's Investment Fund Foundation (CIFF), conducted by Results For Development (R4D).** These efforts will provide the Government of Nigeria with the tools needed to leverage adequate resources from their domestic budgets, as well as from development partners in support of the costed scale-up plan. Within this context, the objectives of this analysis are as follows:

i. To estimate scale-up costs in Nigeria for a set of well-proven nutrition-specific interventions that have the potential to be scaled-up through tested delivery mechanisms;
ii. To conduct a basic economic analysis to calculate the potential benefits and cost effectiveness associated with the proposed scale up;
iii. To propose a series of scenarios for a costed scale-up plan that rolls out this package of nutrition-specific interventions in phases, based on considerations of impact, geography, implementation capacity and costs;
iv. Explore initial costs for a limited number of nutrition-sensitive interventions through the agriculture and education sectors.

30. **While the economic arguments for increasing investments in nutrition are sound, one of the first questions raised by key decision-makers in any country is "How much will it cost?"** In 2010, the World Bank spearheaded a study, *Scaling Up Nutrition: What will it Cost?* to answer that question at the global level. The analysis estimated the level of global financing required to scale up 10 evidence-based nutrition-specific interventions in 36 countries that account for 90 percent of the world's stunting burden and 32 smaller countries which also have a high prevalence of undernutrition. The results of the study highlighted the global financing gap, underscored the importance of investing in nutrition at the global level, and laid out a methodology for estimating the costs for nutrition-specific interventions. However, these global estimates did not capture the nuances and context in each country, nor were these estimates contextualized to every individual country's policy and capacity setting or its fiscal constraints. This report builds on the early work to address this gap, and contextualize the cost estimates for Nigeria.

31. **Further, the multisectoral approach requires nutrition-sensitive approaches or interventions that can be delivered through other sectors.** As discussed above, there is currently very limited guidance on costing for nutrition-sensitive interventions. Therefore, this is an exploratory analysis, to be used primarily to engage other sectors in planning for nutritional outcomes. This initial exercise will contribute to a broader discussion about methodological and other issues for costing nutrition-sensitive interventions, and will thereby encourage the formulation of standard definitions, methodologies and guidance for costing these interventions in the future.

PART III – METHODOLOGY

A. SCOPE OF THE ANALYSIS AND DESCRIPTION OF THE INTERVENTIONS

32. **The costed scale up plan is presented in two sections. The first section** presents estimated costs and benefits for the set of 10 nutrition-specific interventions that were included in World Bank 2010 and are primarily delivered through the health sector. These interventions and the associated target population and current coverage for each intervention are specified in **Table 1**. In the next section, we explore the costs of implementing a few selected the nutrition-sensitive interventions that will be delivered through the agriculture and education sectors. A description of these interventions, associated target populations, and responsible sectors are listed in **Table 2**.

33. **The nutrition-specific interventions considered are a modified package of the interventions included in the 2008 and 2013 *Lancet* series on Maternal and Child Undernutrition**. These ten interventions are based on current scientific evidence and there is general consensus from the global community around the impact of these interventions. Some interventions, such as deworming and iron-fortification of staple foods, which were included in the 2008 *Lancet* series but no longer listed in the 2013 *Lancet* series are included here as they remain relevant. Others, such as calcium supplements for women, or prophylactic zinc supplementation are excluded because delivery mechanisms are not available in client countries and/or there are no clear WHO protocols or guidelines for large scale programming. In other cases, there are limited capacities for scaling up the interventions. Only those nutrition-specific interventions that have strong evidence of effectiveness, have a WHO protocol, and a feasible delivery mechanism for scale-up are included in the proposed scale-up package below.

Table 1. Nutrition-Specific Interventions Delivered Primarily Through Health Sector

Intervention	Description	Target Population	Current coverage
1. Community nutrition programs for growth promotion	Behavior change communication focusing on optimal breastfeeding and complementary feeding practices, proper hand-washing, sanitation and good nutrition practices	Children 0-23 months of age	Negligible
2. Vitamin A supplementation	Semi-annual doses	Children 6-59 months of age	67.2% (MICS 2011)
3. Therapeutic zinc supplementation with ORS	As part of diarrhea management with ORS	Children 6-59 months of age	Negligible
4. Multiple micronutrient powders	For in-home fortification of complementary food (60 sachets between 6-11 months of age, 60 sachets between 12-17 months of age, and 60 sachets between 18-23 months of age).	Children 6-23 months of age not receiving fortified complementary food*	Negligible
5. Deworming	Two rounds of treatment per year	Children 12-59 months of age	28.4% (FMOH)
6. Iron-folic acid	Iron-folic acid supplementation	Pregnant women	28.5% (MICS

supplementation	during pregnancy		2011)
7. Iron fortification of staple foods	Fortification of wheat flour with iron	General population	Negligible
8. Salt iodization	Iodization of centrally-processed salt	General population	77.5% (MICS 2011)
9. Public provision of complementary food for prevention of moderate acute malnutrition	Provision of a small amount (~250 kcals per day) of nutrient-dense complementary food for the prevention of moderate malnutrition (moderate acute malnutrition and/or moderate stunting)	Twice the prevalence of underweight (WAZ < -2) among children 6-23 months of age*	Negligible
10. Community-based management of severe acute malnutrition	Includes the identification of severe acute malnutrition, community or clinic-based treatment (depending on the presence of complications), and therapeutic feeding using ready-to-use therapeutic food	Incidence (estimated as twice the prevalence) of severe wasting (WHZ <-3) among children 6-59 months of age	34.5% (data from 11 states provided by UNICEF)

34. **In the follow-on section, the analysis focuses on nutrition-sensitive interventions that have the potential to have an impact on nutrition outcomes.** As discussed above, there is not as much evidence-based research on nutrition-sensitive interventions as there is for nutrition specific interventions. Therefore, our estimates are exploratory and are limited to four potential interventions that can be scaled up and have potential for impact on nutrition outcomes. Additional interventions were not included in these initial estimates because the impact on nutrition is yet to be clearly documented (Masset et al. 2011; World Bank 2013; Ruel et al. 2013), and because this is an exploratory instead of an exhaustive effort. Furthermore, cost attribution is complex because these interventions are designed for multiple purposes.

Table 2. Multi-Sectorial, Nutrition-Sensitive Interventions – an exploratory process

Intervention	Description	Target Population	Potential for impact
Interventions to be delivered through the agricultural sector			
Biofortification	Promote use of vitamin A-rich cassava varieties to 50,000 farming households in 2013 and potentially expanded to 1.8 million farmers	General population	Increase in vitamin A intakes and improve vitamin A status (Hotz 2012a, 2012b)
Aflatoxin control	Promote use of biocontrols such as AflaSafeTM for maize and groundnuts	General population	Improve child nutrition status (stunting) and reduce morbidity (Khlangwiset and Wu 2011)
Interventions to be delivered through the education sector			
School-based deworming	Distribution of mebendazole/albendazole to school-age children and training to school teachers, community workers and health workers	School-aged children	Reduce anemia and morbidity, improve cognitive outcomes (Miguel and Kremer 2004)

School-based promotion of good hygiene	Hygiene education program to teach healthy practices in schools	School-aged children	Improve child nutrition outcomes (stunting)(Spears 2013)

B. ESTIMATION OF TARGET POPULATION SIZES, CURRENT COVERAGE LEVELS AND UNIT COSTS

35. Target population estimates are based primarily on demographic data obtained from the Federal Ministry of Health and UNICEF Nigeria and are provided in Appendix 2. UNICEF Nigeria projected the sizes of the various subgroups at the state level in 2013 using data from Nigeria's National Population Commission. The prevalence of child stunting (height-for-age Z-score <-2), underweight (weight-for-age Z-score <-2), and severe wasting (weight-for-height Z-score <-3) among children under five years of age in each state were obtained from the 2013 Nigeria MICS survey data.

36. Data on current coverage levels for interventions was obtained from various sources. Current coverage levels for community nutrition programs for behavior change communication, zinc supplementation with ORS, multiple micronutrient powders for home fortification, iron fortification of staple foods, and provision of complementary food for the prevention of moderate malnutrition were set to zero percent either because the intervention was not being implemented and coverage was very minimal or because current reliable data were not available. Coverage data for vitamin A supplementation were obtained from the 2011 Nigeria MICS report. Data on deworming coverage were from programmatic data from the first round of MNCH weeks in 2012 as reported by the Federal Ministry of Health (FMOH). For coverage of iron folic acid supplementation for pregnant women, MNCH programmatic data from the FMOH were used for all states. The 2011 Nigeria MICS survey data were used to estimate the proportion of households consuming adequately iodized salt in each state. Finally, UNICEF provided data on the number of children treated for severe acute malnutrition in the 11 states where programs for Community Management of Acute Malnutrition (CMAM) supported by the Children Investment Fund Foundation (CIFF) are in operation. Data from the more recent semi-annual SMART surveys were explored, but were considered unsuitable for these purposes because of concerns about validity.8 Preliminary results from the Nigeria DHS 2013 provided estimates of the current incidence of severe acute malnutrition and moderately acute malnutrition. We also used the DHS 2013 to classify the states according to levels of stunting

37. **Whenever possible, the unit costs of the nutrition-specific interventions were estimated using programmatic data that were provided by local implementing partners, the Federal Ministry of Health, and state governments based on program experience.** The estimated unit costs and the delivery platforms are listed in **Table 3**. In cases where the intervention was not yet being implemented or local data were not available, the global unit cost estimate from the World Bank (2010a) was used. A complete index of data sources and relevant assumptions for these interventions can be found in **Appendix 3**.

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[8] For example, the state-levels estimates of stunting (a long-term measure of malnutrition) varied tremendously from one semi-annual survey to the next. Even with changes to the growth reference used, erratic patterns remained and could not be reconciled.

Table 3. Unit Costs and Delivery Platforms Used in the Calculations for Nutrition-specific Interventions

Intervention	Unit Cost (US$ per beneficiary per year)	Costed Delivery Platform
1. Community nutrition programs for growth promotion of children*	$5.00	Community nutrition programs
2. Vitamin A supplementation for children*	$0.44	MNCH weeks
3. Therapeutic zinc supplementation with ORS for children*	$0.86	MNCH weeks
4. Multiple micronutrient powders for children**	$3.60	Community nutrition programs
5. Deworming for children*	$0.44	MNCH weeks
6. Iron-folic acid supplementation for pregnant women*	$1.79 (MNCH weeks) $2.00 (community nutrition programs)	40% via MNCH weeks 60% via Community nutrition programs
7. Iron fortification of staple foods for general population**	$0.20	Market-based delivery system
8. Salt iodization for general population**	$0.05	Market-based delivery system
9. Public provision of complementary food for prevention of moderate acute malnutrition in children**	$51.10	Community nutrition programs
10. Community-based management of severe acute malnutrition in children *	$80.00	Primary health care and Community Nutrition programs

*denotes unit cost based on cost data from Nigeria.
** denotes unit cost based on global estimates.

38. **For the nutrition-sensitive interventions, the unit costs were estimated using global estimates with the exception of aflatoxin control.** The unit cost for aflatoxin per hectare comes from the International Institute for Tropical Agriculture (IITA) in Nigeria (Bandyopadhyay 2013). The other interventions are not yet implemented and no programmatic data are available from local implementing partners so the only data available are global data. The unit costs and the delivery platforms are listed in **Table 4**.

Table 4. Unit Costs and Delivery Platforms Used in the Estimations for selected nutrition-sensitive Interventions

Intervention	Unit Cost (US$ per beneficiary per year)	Costed Delivery Platform
1. Biofortification of vitamin A-rich yellow cassava	n/a	Agriculture production
2. Aflatoxin control through biocontrol application	$15.60 per hectare	Agriculture production
3. School-based deworming	$0.08	School-based deworming

		distribution
4. School-based promotion of good hygiene	$2.00	Hygiene education campaign

C. ESTIMATION OF COSTS AND BENEFITS

39. **The "program experience" methodology employed in World Bank (2010a is used for calculating the cost of scaling up in Nigeria.** The "program experience" approach generates unit cost data that capture all aspects of service delivery (e.g. costs of commodities, transportation and storage, personnel, training, supervision, monitoring and evaluation, relevant overhead, wastage etc.) for each intervention from actual programs that are in operation in Nigeria 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 (for example, number of visits to a health center) (e.g. in Bhutta et al. 2013). Although the "program experience" approach tends to yield cost estimates that are higher than the "ingredients approach," the estimates more accurately reflect real programmatic experience, including inefficiencies in service delivery. It should, however, be noted 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.

40. **We calculate the annual public investment required to scale up the interventions as follows:**

$$Y = (x_1 + x_2) - x_3$$

where:
Y = annual public investment required to scale up to full coverage
x_1= *additional total cost to scale up to full coverage*
x_2= *additional cost for capacity development, M&E, and technical assistance*
x_3= *cost covered by households living above poverty line for selected interventions*

Appendix 4 describes the methodology in detail.

The expected benefits from scaling up nutrition interventions are calculated in terms of: (i) DALYs saved; (ii) number of lives saved; (iii) cases of childhood stunting averted; and (iv) increased program coverage. To calculate the number of DALYs, we use the method employed by Black et al. (2008) to estimate the averted morbidity and mortality from scaling up different nutrition interventions. The method uses population attributable fractions (PAF) based on the comparative risk assessment project (Ezzati et al. 2004; Ezzati et al. 2002) to estimate the burden of infectious diseases attributable to different forms of undernutrition using most recent Global Burden of Disease study (2010). DALY estimates in this study are neither discounted nor age-weighted, in line with the methodology used in the IMHE Global Burden of Disease 2010 and the WHO Global Health Estimates 2012. **Appendix 5** describes the detailed methodology for calculation of DALYs. The projected number of lives saved and cases of childhood stunting averted are calculated using the Lives Saved Tool (LiST), which translates measured coverage changes into estimates of mortality reduction and changes in the prevalence of under five stunting. This analysis included all ten interventions to calculate the number DALYs saved. However, due to methodological limitations of the LiST tool, the calculation for number of lives saved is based on only six[9] of the ten interventions, and cases of childhood stunting averted is based on only four[10] of the ten. As such, our estimates are likely to underestimate the number of lives saved and cases of childhood stunting averted. **Appendix 6** describes the methodology for the LiST estimates.

41. **The measures for cost-effectiveness of nutrition-specific interventions are calculated in terms of "cost per DALY saved", "cost per life saved" and "cost per case of stunting averted."** Estimates of benefits were combined with information on costs to produce the cost effectiveness measures for each intervention as well as for overall package of intervention. The evaluation of cost-effectiveness ratio in terms of DALYs saved is based on the categorization used by WHO-CHOICE (Choosing Interventions that are Cost-Effective):[11] an intervention is considered as "very cost-effective" if the range for the cost per DALY averted is less than GDP per capita[12], "cost-effective" if it is between 1 to 3 times GDP per capita, and "not cost-effective" if it exceeds 3 times GDP per capita (WHO 2014). Due to limitations in the available data, we were unable to calculate the number of cases of stunting averted for some of the scenarios.

42. **Cost-benefit analysis (CBA) is conducted 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, we use estimates of number of lives saved and reduction in stunting prevalence produced by the LiST tool. Following established practice, a life year saved is valued as equivalent to GNI per capita, which we consider to be a conservative measure as it only accounts for the economic and not social value of a year of life. In order to estimate the value of the reduction in stunting, we follow the methodology used in Hoddinott et al. (2013), which values a year of life lived without stunting based on the assumption that stunted individuals lose an average of 66 percent of lifetime earnings. Future benefits are then age-adjusted and discounted at three potential discount rates (3, 5 and 7 percent) in order to arrive at their present value. The present value of future benefits is then compared with the annual public investment required, which allows us to estimate the net present value (NPV) and internal rate of return (IRR) of the investment. A detailed explanation of the benefit estimation methodology can be found in **Appendix 7**.

43. **The annual increase in economic productivity attributable to each package of interventions is calculated based on the same estimates of future benefits.** Although these benefits only occur once beneficiaries have reached productive age, we assume that these

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[9] The six interventions are community nutrition programs for growth promotion, vitamin A supplementation, therapeutic zinc supplementation with ORS, iron-folic acid supplementation, the public provision of complementary food for the prevention of moderate acute malnutrition and community-based management of severe acute malnutrition.

[10] The four interventions are community nutrition programs for growth promotion, vitamin A supplementation, iron-folic acid supplementation and the public provision of complementary food for the prevention of moderate acute malnutrition.

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

[12] Nigeria's GDP per capita in current USD was $3,010 in 2013 (World Bank 2013)

benefits serve as an approximation of the present value of economic productivity lost each year as a result of mortality and morbidity that would otherwise be prevented by scaling up nutrition interventions. Values presented are taken from a year in which all beneficiaries have reached productive age.

44. **The approach for estimating the potential costs and benefits of nutrition sensitive interventions differs from the methodology used for nutrition specific interventions.** Similar to nutrition specific interventions, the total cost for scaling up the interventions is calculated by multiplying the unit cost by the target population (local Nigerian unit costs or regional unit costs are used depending on availability). However, since most nutrition-sensitive interventions have multiple objectives, it is not always feasible to attribute the nutrition related benefits to the overall costs of the interventions. Because these constraints limit the accuracy of cost-effectiveness estimates, we instead rely on secondary sources/published literature when available, with cost-effectiveness presented in terms of cost per DALY saved.

D. SCENARIOS FOR SCALING UP NUTRITION INTERVENTIONS

45. **When estimating the costs and benefits of scaling up nutrition interventions, we begin with estimates for scaling all ten interventions to full national coverage, followed by estimates for various scale up scenarios.** The "full coverage" estimates can be considered the medium-term policy goal for FGoN, however, resource constraints will likely limit the government's ability to achieve full national coverage in the short-term. Therefore, we also propose 5 scenarios for prioritizing the scale up of nutrition interventions over a shorter-term time frame of 5 years:

- **Scenario 1**: Prioritize scale up by region
- **Scenario 2**: Prioritize scale up by intervention
- **Scenario 3**: Prioritize scale up by state
- **Scenario 4:** Prioritize scale up by state and by intervention
- **Scenario 5**: Prioritize scale up by target coverage

Within each scenario we consider several variations and analyze their cost-effectiveness in terms of cost per DALY saved, cost per life saved and cost per case of childhood stunting averted. After our initial analysis, we present the 5 most attractive scale-up scenarios and discuss them in more detail.

46. **"Full coverage" is defined as 100 percent of the target population for all interventions except the treatment of severe acute malnutrition, for which full coverage is assumed to be 80 percent.** This is consistent with the methodology used in World Bank, 2010a, and is based on the reality that few community-based treatment programs have successfully achieved more than 80 percent coverage at scale. Under Scenario 5, we also propose several "partial coverage" scenarios that reduce coverage targets to more realistic levels, including some coverage rates that are in line with the coverage envisioned in the Government's draft National Strategic Plan for Nutrition.

PART IV – RESULTS FOR NUTRITION-SPECIFIC INTERVENTIONS

A. TOTAL COST, EXPECTED BENEFITS AND COST EFFECTIVENESS

47. **The total additional public investment required to scale up 10 nutrition-specific interventions from current coverage levels to full coverage at the national-level in Nigeria is estimated at US$837 million annually (Table 5)**. This cost includes the additional cost of scaling up all ten interventions across the entire country (US$892 million per year) plus additional resources for monitoring and evaluation, operations research and technical support, and capacity development for program delivery (estimated at US$98 million). Of this total amount of US$991 million, part of the costs for iron fortification, multiple micronutrient powders, salt iodization and complementary food could be covered from private resources from households above the poverty line (estimated at US$153 million), which leaves a financing gap of US$837 million for a full scale-up nationwide.

Table 5. Estimated Cost of Scaling Up 10 Nutrition Specific Interventions to Full Coverage

Intervention	Annual Cost (US$ million)
Community programs for growth promotion of children	70
Vitamin A supplementation for children	5
Therapeutic zinc supplementation with ORS for children	27
Micronutrient powders for children	19
Deworming for children	18
Iron-folic acid supplementation for pregnant women	12
Iron fortification of staple foods for general population	35
Salt Iodization for general population	2
Public provision of complementary food for prevention of moderate acute malnutrition in children	413
Community-based management of severe acute malnutrition in children	294
Total cost for scaling up all 10 interventions	**892**
Capacity development for program delivery	80
M&E, operations research and tech. support	18
Household contributions	**(153)**
ANNUAL PUBLIC INVESTMENT REQUIRED	**837**

48. **A five-year budget for the scale up of all 10 interventions nationwide is estimated to cost between US$ 2.4 and 2.9 billion, depending on the how fast the program reaches full coverage.** We have provided these figures (**Table 6**) for the purpose of comparison only. When the 10 interventions are fully scaled up by year 3, the total programmatic costs over five years is estimated at US$2.9 billion. If full coverage is reached by year 4, then the total cost is US$2.7 billion. If it takes five years to reach full coverage, then the total five-year budget would be US$2.4 billion

Table 6. Scale up of all 10 Interventions Over 5 years, 3 Scenarios in US$ Millions

Time to Reach 100% Scale	Year 1 (20% coverage)	Year 2 (40% Coverage)	Year 3 (60% coverage)	Year 4 (80% coverage)	Year 5 (100% coverage)	Total Scale Up Costs Over 5 Years
3 Years	192	403	773	765	765	**2,897**
4 Years	192	403	576	765	765	**2,700**
5 Years	184	327	462	614	765	**2,351**

49. **The expected benefits from scaling up these ten nutrition-specific interventions across the entire country are enormous (Table 7).** Over 8.7 million DALYs and 183,000 lives would be saved annually, while more than 3 million cases of stunting among children under five would be averted. Program coverage is assumed to expand as follows:

- 14 million families with children 0-23 months reached by community programs for behavior change communication and growth promotion;
- 10.6 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 31.4 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 5.2 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 39.9 million children 12-59 months receive deworming medication;
- 6.3 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million people consume staple foods fortified with iron;
- 38.8 million more people who do not currently use iodized salt obtain it;
- 3.7 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 8.1 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

Table 7. Estimated Annual Benefits for Scaling Up 10 Nutrition Interventions to Full Coverage

Intervention	Beneficiaries Covered	DALYs Saved*	Lives Saved	Number of Stunting Cases Averted
Community nutrition programs for growth promotion of children	13,955,394	5,795,862	89,140	1,859,167
Vitamin A supplementation for children	10,545,198	161,396	10,718	303,844
Therapeutic Zinc supplementation with ORS for children	31,399,636	125,270	28,988	n/a
Micronutrient powders for children	5,217,156	426,585	n/a	n/a
Deworming for children	39,893,072	66,399	n/a	n/a
Iron-folic acid supplementation for pregnant women	6,276,280	269,893**	1,867	12,033
Iron fortification of staple foods for general population	174,442,422	n/a	n/a	n/a
Salt Iodization for general population	38,757,068	n/a	n/a	n/a
Public provision of complementary food for prevention of moderate acute malnutrition in children	8,072,408	126,677	14,445	2,006,577
Community-based management of severe acute malnutrition in children	3,669,417	1,735,878	91,340	n/a
Total when all interventions implemented simultaneously* **	n/a	8,707,960	183,411	3,056,494

* DALY estimates in this study are neither discounted nor age-weighted, in line with the methodology used in the IMHE Global Burden of Disease 2010 and the WHO Global Health Estimates 2012. For more information on the methodology used to calculate DALYs averted, see Appendix 5.
** DALY estimates for IFA supplementation are calculated for DALYs averted among pregnant women. They do not include the DALYs averted among children born to mothers who received these supplements.
*** The total of the interventions implemented simultaneously does not equal to the sum of the individual interventions. This is because some interventions affect nutrition outcomes via similar pathways causing their combined impact to be different than the individual sums.

50. **Most proposed nutrition-specific interventions are highly cost-effective (Table 8).** With the exception of the public provision of complementary food, our analysis finds that all interventions are "very cost-effective" according to WHO criteria (WHO 2014). Using the same criteria, the public provision of complementary food is considered to be "cost-effective". DALY estimates for salt iodization and iron fortification of flour in Nigeria are not available at this time.

51. **In countries such as Nigeria where fiscal and capacity constraints will limit scale-up, the public provision of complementary foods may be a lower priority.** Issues of governance, accountability, and supply logistics will further constrain the scale-up of the public provision of complementary foods. While the benefits are clear, the relatively high cost of this type of intervention, in addition to the aforementioned concerns, lead us to conclude that the public provision of complementary food should be implemented only once adequate capacity has been developed.

52. **For the package as a whole, the total cost per DALY saved is estimated at $102, the total cost per life saved is estimated at $4,865, and the total cost per case of stunting averted is estimated to be $292.**[13] Variation in costs among the interventions is high, with costs per life saved ranging from $433 for vitamin A supplementation to $28,557 for the public provision of complementary foods. Overall, these cost estimates translate into an increase in annual public resource requirements of $14.50 per child. This compares favorably to global estimates of $30 per child calculated in World Bank (2010a).

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[13] For the total cost per benefit unit, we divide the total annual program cost for all 10 interventions (excluding M&E, and capacity development costs, but before subtracting household contributions) by the benefits estimates available. Note that DALYs saved estimates are not available for 2 of the 10 interventions, lives saved estimates are not available for 4 of the 10 interventions and stunting reduction estimates are not available for 6 of the 10 interventions.

Table 8. Cost Effectiveness of Scaling Up 10 Nutrition Interventions to Full Coverage, US$

Intervention	Cost/DALY Saved		Cost/Life Saved	Cost/Stunted Case Averted
	Nigeria	Global		
Community nutrition programs for growth promotion of children	12*	53-153	783	38
Vitamin A supplementation for children	29*	3-16	433	15
Therapeutic Zinc supplementation with ORS for children	216*	73	932	
Micronutrient powders for children	44*	12		
Deworming for children	264*	n/a		
Iron-folic acid supplementation for pregnant women	43*	66-115	6,280	974
Iron fortification of staple foods for general population		n/a		
Salt Iodization for general population		n/a		
Public provision of complementary food for prevention of moderate acute malnutrition of children	3,256**	500-1000	28,557	206
Community-based management of severe acute malnutrition of children	169*	41	3,214	
TOTAL when all interventions implemented simultaneously* **	**102***	**n/a**	**4,865**	**292**

*Very cost-effective according to WHO-CHOICE criteria (WHO 2014).
**Cost-effective according to WHO-CHOICE criteria (WHO 2014).
*** The total of the interventions implemented simultaneously does not equal to the sum of the individual interventions. This is because some interventions affect nutrition outcomes via similar pathways causing their combined impact to be different than the individual sums.

B. POTENTIAL SCALE-UP SCENARIOS

53. **Scenario 1: Scale Up by Region**. **Table 9** shows the estimated costs and benefits of scaling up the ten nutrition specific interventions by region. The regions display significant disparities in malnutrition rates. All states in the North-Western region have stunting levels above 40 percent (nearly 2.5 times that in the South East) and this region accounts for almost 40 percent of the overall costs. The states with high malnutrition rates will disproportionately benefit from scaling up nutrition interventions as demonstrated by high expected benefits in terms of DALYs saved and lives saved.

Table 9. Scenario 1: Cost and Benefits of Scaling Up 10 Nutrition Interventions by Region

Region	Annual Public Investment (US$ million)	Annual Benefits	
		DALYs Saved	Lives Saved
North-Central	$81	1,255,680	24,530
North-Eastern	$134	1,205,553	27,570
North-Western	**$405**	**2,502,917**	**60,022**
South-Eastern	$58	899,369	16,278
South-South	$69	1,199,935	22,212
South-Western	$91	1,644,492	32,798
TOTAL	**$837**	**8,707,946**	**183,411**

54. **Given the high stunting rates in the North-West, the preferred scenario (Scenario 1) is to scale up interventions in states in the North-West region, with an annual public investment of $405 million. This scenario would save over 2.5 million DALYs and at least 60,000 lives.** It would also increase program coverage as follows:

- 3.6 million families with children 0-23 months reached by community programs for behavior change;
- 3.6 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 8.0 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 0.08 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 9 million children 12-59 months receive deworming medication;
- 1.2 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 44.3 million people able to consume staple foods fortified with iron;
- 16.6 million more people gain access to iodized salt;
- 2.0 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 16.5 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

However, because budgetary allocations in Nigeria are done by state, rather than by region, the regional scale-up approach is not a pragmatic option.

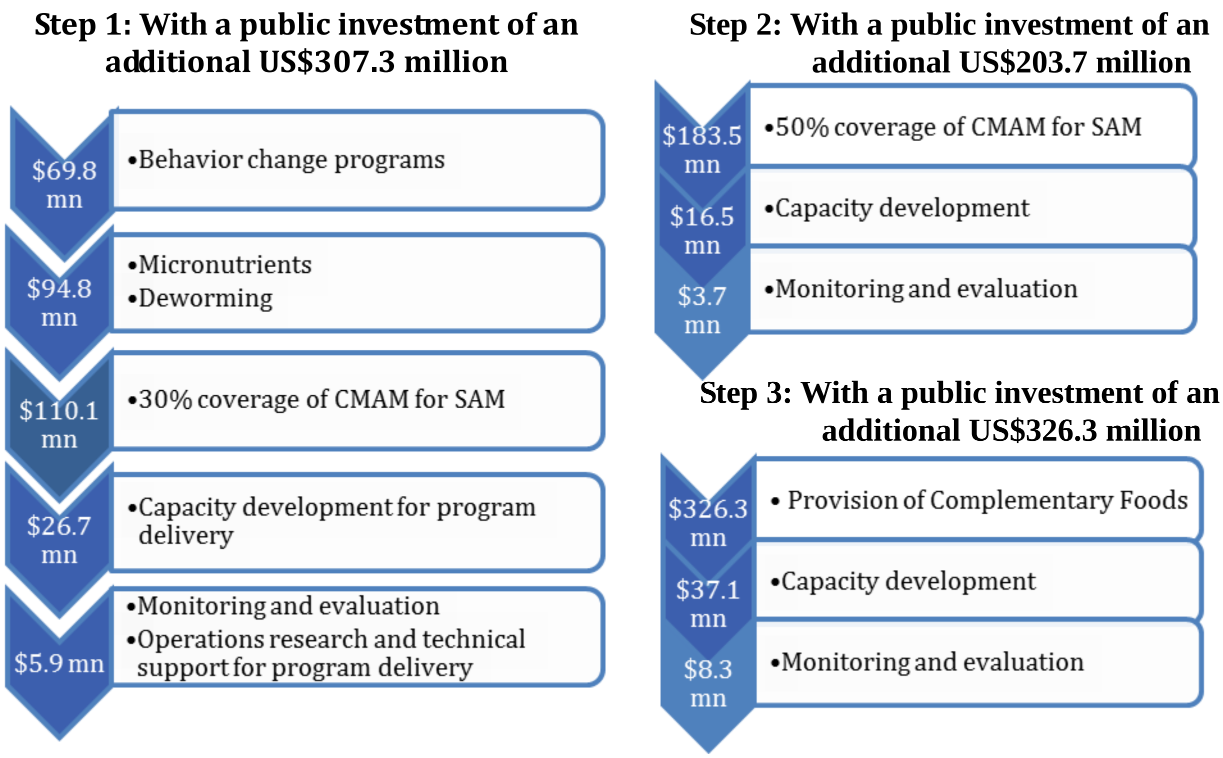
55. **Scenario 2: Scale Up by Intervention.** Scenario 2 is based on step-wise scale-up by intervention. The primary considerations for choosing the interventions in each step are cost effectiveness, recommended phasing of interventions, implementation capacity and delivery mechanisms. The proposed plan for a step-wise scale-up by intervention is summarized below and illustrated in **Figure 6**.

- **Step 1** focuses on a package of primarily preventive interventions that can be scaled up quickly, either with existing capacities or with modest investment in capacity-building for community nutrition programs and child health days. It also includes community-based management of severe acute malnutrition at 30 percent coverage. Although in most other country contexts, this is a resource-intensive intervention and relatively complex to implement, in Nigeria, efforts are already underway to implement community-based management of severe acute malnutrition in 11 states, and some capacities have been built, making the 30 percent coverage goal feasible. The cost of scaling up community nutrition programs for behavior change communication and all micronutrient and deworming interventions at full coverage in all states and community-based management of severe acute malnutrition to reach 30 percent of the target population is US$296.4 million. An additional US$26.7 million for capacity development and US$5.9 million for monitoring and evaluation, operations research, and technical support is budgeted, which brings the total cost of step one to US$329.0 million. The portion of scale up costs that could be covered by households above the poverty line is estimated at US$21.7 million. **Therefore the total public investment required for Step 1 is estimated at US$307.3 million**.

- **Step 2** includes the costs of a full scale up of treatment for severe acute malnutrition from a base of 30 percent in Step 1 to 80 percent coverage, with the assumption that additional implementation capacities are built in Step 1. The estimated cost of this scale-up is US$183.5 million. We also include an additional US$3.7 million for monitoring and evaluation, operations research, and technical support and US$16.5 million for capacity development in step two, which brings the total **public investment required for Step 2 to US$203.7 million**.
- **Step 3** adds scaling up of the public provision of complementary foods to prevent moderate acute malnutrition among children under 2 years of age. The total cost of this intervention is US$412.5 million. The additional cost for monitoring and evaluation, operations research, and technical support and capacity development in step three is US$45.4. Of the total cost, an estimated US$131.6 million could be resourced from private resources in households above the poverty line. This brings **the estimated public investment required for Step 3 to US$326.3 million**.

Step 3 interventions are assigned the lowest priority for the following reasons: (i) the 2013 *Lancet* nutrition series concluded that there are no additional benefits of public provision of complementary foods beyond those provided by dietary counseling and education; (ii) at US$6,849 per DALY saved, the cost-effectiveness of public provision of complementary foods is much less attractive than that of other proposed interventions; (iii) the total cost of complementary foods is overwhelming and accounts for more than half cost of the total cost of scaling up all interventions, while the benefits as estimated lives saved or DALYs saved are lower than other interventions; (iv) governance, accountability, supply-chain, and logistics are key challenges associated with large-scale food distribution and are not inconsequential in a country the size of Nigeria. The estimated benefits do not out-weigh these risks, and the costs are high, as compared with other interventions. Under these circumstances, rapid scale-up is neither feasible nor is it recommended.

Figure 6. Scenario 2: Step-wise Scale-Up by Intervention



Note: A portion of the intervention will be resourced from private resources from households above the poverty line, which explains why the arrows do not sum exactly to total. (See text for details.)
Source: Authors' calculations.

56. **The preferred scale-up Scenario 2 would be to scale up Step 1 and Step 2 interventions, requiring an annual public investment of $511 million. As shown in Table 10, this would save over 8.5 million DALYs and over 164,000 lives. It would also provide the following additional program coverage:**

- 14 million families with children 0-23 months reached by community programs for behavior change;
- 10.6 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 31.4 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 5.7 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 39.9 million children 12-59 months receive deworming medication;
- 6.3 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million people able to consume staple foods fortified with iron;
- 38.8 million more people gain access to iodized salt;
- 3.7 million more children 6-59 months treated for severe acute malnutrition using community-based management practices.

Table 10. Scenario 2: Cost and Benefits for Scaling Up 10 Nutrition-specific Interventions by Intervention

Interventions	Annual Public Investment (US$ millions)	Annual Benefits	
		DALYs Saved	Lives Saved
Step 1: Community nutrition programs for growth promotion, all micronutrient and deworming, 30% coverage of community-based management of severe acute malnutrition	**$307**	**7,496,345**	**122,638**
Step 2: 50% of community-based management of severe acute malnutrition	**$204**	**1,084,924**	**56,742**
SUBTOTAL (STEP 1 AND 2 INTERVENTIONS WHEN IMPLEMENTED SIMULTANEOUSLY)*	**$511**	**8,581,269**	**164,390**
Step 3: Public provision of complementary food for moderate acute malnutrition	$326	126,677	14,445
TOTAL when all interventions implemented simultaneously*	**$837**	**8,707,946**	**183,411**

** The total of the interventions implemented simultaneously does not equal to the sum of the individual interventions. This is because some interventions affect nutrition outcomes via similar pathways causing their combined impact to be different than the individual sums.*

57. **Scenario 3: Scale Up by State.** Scenario 3 proposes scaling up all 10 interventions in three steps using state-level geographic targeting criteria based on the prevalence of child stunting in these states. First are the **highest burden states** with a stunting prevalence above 35 percent. The **middle burden states** are those with a stunting prevalence between 25 and 35 percent and the **lowest burden states** are those with stunting prevalence below 25 percent. The step-wise scale-up by state is summarized below and **Table 11** shows the estimated cost and benefits for each step.

- For the **highest burden states**, all 10 interventions would be scaled up in the 13 states with a stunting prevalence above 35%. Eleven of the 13 states are in North-Western and North-Eastern regions, and one (Plateaux) is in the North-Central region. It is proposed that Nasarawa would also be included since it is currently participating in the results-based financing program. The total cost including costs of M&E operations research, technical assistance, and capacity development would be US$578.8 million. Adjusting for household contributions, **the annual public investment required for the highest burden states is estimated at US$506.9 million.**
- Next, for the **middle burden states**, all 10 interventions would be scaled up in 5 states with a stunting prevalence between 25 and 35 percent. The total cost including costs of M&E operations research, technical assistance, and capacity development would be US$132.1 million. After subtracting contributions from household living above the poverty line, **an annual public investment required for middle burden states is US$105.0 million**.

- For the **lowest burden states**, all 10 interventions would be scaled up in the remaining 19 states with a stunting prevalence below 25 percent. Most of states are in southern regions (South-East, South-South and South-West) with the exceptions of FCT Abuja, Kogi and Benue which are in the North-Central region. The total annual cost of this step including costs of M&E operations research, technical assistance, and capacity development would be US$279.8 million. After adjusting for contributions from households living above the poverty line, **the annual public investment required for the lowest burden states is US$ 225.4 million.**

58. **The preferred Scenario 3 is to prioritize the highest burden states, which would focus on scaling-up all interventions in the 13 states with the most severe stunting rates. This would require an annual public investment of $507 million; saving at least 3.5 million DALYs and over 80,000 lives.** Program coverage would increase as follows:

- 5.2 million families with children 0-23 months reached by community programs for behavior change;
- 5.3 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 11.7 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 0.6 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 13.1 million children 12-59 months receive deworming medication;
- 2.1 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 65.1 million people able to consume staple foods fortified with iron;
- 22.9 million more people gain access to iodized salt;
- 2.3 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 22.9 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

Table 11. Scenario 3: Costs and Benefits for Scaling Up 10 Nutrition-specific Interventions by State

States	Criteria	Annual Public Investment (US$ million)	Annual Benefits	
			DALYs Saved	Lives Saved
Highest Burden[1]	**13 States with >35% stunting and/or RBF States**	**$507**	**3,505,652**	**81,678**
Middle Burden[2]	5 States with 25-35% stunting	$105	1,276,744	28,835
Lowest Burden[3]	States with <25% stunting	$225	3,925,549	72,898
TOTAL		**$837**	**8,707,946**	**183,411**

[1]*Bauchi, Gombe, Taraba, Yobe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara, Nasarawa, Plateau.*
[2]*Borno, Adamawa, Niger, Kwara, Oyo.*
[3]*FCT Abuja, Benue, Kogi, Ondo, Ebonyi, Cross-Rivers, Abia, Anambra, Enugu, Imo, Akwa-Ibom, Bayelsa, Delta, Edo, Rivers, Ekiti, Lagos, Ogun, Osun.*

59. Scenario 4: Scale Up by State and by Intervention. Scenario 4 is a hybrid of Scenario 2 and 3 and proposes the scaling up by state and by selected interventions as listed in Table 12 below. The first variation, Scenario 4a, is to scale up step 1 and step 2 interventions in 18 states where stunting rates are higher than 25 percent (highest and middle burden states), requiring an annual public investment of $337 million, saving almost 4.7 million DALYs and 96,000 lives. Scenario 4a would provide the following program benefits:

- 7.2 million families with children 0-23 months reached by community programs for behavior change;
- 6.9 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 16.1 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 1.4 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 17.4 million children 12-59 months receive deworming medication;
- 2.9 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 89.1 million people able to consume staple foods fortified with iron;
- 28.3 million more people gain access to iodized salt;
- 2.8 million more children 6-59 months treated for severe acute malnutrition using community-based management practices.

Table 12. Scenario 4: Cost of Scaling Up 10 Nutrition Interventions by State and by Intervention, US Millions

Intervention/State	Highest Burden[1]	Middle Burden[2]	Lowest Burden[3]
Step 1 Interventions: Community nutrition programs for growth promotion, all micronutrient and deworming, 30% coverage of community-based management of severe acute malnutrition	**$144**	**$41**	$123
Step 2 Interventions: 50% of community-based management of severe acute malnutrition	**$128**	**$25**	$51
Step 3 Interventions: Public provision of complementary food for prevention of moderate acute malnutrition	$236	$39	$52

[1]Bauchi, Gombe, Taraba, Yobe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara, Nasarawa, Plateau.
[2]Borno, Adamawa, Niger, Kwara, Oyo.
[3]FCT Abuja, Benue, Kogi, Ondo, Ebonyi, Cross-Rivers, Abia, Anambra, Enugu, Imo, Akwa-Ibom, Bayelsa, Delta, Edo, Rivers, Ekiti, Lagos, Ogun, Osun.

Table 13. Annual Costs and Benefits from Scenarios 4a and 4b

Scenarios	Annual Public Investment (US$ million)	Annual Benefits	
		DALYs Saved	Lives Saved
Scenario 4a	$337	4,694,076	96,092
Scenario 4b	$271	3,439,969	70,911

60. **Scenario 4b would limit scaling up step 1 and step 2 interventions to the 13 states with the highest burden of stunting. Scenario 4b would require an annual public investment of $271 million, and would save over 3.4 million DALYs and 70,000 lives (Table 13).** Furthermore, Scenario 4b would provide the following program benefits:

- 5.2 million families with children 0-23 months reached by community programs for behavior change;
- 5.3 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 11.7 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 0.6 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 13.1 million children 12-59 months receive deworming medication;
- 2.1 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;

- 65.1 million people are able to consume staple foods fortified with iron;
- 22.9 million more people gain access to iodized salt;
  2.3 million more children 6-59 months treated for severe acute malnutrition using community-based management practices.

61. **Scenario 5: Scale up by varying program coverage targets**. As discussed above, the previous scenarios assume full program coverage. Scenario 5 allows for "partial" coverage rates as a way to scale-up to the eventual "full coverage" scenario (Table 14). These partial program coverage targets were agreed upon at a meeting between donors and the Government of Nigeria in February, 2014.[14]

Table 14. Full and Partial Program Coverage Targets

Intervention	Percent of target population covered by Year 5	
	Full Coverage (Scenarios 1-4)	Partial Coverage (Scenario 5)
Community nutrition programs for growth promotion of children	100	50
Vitamin A supplementation for children	100	90
Therapeutic zinc supplementation with ORS for children	100	80
Micronutrient powders for children	100	90
Deworming for children	100	90
Iron-folic acid supplementation for pregnant women	100	90
Iron fortification of staple foods for general population	100	100
Salt Iodization for general population	100	100
Public provision of complementary food for prevention of moderate acute malnutrition in children	100	35
Community-based management of severe acute malnutrition in children	80	35

[14] The interventions are expected to reach the following share of targeted coverage: 10% in year 1, 32.5% in year 2, 55% in year 3, 77.5% in year 4 and 100% by year 5. Capacity building is assumed to be 9% of total costs, and within that, 79% is for capacity building and training 13% is for resource mobilization and advocacy and 8% is for coordination. Capacity building will be distributed across the five years as follows: 20% in year 1, 30% in years 3 and 4, 10% in year 4 and the final 10% in year 5. Finally, monitoring and evaluation is estimated to be 2% of intervention costs.

Table 15. Scenarios Considered Within Scenario 5

Scenario	Annual Public Investment (US$ million)	Annual Benefits		
		DALYs Saved	Lives Saved	Cases of Stunting Averted
5a) All interventions in all states at "partial" coverage rates	$353	4,388,415	96,463	1,434,988
5b) Micronutrients and deworming interventions at "partial" coverage rates in all states and community nutrition programs and community-based management of severe acute malnutrition at "partial" coverage rates in highest burden states*	$184	2,256,091	58,519	n/a

**Highest burden states are Bauchi, Gombe, Taraba, Yobe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, Zamfara, Nasarawa, Plateau.*

62. **Scenario 5a would scale up all 10 interventions to the partial coverage levels and would require total annual public investment of US$353 million (Table 15).** This includes the total cost of scaling up the 10 interventions of US$371 million plus US$34 million for capacity development and $8 million for monitoring and evaluation, operations support and technical support. We also assume households above the poverty line can contribute $59 million towards the costs of some interventions, yielding the net total of US$353.

63. **This scenario would save over 4.3 million DALYs, 96,000 lives, and avert over 1.4 million cases of stunting among children under five years of age.** (**Appendix 8** provides the estimates of cost and benefits by state). Additionally, this scenario would provide the following program benefits:

- 7.4 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 7.0 million families with children 0-23 months reached by community programs for behavior change;
- 25.1 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 4.9 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 34.3 million children 12-59 months receive deworming medication;
- 5.4 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million more people able to consume staple foods fortified with iron;
- 38.8 million more people gain access to iodized salt;

- 1.4 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;
- 2.4 million children aged 6-23 months receive a small amount of nutrient-dense complementary food (~250 kcals/day) for the prevention or treatment of moderate malnutrition.

64. **Another scenario (Scenario 5b) would scale up interventions that require less capacity and lower dependence on strong health systems and are relatively low-cost (such as micronutrient and deworming interventions[15]) in all 36 states. It would also provide community nutrition programs and community-based management of severe acute malnutrition at "partial" coverage in the 13 states with the highest burden of stunting. Scenario 5b would require an annual public investment of $184 million, and would save over 2.2 million DALYs and 58,000 lives.** This option would provide the following program benefits:

- 7.4 million additional children 6-59 months receive twice-yearly doses of life-saving vitamin A supplementation;
- 2.6 million families with children 0-23 months reached by community programs for behavior change;
- 25.1 million children 6-59 months receive zinc supplementation as part of diarrhea management;
- 4.9 million children 6-23 months receive vitamins and minerals through multiple micronutrient powders;
- 34.3 million children 12-59 months receive deworming medication;
- 5.4 million additional pregnant women receive iron-folic acid tablets as part of their antenatal care;
- 174.4 million more people able to consume staple foods fortified with iron;
- 38.8 million more people gain access to iodized salt;
- 0.9 million more children 6-59 months treated for severe acute malnutrition using community-based management practices;

C. COST-BENEFIT ANALYSIS OF THE SCALE-UP SCENARIOS

65. **The scenario with the greatest impact per dollar spent is Scenario 2, with a cost per DALY saved of $56 and a cost per life saved of US$2,919.** Yet this scenario is also extremely costly and requires an annual public investment of US$511 million. We will therefore consider other scenarios that are also cost-effective but require fewer public resources.

66. **Table 16 presents a comparison of the various scenarios and shows that scenarios 4a, 4b, 5a and 5b are cost-effective and require relatively modest public investments in order to reach scale.** Scenarios 4a and 4b are more cost-effective but also target specific states. It is worth noting that the two scenarios under Scenario 5 may be more politically feasible, given that the interventions are scaled up in all Nigerian states.

Table 16. Costs and Benefits of Most Cost-Effective Scenarios

[15] This include deworming, vitamin A supplements, zinc supplements, multi micronutrient powders, iron fortification of staple foods and salt iodization

Scenario	Annual Public Investment (US$ million)	Annual Benefits			Cost per Benefit Unit (US$)		
		DALYs Saved	Lives Saved	Cases of Stunting Averted	DALY Saved	Life Saved	Case of Stunting Averted
Full National Coverage	$837	8,707,960	183,411	3,056,494	102	4,865	292
Scenario 1	$405	2,502,917	60,022	n/a	167	6,980	n/a
Scenario 2	$511	8,581,269	164,390	n/a	56	2,919	n/a
Scenario 3	$507	3,505,652	81,678	n/a	149	6,383	n/a
Scenario 4a	$337	4,694,076	96,092	n/a	66	3,229	n/a
Scenario 4b	$271	3,439,969	70,911	n/a	72	3,496	n/a
Scenario 5a	$353	4,388,415	96,463	1,434,988	85	3,849	259
Scenario 5b	$184	2,256,091	58,519	n/a	82	3,152	n/a

67. **Recognizing the difficulty of scaling to full coverage in one year, and following the five-year time frame of the Government's National Strategic Plan of Action for Nutrition, we consider the costs over five years for Scenarios 4a, 4b, 5a and 5b (Table 17).** Interventions are assumed to increase from current coverage as follows: 20 percent of coverage in year 1, 40 percent in year 2, 60 percent in year 3, 80 percent in year 4 and 100 percent in year 5. For these calculations, we consider the expenditures on capacity development and system strengthening required to scale to full coverage to be a fixed cost, with some additional funds allocated to refresher training and rehiring in the years after scale has been reached. Thus, the average annual amount spent on capacity development is allocated across the five years, rather than increasing in proportion to coverage as is the case with the other costs.

Table 17. Scale Up of Scenarios 4 and 5 in US$ Millions

Scenario	Year 1 (20% coverage)	Year 2 (40% Coverage)	Year 3 (60% coverage)	Year 4 (80% coverage)	Year 5 (100% coverage)	Total Scale Up Costs Over 5 Years
Scenario 4						
4a	$74	$134	$191	$254	$316	**$987**
4b	$59	$106	$173	$201	$251	**$769**
Scenario 5						
5a	$39	$113	$186	$251	$323	**$912**
5b	$20	$59	$97	$131	$169	**$476**

68. **A high burden of malnutrition negatively impacts a nation's human capital. Therefore, an investment in improving nutrition outcomes among children is also an investment in Nigeria's economic future.** The two main ways through which malnutrition affects economic productivity are increased mortality and morbidity, or in other words, lives lost and years lived with a disease or disability. For the purposes of this analysis, we estimate the potential economic benefits of scaling up nutrition interventions in terms of lives saved (reduction in mortality) and cases of stunting averted (reduction in morbidity). Because each life lost results in one less citizen contributing to the nation's economy, and because stunted children tend to earn and consume less, these impact estimates help us to arrive at approximations of the return on investment attributable to the scale up of a particular package of interventions.

69. **It should be noted that these estimates of economic benefits are based on a highly conservative methodology that does not necessarily account for all of the potential benefits associated with improving nutrition outcomes among Nigerian children.** However, they clearly demonstrate that the opportunity costs of *not* scaling up nutrition interventions are substantial: we estimate that a five-year scale up plan that brings all ten interventions to full national coverage could produce $2.6 billion in annual returns over the productive lives of the children affected.

70. **Although it was only possible to assess two scenarios (full coverage and Scenario 5a), our analysis finds that both yield positive net present values produce internal rates of return greater than 18 percent (Table 18)**. An increase in the assumed discount rate reduces the present value of future benefits, and therefore we perform a sensitivity analysis using 3 possible discount rates: 3, 5 and 7 percent. For the full national coverage the net present value varies between US$103 billion (3 percent discount rate) to US$34 billion for the 7 percent discount rate. For Scenario 5a it varies between US$40 and 12 billion.

71. **All scenarios have the potential to increase economic productivity by increasing the economic productivity of beneficiaries once they enter the labor force.** Reaching full national coverage for all 10 nutrition specific interventions could add as much as $2.6 billion annually. Scenario 5a also has a high positive impact on economic productivity with an annual addition to the Nigerian economy of $1.04 billion.

Table 18. Economic Benefits of Two Scenarios, 5 year scale up

Scenario	Net Present Value by Discount Rate (US$ billions)			Internal Rate of Return (percent)	Annual Increase in Economic Productivity[16] (US$ billions)
	3%	5%	7%		
Full National Coverage	$102.9	$57.6	$33.6	25.14%	$2.6
Scenario 5a	$40	$21.9	$12.4	18.54%	$1.04

D. PROPOSED SCENARIOS

72. **Based on their cost-effectiveness, economic contributions and resource requirements, we propose consideration of Scenarios 4a, 4b, and 5a for implementation.** First, these three scenarios require relatively modest public investments when compared with the requirements for reaching full national coverage. Second, each scenario is highly cost effective, with scenarios 4a/4b/5a featuring estimated costs of $66/$72/$85 per DALY saved and $3,229/$3,496/$3,849 per life saved. For Scenario 5a we were also able to calculate the cost per case of childhood stunting averted which is US$259 as compared with US$292 for the full coverage scenario. While Scenarios 4a and 4b are more cost-effective, Scenario 5a offers the political advantage of distributing benefits more evenly among the states, while Scenarios 4a and 4b focuses solely on states with the highest burden of stunting.

E. FINANCING CURRENT COVERAGE

73. **The costs discussed thus far relate to the scale up from current coverage and do not take into account the financing necessary to maintain existing coverage levels, which we estimate at approximately US$49 million annually (Table 19).** In order to estimate the cost of financing nutrition interventions at their current scale, this report uses a recent fiscal space analysis for nutrition in Nigeria conducted by R4D (2014). This analysis attempts to identify funding for nutrition by source, which we consider to be a proxy for the resources dedicated to fund existing interventions. However, because this analysis accounts for total funding, it is not possible to separate financing for program costs from overhead costs. Therefore, it is likely that these financing numbers overestimate the "sustaining costs" required for baseline intervention coverage.

74. **The R4D analysis has also identified several sources of "planned" investments in nutrition (Table 20) estimated at about $175 million over the next 4 years.** This represents a potential increase in funding of approximately $126 million between 2014 and 2017. Considering our previous analysis, which demonstrated financing needs over five years of between $769 million and $987 million for scaling up under the three proposed scenarios, the estimated financing gap ranges between $543 and $861 million over this time period, even after

[16] The annual increase in economic productivity is measured as the estimated annual addition to economic productivity once all beneficiaries have reached productive age.

accounting for the planned $126 million in increased investments and the $49 million in sustaining costs for maintaining current coverage. Our analysis predicts additional financing needs over five years of between $769 million and $987 million for scaling up under the three proposed scenarios, resulting in an estimated financing gap of between $543 and $861 million over five years. Therefore, there is clearly a need to leverage additional financing for scaling-up nutrition interventions, while also prioritizing these interventions based on both need and cost-effectiveness.

Table 19. Fiscal Space Analysis for Current National Nutrition Expenditures (2013)

Donor	**Estimated 2013 Expenditure on Nutrition (US$ millions)**
DFID*	17.71
Micronutrient Initiative	1.03
EU	0.93
ECHO	5.47
CIDA	1.25
CIFF	10.62
UNICEF (non-grant)	1.94
Federal Government	10.00
GAIN	TBC
TOTAL	**48.90**

**includes DFID Working to Improve Nutrition in Northern Nigeria program as well as contributions channeled through UNICEF.*
Source: R4D 2014.

Table 20. Projected Funding Available for Nutrition 2014-2017

Donor	**Projected Funding for Nutrition 2014-2017 (US$ millions)**
UNICEF –IYCF	6.40
UNICEF – CMAM	59.84
UNICEF - Policy Support	3.20
UNICEF – Micronutrients	10.56
DFID WINNN	55.00
Federal Government	40.00
Total Available Financing	**175.00**

Source: R4D 2014.

F. UNCERTAINTIES AND SENSITIVITY ANALYSES

75. **Because actual unit costs may differ from our estimates, it is important to consider the effects of either an increase or decrease in these costs on the overall cost of the interventions.** This uncertainty is greatest for higher-cost interventions, and less significant for those with lower-costs. For example, given the prevalence of information on and experience

with less expensive micronutrient and deworming interventions, there is a higher degree of certainty around their estimated costs and financing needs. On the other hand, the costs of community nutrition programs can vary greatly depending on their context, with the intensity of behavior change campaign campaigns, the number of community health workers employed, and the amount of incentives provided all affecting unit costs. Finally, there is very little information concerning the costs associated with the public provision of complementary food. In Nigeria, there is no delivery mechanism that can be used as a reference for these programs, while unit costs are highly dependent on the choice of targeting method and other factors such as widespread corruption and diversion of food supplies. In order to account for these uncertainties, we perform a partial sensitivity analysis on both the Full National Coverage Scenario and Scenario 5a (which also corresponds to the scale up used in in Nigeria's National Strategic Plan of Action for Nutrition). This sensitivity analysis considers the impact of variation in unit costs while holding other variables constant. The results of the sensitivity analysis are presented in **Appendix 9**.

PART V – NUTRITION-SENSITIVE INTERVENTIONS

76. **We present cost-benefit estimates for four nutrition-sensitive interventions delivered through the agriculture and education sectors**: **biofortification of cassava; aflatoxin reduction through biocontrol interventions; school-based deworming; and school-based promotion of good hygiene practices. Table 21** summarizes the cost of scaling up these interventions and, when available, DALYs saved and cost per DALYs saved. Biofortification of cassava, school-based deworming, and aflatoxin control through biocontrol are considered to be cost-effective scenarios in Nigeria. Costs per DALYs saved are not available for school-based promotion of good hygiene.

Table 21. Preliminary results for costing nutrition-sensitive interventions

Intervention	Annual Cost (US$ million)	DALYs Saved	Cost/DALY Saved
Biofortification of cassava	25	800,000	$0.3-0.5
Aflatoxin control (biocontrol)	65	1,537,790	$43.00
School-based deworming	8	n/a	$4.55*
School-based promotion of good hygiene	60	n/a	n/a

**Estimate for Kenya as cost/DALYs saved not available for Nigeria.*

A. BIOFORTIFICATION OF CASSAVA

77. **The projected total cost of scaling up biofortification of yellow cassava is US$ 25 million.** This cost includes only maintenance breeding and release and dissemination components. The R&D and adaptive breeding phases are already completed, thus the costs of these components are no longer relevant and have been excluded from the calculation. Given the unavailability of current programmatic costing information, the total cost of scaling up is obtained from the ex-ante assessment of biofortification in Nigeria (Fiedler 2010).

78. **The cost per DALY saved for biofortification of cassava in Nigeria is estimated to be between US$ 0.30 (optimistic) to US$0.50 (pessimistic), which is highly cost-effective (Birol et al. 2014).** The cost estimate of $25 million comes from Meenakshi et al. (2010). No estimations are currently possible for lives saved through biofortification.

B. AFLATOXIN REDUCTION THROUGH BIOCONTROL

79. **The total cost of scaling up aflatoxin reduction through biocontrol is estimated to be US$65 million.** The cost calculation uses the unit cost of Afla-safeTM biocontrol developed by IITA and tested in Nigeria, with a cost per hectare of approximately US$15.6, including material and distribution costs (Bandyopadhyay 2013). Crop area is based on FAO's 2010 projections of

Nigerian maize planting area, which is estimated at 4.19 million hectares. For the purposes of this exercise, it is assumed that AflaSafeTM will be applied to all maize fields.[17]

80. **The cost per DALY saved for biocontrol in Nigeria is US$ 43, which is considered highly-cost effective.** An ex-ante assessment of several aflatoxin control measures in Nigeria identified biocontrol as the most cost-effective for aflatoxin control compared to other agricultural interventions. The estimated DALYs saved annually and the tentative numbers of stunting cases prevented annually via biocontrol in Nigeria are 1,537,079 and 875,560, respectively, albeit stunting estimates are based on tentative evidence. By comparison, the postharvest intervention package will tentatively prevent 254,880 cases of stunting and save 439,329 DALYs (Khlangwiset 2011). No estimations are currently possible for lives saved through aflatoxin control.

C. SCHOOL-BASED DEWORMING

81. **The cost of scaling up school-based deworming is estimated to be US$8 million annually.** The unit cost (US$0.08) used in the calculation is obtained from regional estimates of delivery cost in schools for Ghana (Guyatt et al. 2003), assuming twice a year treatment. These estimates compare well with recent regional "bottom-up" cost analysis, based on NTD national plans from 36 sub-Saharan Africa countries (Sedosh et al. 2013) which estimates the unit cost of preventive chemotherapy (PCT) of five NTDs (lymphatic filariasis, onchocerciasis, schistosomiasis, trachoma and soil-transmitted helminthiasis) in the Africa region at $0.26. The major cost components for deworming are human resources, surveillance and mapping, non-donated drugs, advocacy, infrastructure and logistics, and implementation and management. The target population is school-age children (6-19 years-old) enrolled in primary and secondary schools and the current coverage is assumed to be negligible.

D. SCHOOL-BASED PROMOTION OF GOOD HYGIENE

82. **The cost of scaling up school-based promotion of hand-washing and good hygiene behavior is estimated to be US$60 million.** While promotion of WASH in schools normally includes sustainable, safe water supply points, hand-washing stands and sanitation facilities; the costing includes only the component for hygiene education. Due to unavailability of unit cost estimate specifically for Nigeria, the unit cost is obtained from UNICEF report (2012) on WASH in schools. The unit cost for hygiene education component is estimated to be US$2 per student and includes the cost of capacity building, monitoring, advocacy, social mobilization. The target population is school-age children and the current coverage is assumed to be negligible.

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[17] Most maize is for human consumption in Nigeria but some is also for other purposes. We were not able to estimate how many hectares produce maize for human consumption versus other purposes.

PART VI – CONCLUSIONS AND POLICY IMPLICATIONS

83. **Systematic costing of highly effective nutrition interventions is important for priority-setting, resource mobilization and advocacy**. Combining costing with estimates of impact (in terms of DALYs and lives saved) and cost-effectiveness analysis will make the "case for nutrition" stronger and will aid in priority setting by identifying the most cost-effective packages of interventions in situations where financing is constrained. This will potentially be a powerful evidence-based advocacy tool for policymakers when making budget allocations (i.e. Ministry of Finance) as it provides useful evidence on what the government can "buy" (in terms of DALYs and lives saved) given available resources, thereby maximizing allocative efficiencies.

84. **Reaching full national coverage will be expensive and will require a significant increase in the amount of public resources devoted to nutrition in Nigeria.** As it is unlikely that the government or its partners will find the $837 million necessary to reach full national coverage, it is important to consider scenarios that make the most of the resources available. Therefore, our findings and recommendations are based on cost-benefit analyses that can help policy makers to prioritize the allocation of resources more effectively so as to maximize allocative efficiencies and potential for impact. The scenarios (4a, 4b, 5a and 5b) proposed in this report represent a compromise between the need to move to full coverage and the constraints imposed by limited resources.

85. **A high burden of malnutrition negatively impacts a nation's human capital. Therefore, an investment in improving nutrition outcomes among children is also an investment in Nigeria's economic future.** All scenarios have the potential to increase the economic productivity of beneficiaries once they enter the labor force. Reaching full national coverage for all 10 nutrition-specific interventions could add as much as $2.6 billion annually to the Nigerian economy, while the lower-cost scenario 5a would add US$1.04 billion annually. Our analyses also find that all scenarios yield positive net present values, and most produce internal rates of return greater than 18 percent. It should be noted that these estimates of economic benefits are based on a highly conservative methodology that does not necessarily account for all of the potential benefits associated with improving nutrition outcomes among Nigerian children.

86. **Although this report focuses extensively on nutrition specific interventions, the causes of malnutrition are multisectoral and therefore any longer-term approach to improving nutrition outcomes must include nutrition sensitive interventions.** This analysis takes an innovative approach to nutrition costing by not only estimating the costs and benefits of nutrition-specific interventions, but also exploring costs for a selected number of nutrition-sensitive interventions implemented outside of the health sector. We have identified four candidate nutrition-sensitive interventions with high impact potential for Nigeria, including biofortification of cassava, aflatoxin control, school-based deworming, and school-based promotion of good hygiene. However, these interventions are just a starting point, and as the Government begins to develop a multisectoral nutrition policy, it would be useful consult across sectors and ministries in order to identify other possible nutrition sensitive interventions that are cost-effective.

87. **Overall, these findings point to a powerful set of nutrition-specific interventions and a candidate list of nutrition-sensitive approaches that represent a highly cost-effective approach to reducing the high levels of child malnutrition in Nigeria. Most of the malnutrition that occurs in the first 1000 days of a child's life is essentially irreversible.** Investing in early childhood nutrition interventions offers a window of opportunity to permanently lock-in human capital, and to super-charge the potential demographic dividend in Nigeria. This fits in to the President's Transformational Agenda for Nigeria and the government's flagship Saving One Million Lives (SOML) initiative, which focus on six pillars, one of which is nutrition. However, despite strong commitments to address malnutrition, the government of Nigeria currently has no financial allocations for nutrition in FGoN's 2014 budget.

88. **Moving forward, these results will be useful to decision makers as they plan future efforts to scale-up action against malnutrition in Nigeria and develop nutrition financing plans that bring together the health, education and agriculture sectors**. In the health sector, plans for financing Universal Health Coverage (UHC) and SOML must include these costs under the nutrition pillar of SOML. There also exist several opportunities to incorporate these highly cost-effective interventions into the World Bank's existing and pipeline investments in Health (e.g. the State Health Project and planned support for SOML), agriculture (such as FADAMA III) and education (e.g. the State Education Project and the Global Partnership on Education).

APPENDICES

Appendix 1: Partners Collaborating on Nutrition in Nigeria, 2014

Region and State	Partners Present	Activities
NORTHWEST REGION		
Jigawa	Save the Children ACF MSF UNICEF	WINN, EveryOne Advocacy WINN, CMAM CMAM WINN; MNCHW; Zinc supp; IYCF
Kaduna	None	None
Kano	UNICEF World Bank WHO MCHPS	MNCHW, CMAM, IYCF, MNDC RBM MCHW, CMAM, IYCF, MNDC MNCHW, CMAM, IYCF, MNDC
Katsina	Save the Children	CMAM (cash transfers), FSL project, EveryOne Advocacy
Kebbi	UNICEF Save the Children ACF	WINN, CMAM, Zinc supp WINN WINN
Sokoto	UNICEF MSF Poland	CMAM and IYCF CMAM and SAM treatment
Zamfara	Save the Children Save the Children UK UNICEF ACF	WINN CMAM and IYCF WINN, CMAM; IYCF WINN
NORTH-CENTRAL REGION		
Benue	SPRING UNICEF and HKI	IYCF MNDC; IYCF; CMAM
FCT- Abuja	SPRING	IYCF
Kogi	None	None
Kwara	None	None
Niger	UNICEF	IYCF; MNDC; NISS
Nasarawa	UNICEF IHVN	MCHW; IYCF RUTF Supply
Plateau	None	None
NORTHEAST REGION		
Adamawa	UNICEF	CMAM; IYCF; MNDC
Bauchi	None	None
Borno	UNICEF HKI	
Gombe	ANJIHH Save the Children	MNCHW EveryOne Advocacy

	UNICEF	CMAM; IYCF
Taraba	MITSOAH UNICEF	MNCHW; SAM Treatment; IYCF; IDD Monitoring; Training
Yobe	Save the Children UNICEF ACF	WINN Project WINN Project WINN Project
SOUTHEAST REGION		
Abia	UNICEF BASICS II	IYCF; MNDC IYCF; MNDC
Anambra	None	None
Ebonyi	None	None
Enugu	UNICEF WHO GAIN	IYCF; MNDC; Treatment of SAM MNDC
Imo	None	None
SOUTH-SOUTH REGION		
SOUTHWEST REGION		
Ekiti	UNICEF	MNCHW; MNDC
Lagos	None	None
Ogun	UNICEF FBFI	SAM Treatment; MNCHW; MNDC; Training Support for IYCF
Ondo	UNICEF	MNCHW
Osun	None	None
Oyo	UNICEF	Vit A, Zinc, IFA Supp, Training, GMP equipment, IEC materials, RUTF supplies, MNCHW

Source: Government documents and consultation with partners.

Appendix 2: Target Population Size

Region	Total population and population to benefit from iron fortification of staples (1)	Children 0-23 months to cover under the community nutrition programs (2)	Children 6-59 months not covered by vitamin A supplementation (3)	Children 6-59 months to cover under the therapeutic zinc supplementation with oral rehydration salts (4)	Children 6-23 months not covered by multiple micronutrient powders (5)	Children 12-59 months not covered by deworming (6)	Pregnant women not receiving iron folic acid supplementation (7)	Population not consuming iodized salt (8)	Children 6-23 months to receive complementary feeding (9)	Children 6-59 months not treated for severe acute malnutrition (10)
North-Central	25,869,988	2,069,599	1,674,207	4,656,598	1,018,615	2,907,551	712,145	6,404,668	533,584	361,945
North-Eastern	23,699,434	1,895,955	2,107,576	4,265,898	555,785	2,091,285	1,001,205	6,428,538	866,181	733,398
North-Western	44,296,509	3,543,721	3,540,604	7,973,372	74,135	4,485,859	1,076,338	16,510,527	2,583,655	2,416,719
South-Eastern	20,037,552	1,603,004	755,367	3,606,759	927,210	2,904,244	847,783	2,053,174	275,043	348,090
South-South	26,104,018	2,088,321	1,137,854	4,698,723	1,165,903	3,172,578	996,739	2,944,841	400,338	346,023
South-Western	34,434,921	2,754,794	1,329,592	6,198,286	1,475,508	4,385,019	1,485,268	4,415,320	590,588	380,595
NATIONAL	**174,442,422**	**13,955,394**	**10,545,198**	**31,399,636**	**5,217,156**	**19,946,536**	**6,119,478**	**38,757,068**	**5,249,389**	**4,586,771**

Sources and notes

(1) UNICEF 2013 projections based on the National Population Council (Total population)
(2) UNICEF 2013 projections based on the National Population Council (Children 0-23 months)
(3) UNICEF 2013 projections based on the National Population Council (Children 6-59 months) , State-level vitamin A coverage estimates from MICS 2011 report and September 2012 SMART survey results for 8 states (Borno, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, Zamfara)
(4) UNICEF 2013 projections based on the National Population Council (Children 6-59 months)
(5) UNICEF 2013 projections based on the National Population Council (Children 6-23 months)
(6) UNICEF 2013 projections based on the National Population Council (Children 12-59 months), State-level deworming coverage estimates from the FMOH 2012 programmatic data from the first round of MNCH weeks in 2012 and September 2012 SMART survey results for 8 states (Borno, Jigawa, Kano, Katsina, Kebbi, Sokoto)
(7) UNICEF 2013 projections based on the National Population Council (Total population), State-level iron folic acid coverage estimates from the FMOH 2012 programmatic data from the first round of MNCH weeks in 2012
(8) UNICEF 2013 projections based on the National Population Council (Total population), Percent of households consuming iodized salt from MICS 2011
(9) UNICEF 2013 projections based on the National Population Council (Children 6-23 months), State-specific data on underweight from MICS 2011
(10) UNICEF 2013 projections based on the National Population Council (Children 6-59 months), State-specific data on severe wasting from MICS 2011, UNICEF provided coverage data for 11 states (Adamawa, Bauchi, Borno, Gombe, Yobe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Zamfara)
This represents the total population of children 6-59 months not treated for severe acute malnutrition although we expect to reach 80 percent of this population

Appendix 3: Data Sources and Relevant Assumptions

Intervention	Costed delivery platform	Cost estimate	Source	Assumptions
Behavior change interventions				
Breastfeeding promotion	Community nutrition programs	Included in community nutrition programs $ 5 per participant per year	UNICEF (2013)	Behavior change campaign interventions cost US$ 5 per child under five years of age and we assume there are two children under five years of age per participating mother. Focus is on exclusive breast feeding, infant and young child complementary food, hygiene practices among others.
Education on appropriate complementary feeding practices (excluding provision of food)	Community nutrition programs	Included in community nutrition programs	UNICEF (2013)	Assume zero additional cost as it is included in community nutrition program
Hand washing	Community nutrition programs	Included in community nutrition programs	UNICEF (2013)	Assume zero additional cost as it is included in community nutrition program
Micronutrients and deworming interventions				

Vitamin A supplementation	Maternal, New Born and Child Health Weeks	US$ 0.44 per child per year. Freight and handling costs added to the unit capsule cost of US$0.02	UNICEF (2013); Federal Republic of Nigeria (2011); Takang et al (2012); Katsina State Government (2012); Anger (2012); Federal Capital Territory (2012); Zoakah (2012); Ososanya (2013)	Supplements are distributed through biannual MNCH weeks, with overhead costs (for planning; advocacy; social mobilization; health worker and volunteer training; monitoring; supervision; and logistics support to fixed facilities and outreach stations) shared with other interventions (therapeutic zinc supplementation with ORS, deworming and iron folic acid supplementation).
Therapeutic zinc supplementation with ORS	Maternal, New Born and Child Health Weeks	US$0.86 per child per year.	UNICEF (2013); Takang et al (2012)	Each child is assumed to have 2-3 episodes of diarrhea per year with average of 12 tablets needed to treat one episode. MNCHW implementation overhead costs are shared with other interventions
Micronutrient powders	Community nutrition programs	US$1.80 per child 6-11 months of age per year and US$3.60 per year per child 12-23 months of age.	Horton et al (2010)	Global estimates are used. There is insufficient information on in-country implementation of this intervention that is just commencing in 2 of 36+1 states.

Deworming	Maternal, New Born and Child Health Weeks	US$0.44 per child 12-59 months of age per year	UNICEF (2013); Federal Republic of Nigeria (2011); Takang et al (2012); Katsina State Government (2012); Anger (2012); Federal Capital Territory (2012); Zoakah (2012); Ososanya (2013)	Assume ½ tablet of Albendazole per child 12 – 23 months of age and one tablet per child 24 – 59 months of age is given in each round of the biannual MNCHW. Overhead costs are shared with other interventions
Iron-folic acid supplementation for pregnant women	Maternal, New Born and Child Health Weeks/Community nutrition programs	US$ 1.79 per pregnancy through MNCHW; US$2.00 per pregnancy through community nutrition programs	UNICEF (2013); Federal Republic of Nigeria (2011); Takang et al (2012); Katsina State Government (2012); Anger (2012); Federal Capital Territory (2012); Zoakah (2012); Ososanya (2013); Horton et al (2010)	Assume daily IFA supplementation for last two trimesters of pregnancy (about 180 tablets) delivered through MNCHWs to 40% of target population and remaining reached through community nutrition programs and ANTE-NATAL CARE services. MNCHW overhead costs shared with other interventions. Provision made for weekly SMS reminders
Iron fortification of staple foods	Market-based delivery systems	US$0.20 per person per year (flour fortification)	Horton et al (2010); Aminu (2013); UNICEF (2013)	Global estimate is used. No specific information on Nigeria available.
Salt iodization	Market-based delivery systems	US$0.05 per person per year	Horton et al (2010); Aminu (2013)	Global estimate is used. No specific information on Nigeria available.
Complementary and therapeutic food interventions				

Treatment of severe acute malnutrition	Primary Health Care and Community Nutrition Programs	US$80.00 per child per episode	UNICEF (2013)	Food cost about US$50. Additional costs are for freight and handling; training, monitoring and supervision of health workers; and provision of equipment. Cases are managed in PHC facilities. Screening carried out at community and facility levels.
Prevention/treatment of moderate malnutrition	Community Nutrition Programs or Primary health care system	US$51.10 per child per year	Horton et al (2010); UNICEF (2013)	Global estimate is used. There is no programmatic delivery mechanism as yet in Nigeria.

Appendix 4: Methodology for Estimating Costs for Nigeria

The following steps lay out the methodology used to estimate costs for each intervention:

1. Description of each intervention;
2. Definition of target populations for each intervention;
3. Estimation of the size of the target populations for each intervention in each state/region using the most current demographic data;
4. Specification of the delivery platform or channel(s) for each intervention, based on the country context and the accepted delivery modes;
5. Data on the current coverage levels for each intervention in each state/region;
6. Estimation of unit cost per beneficiary for each intervention from program experience in Nigeria, whenever possible, and/or Africa region;
7. Calculation of additional costs of scaling up to full coverage by multiplying the unit cost for each intervention with the size of the "uncovered" target population for each intervention by state/region. The formula for calculation is:

   $$x_1 = z_1(100 - z_2)$$

   where:
   x_1 = *additional costs of scaling up to full coverage*
   z_1 = *unit cost per beneficiary*
   z_2 = *current coverage level (percentage)*

8. Estimation of additional resources for: (i) capacity development for program delivery and (ii) M&E and technical support, estimated at 9% and 2% of total cost of interventions, respectively;
9. Estimation of a portion of the total cost that can be covered by private household resources. It is assumed that households above poverty line could cover the cost of iron fortification, multiple micronutrient powders, salt iodization and complementary food from private resources;
10. Calculating the annual public investment required to scale up these interventions to full coverage using the following formula:

    $$Y = (x_1 + x_2) - x_3$$

    where:
    Y = annual public investment required to scale up to full coverage
    x_1= *additional total cost to scale up to full coverage*
    x_2= *additional cost for capacity development, M&E, and technical assistance*
    x_3= *cost covered by households living above poverty line for selected interventions*

Full coverage is defined as 100% of the target population for all interventions except the treatment of severe acute malnutrition, which is set to 80%. This is consistent with World Bank (2010a) methods and is based on the reality that few community-based treatment programs have successfully achieved more than 80% coverage at scale.

Appendix 5: Methodology for Estimating DALYs for Nigeria

The following steps were undertaken to estimate the impact in DALYs averted of implementing the various nutrition interventions:

1. Estimate the effectiveness of each intervention on mortality and morbidity for each targeted cause
2. Calculate the rate of YLL and YLD due to each cause-risk factor combination for the target population
3. Calculate the DALYs averted under current or counterfactual coverage scenario
4. Calculate the DALYs averted under the proposed intervention coverage scenario
5. Calculate the net DALYs averted by the proposed intervention

1. Estimate the effectiveness of each intervention on mortality and morbidity for each targeted cause

To estimate the effectiveness of the interventions, key articles by Black et al and Bhutta et al in the Lancet series on maternal and child undernutrition were first consulted. Additional literature searches for the latest evidence were conducted in the Pubmed online database and the Cochrane Library of systematic reviews and meta-analyses. Effectiveness figures that were reported as statistically significant were extracted and used for the calculations.

2. Calculate the rate of YLL and YLD

The WHO's 2012 Global Health Estimates (GHE 2012) data tables provide country-specific YLL and YLD rates for each cause of death or disease. GHE 2012 morbidity and mortality estimates were used in combination with country-specific population attributable fractions (PAF) from the 2010 GBD. This assumes that the risk factor impacts on morbidity and mortality did not differ significantly between the two estimates.

To calculate the rate of morbidity and mortality from a cause due to a specific risk factor, the first step is to calculate the PAF for the cause-risk factor combination. The PAF was extracted from the country-specific risk factor attribution table from the 2010 GBD data. This was done separately for YLL and YLD. In the second step, the country-specific YLLs and YLDs for the target population, in most cases under-fives, were extracted from the GHE 2012 estimates. To calculate the YLL rate, the country-specific YLL is multiplied by the YLL PAF and then by 100,000. The final figure is divided by country-specific population of interest (usually under-fives) to get the rate. The same final steps are followed to calculate the YLD, although instead multiplying country-specific YLDs by the YLD PAF. The population estimate for the rate calculation was extracted from GHE 2012.

YLL per 100,000 = (U-5_cause_total_YLL * YLL_PAF * 100,000)/U-5_ population
YLD per 100,000 = (U-5_cause_total_YLD * YLD_PAF * 100,000)/U-5_population

3. Calculate counterfactual DALYs averted

To calculate the DALYs averted if current intervention coverage were maintained, the following formula was used:
YLL = U-5_population_intervention_year * current_coverage * intervention_mortality_reduction * YLL_rate
YLD = U-5_population_intervention_year * current_coverage * intervention_morbidity_reduction * YLL_rate

DALY_current = YLL+YLD

4. Calculate total DALYs averted under intervention coverage

To calculate the potential DALYs averted under the intervention coverage, a similar formula as above was used:

YLL = U-5_population_intervention_year * intervention_coverage * intervention_mortality_reduction * YLL_rate
YLD = U-5_population_intervention_year * intervention_coverage * intervention_morbidity_reduction * YLL_rate

DALY_intervention = YLL+YLD

5. Calculate net DALYs averted

The potential net DALYs averted by the intervention is:
DALYs averted = DALY_intervention - DALY_current

Appendix 6: Methodology for Nigeria LiST estimates

The Lives Saved Tool (LiST) is a part of an integrated set of tools that comprise the Spectrum policy modeling system. These tools include DemProj for creating demographic projections; AIM to model and incorporate the impact of HIV/AIDS on demographic projections and child survival interventions; and FamPlan for incorporating changing fertility into the demographic projection. LiST is used to project how increasing intervention coverage would impact child and maternal survival. The table below summarizes data sources used for the Nigeria LiST estimates.

Nigeria LiST estimates - Data Sources	
Demographic data	Source
First year population	2011 MICS and provided Cost table
Sex ratio at birth	2011 MICS
Life expectancy	2008 NDHS
Family Planning	
Unmet need	2011 MICS
Total fertility rate	2011 MICS
Age-specific fertility rate	Used sub-Saharan Africa model
Health, mortality, economic status	
Vitamin A deficiency	2011 MICS
Zinc deficiency	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.
Diarrhea incidence	Diarrhea incidence in low- and middle-income countries in 1990 and 2010: a systematic review. Fisher Walker CL. BMC Public Health 2012, 12:220
Severe pneumonia incidence	Global burden of childhood pneumonia and diarrhoea. Fischer Walker C, Rudan I, Liu L, Nair H, Theodoratou W, Bhutta ZA, O'Brien KL, Campbell H, Black RE. Lancet 2013; 381: 14
Malaria exposure (women)	The Limits and Intensity of Plasmodium falciparum Transmission: Implications for Malaria Control and Elimination Worldwide. Guerra CA, Gikandi PW, Tatem AJ, Noor AM, Smith DL, et al. PLoS Medicine Vol. 5, No. 2, e38
Stunting distribution	LiST default; data has been calculated using DHS and MICS datasets.
Wasting distribution	LiST default; data has been calculated using DHS and MICS datasets.
Neonatal mortality	2008 DHS
Infant mortality	2011 MICS

Child mortality	2011 MICS
Distribution of causes of death	Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C, Black RE. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet, 379(9832):2151 - 2161
Maternal mortality ratio	2008 DHS
Household poverty status	2008 DHS
Household size	2008 DHS

Once the demographic and health data have been updated, the coverage and scale-up plan for each intervention is introduced into LiST. LiST can use either a sequential method to calculate the impact of individual interventions or LiST can calculate the simultaneous impact of a set of interventions implemented at the same time. The second, simultaneous method is like to yield slightly lower estimates because interventions may have overlapping benefits. In this analysis we present the both the individual/sequential results of the individual interventions in the "full coverage" scenario (with totals calculated using the simultaneous method) and the simultaneous impact in the various scale-up scenarios.

Note on Estimates of Cases of Stunting Averted:

In order to estimate the number of cases of under-five stunting averted attributable to the annual investment in scaling up of nutrition interventions, we use LiST to model changes in the prevalence of stunting over 5 years during which the interventions have reached 100 percent scale. Next, we model changes in the prevalence of stunting over 5 years with no scale-up of the interventions. We then take the difference between the estimated stunting prevalence in year 5 with the scale up and the prevalence in year 5 absent a scale-up, and multiply this percentage point difference by the total population of children under five.

Our 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 stunting 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. We assume that continuing investments in maintaining scale after year 5 will serve to maintain the gains in stunting prevalence reduction, and therefore we present this reduction as the benefits 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, we model this scale up directly in LiST and use the annual results over 5 years in our cost-benefit analysis. This provides a more accurate portrayal of the direct benefits attributable to a five year scale up plan, and does not assume that the scale will necessarily be maintained following the end of the period covered in the plan.

Appendix 7: Methodology for Estimating Economic Benefits

There is considerable debate in the literature regarding the methodology for monetizing the value of a life saved. In this analysis, we chose to focus solely on the economic value of a life year, which we measure as equal to GNI per capita. Other studies also attempt to estimate the social value of a life year, and therefore we acknowledge that our results may underestimate the true value of a life year saved.

Still, valuing years of life saved alone does not account for the economic benefits of reduced morbidity, which includes the long-term, non-lethal impacts of malnutrition on individuals. While there are a number of long-term impacts of nutritional deficiencies, we choose to focus on stunting given the availability of country-specific impact estimates produced by the LiST tool.[18]

In order to estimate the value of a case of childhood stunting averted, we follow the methodology used in Hoddinott et al. (2013), the authors begin by assuming that stunted individuals lose an average of 66% of lifetime earnings, based on direct estimates of the impact of stunting in early life on later life outcomes found in Hoddinott et al. (2011).[19] This point estimate for the effects of stunting on future consumption is used as a proxy for the effect of stunting on lifetime earnings. Additionally, Hoddinott et al. (2013) account for uncertainty by assuming that only 90% of the total gains will be realized, which we also include in our calculations. However, unlike the authors, we also adjust our calculations to reflect the country's labor force participation rate.

For both lives saved and cases of stunting averted, the benefits of a five year scale up plan are attributed to a group of children that is assumed to enter the labor force at age 15 and exit the labor force at age 52, which is equivalent to Nigeria's life expectancy at birth. Benefits from both stunting and lives saved are then multiplied by a lifetime discount factor (LDF) derived from three potential discount rates (3% 5% and 7%), an adjustment for age at the time of investment (for simplicity we assume an average age of two years for all children), as well as the years of lifetime productivity expected. The LDF represents the years of productivity that are "counted" in the calculation, discounted back to their present value in the year in which the investment in nutrition is made. As we assume an average age of two years for all beneficiaries, we use an LDF that assumes that these children will enter the labor force in 13 years from the time of investment. Importantly, given the time frame considered under this analysis (50 years), we do not attempt to account for projected growth in the country's GDP and per capita incomes. This downward bias contributes to the conservative nature of our estimates.

The following equations are used to estimate 1) the economic value of lives saved (reduced mortality); and 2) increased future productivity (reduced morbidity):

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[18] It should be noted that because stunting is just one of many long-term consequences of poor nutrition, actual economic benefits may be much higher than estimated here.

[19] Hoddinott et al. (2011) provided direct estimates of the impact of stunting in early life on later life outcomes, which found that an individual stunted at age 36 months had, on average, 66% lower per capita consumption over his or her productive life.

1) $$(lives\ saved\ attributable\ to\ intervention\ scale\ up) * (1.5 * GDP\ per\ capita) * LDF = (present\ value\ of\ reduced\ mortality)$$

2) $$(cases\ of\ child\ stunting\ averted) * (coefficient\ of\ deficit) * (actual\ gains\ realized) * (per\ capita\ income) * (labor\ force\ participation\ rate) * LDF = (present\ value\ of\ reduced\ morbidity)$$

Where:

- Lives saved attributable to the intervention scale up are estimated using the LiST tool.
- Cases of child stunting averted are calculated by subtracting the under five stunting prevalence (%) after the intervention calculated by LiST from the stunting prevalence in year 0 and multiplying it by the total under five population.
- The coefficient of deficit is equal to the reduction in lifetime earnings attributable to stunting.
- The lifetime discount factor (LDF) is used to discount future benefits to their value at the time of investment. It is derived from a discount rate, age at the time of investment and the estimated age of entry and exit into the workforce. The equation used to calculate the LDF is:

$$LDF = \sum_{t=13}^{n} \frac{1}{(1+r)^t}$$

Where:

- o *LDF* is the lifetime discount factor
- o *r* is the discount rate
- o *t* is the number of years since the initial investment in scaling up the interventions (we assume that children enter the labor force at 15 years old, which is reflected in the starting value for *t*)
- o *n* is the life expectancy at birth

The following values and sources are used in our calculations:

Indicator	Value	Source
GNI per capita	$2,710	World Bank 2013
Life expectancy at birth	52 years	World Bank 2011
Labor force participation rate	56%	World Bank 2012
Coefficient of deficit (stunting)	0.66	Hoddinott 2011
Actual gains realized	90%	Hoddinott 2013

To arrive at a Net Present Value (NPV), we use the following equation:

$$NPV = \sum_{t=1}^{5} (PV\ of\ reduced\ mortality)_t + (PV\ of\ reduced\ morbidity)_t - (PV\ of\ Investment\ cost)_t$$

Finally, the annual addition to economic productivity is measured by taking the total economic benefits for a year in which all beneficiaries of the initial one-year investment have reached productive age (i.e. in year 13). These benefits are not discounted back to their present value, as they are considered the annual opportunity cost of not investing in scaling up nutrition interventions. It should be noted that these benefits are derived from a progressive, 5-year scale up plan, and therefore subsequent investments that maintain the target scale will increase the total annual benefits as new beneficiaries are reached.

Appendix 8: Scenario 5a Costs and Benefits by Intervention and by State

Interventions	Annual Public Investment (US$ million)	Annual Benefits		
		DALYs Saved	Lives Saved	Cases of Stunting Averted
Community programs for growth promotion	$34.9	2,897,931	8,974	1,859,167
Vitamin A supplementation	$3.3	112,190	1,485	303,844
Therapeutic zinc Supplementation with ORS	$21.6	100,216	4,278	n/a
Micronutrient powders	$17.5	383,927	n/a	n/a
Deworming	$15.1	57,125	n/a	n/a
Iron-folic acid supplementation	$10.2	232,146	321	12,033
Iron fortification of staple foods	$34.9	n/a	n/a	n/a
Salt Iodization	$1.9	n/a	n/a	n/a
Comp. Food for Prevention of MAM	$119.4	44,337	998	2,006,577
CMAM for Severe Malnutrition	$112.7	560,544	5,859	n/a
TOTAL (WHEN IMPLEMENTED SIMULTANEOUSLY)	**$371.3**	**4,388,415**	**96,463**	**1,434,988**
Capacity development for program delivery	$33.5			
M&E, operations research	$7.5			
Household contributions	($59.3)			

		Intervention Costs						
Region	State	CNPs for BCC (children U2)	Vitamin A Supp	Therapeutic Zn Supp	Multiple Micronutrient Powders (if comp food for prevention of MM provided)	Deworming	Iron Folic-Acid Supp	Salt Iodization
North-Central	FCT Abuja	$1,047,465	$37,539	$405,369	$423,092	$191,728	$150,521	$12,439
North-Central	Benue	$2,075,655	$207,545	$803,279	$867,541	$723,324	$34,798	$44,108
North-Central	Kogi	$1,612,850	$111,771	$624,173	$616,625	$289,539	$274,257	$44,757
North-Central	Kwara	$1,166,456	$37,184	$451,419	$456,038	$410,593	$279,366	$25,662
North-Central	Nasarawa	$916,637	$74,594	$354,739	$288,081	$193,594	$219,535	$27,270
North-Central	Niger	$1,996,771	$155,772	$772,750	$517,563	$302,231	$57,387	$126,545
North-Central	Plateau	$1,532,161	$112,246	$592,946	$498,075	$447,636	$348,605	$39,453
North Central Subtotal		**$10,347,995**	**$736,651**	**$4,004,674**	**$3,667,014**	**$2,558,645**	**$1,364,469**	**$320,233**
North-Eastern	Adamawa	$1,547,985	$98,693	$599,070	$449,720	$435,912	$285,472	$45,279
North-Eastern	Bauchi	$2,363,858	$254,148	$914,813	$239,979	$141,453	$413,285	$93,372
North-Eastern	Borno	$2,098,344	$277,535	$812,059	$605,078	$258,516	$487,477	$25,705
North-Eastern	Gombe	$1,173,821	$71,119	$454,269	$228,191	$400,790	$258,640	$59,571
North-Eastern	Taraba	$1,114,280	$110,976	$431,226	$306,873	$341,237	$266,870	$68,110
North-Eastern	Yobe	$1,181,485	$114,862	$457,235	$170,984	$262,422	$206,565	$29,389
North Eastern Subtotal		**$9,479,773**	**$927,333**	**$3,668,672**	**$2,000,826**	**$1,840,330**	**$1,918,308**	**$321,427**
North-Western	Jigawa	$2,124,819	$148,933	$822,305	$135,393	$320,117	$0	$112,350
North-Western	Kaduna	$2,984,442	$200,913	$1,154,979	-$244,963	$724,861	$157,250	$93,264
North-Western	Kano	$4,711,243	$504,659	$1,823,251	-$407,051	$1,111,100	$1,128,343	$159,593
North-Western	Katsina	$2,849,656	$158,549	$1,102,817	$123,105	$902,771	$252,522	$113,274
North-Western	Kebbi	$1,604,101	$100,365	$620,787	$190,567	$564,644	$384,182	$83,614
North-Western	Sokoto	$1,818,737	$257,118	$703,851	$241,601	$249,676	$34,847	$150,046
North-Western	Zamfara	$1,625,605	$187,328	$629,109	$228,235	$74,388	$105,120	$113,386
North Western Subtotal		**$17,718,604**	**$1,557,866**	**$6,857,100**	**$266,887**	**$3,947,556**	**$2,062,264**	**$825,526**
South-Eastern	Abia	$1,366,007	$52,471	$528,645	$566,510	$384,667	$235,554	$21,856
South-Eastern	Anambra	$2,029,547	$79,968	$785,435	$786,896	$700,113	$369,418	$19,534
South-Eastern	Ebonyi	$1,054,804	$67,250	$408,209	$428,335	$293,320	$217,258	$15,427
South-Eastern	Enugu	$1,602,426	$51,082	$620,139	$742,436	$507,649	$341,565	$25,238
South-Eastern	Imo	$1,962,237	$81,590	$759,386	$813,779	$669,986	$460,557	$20,603
South Eastern Subtotal		**$8,015,021**	**$332,361**	**$3,101,813**	**$3,337,956**	**$2,555,735**	**$1,624,352**	**$102,659**
South-South	Akwa-Ibom	$1,981,586	$56,107	$766,874	$746,899	$488,263	$199,328	$15,853
South-South	Bayelsa	$832,288	$46,307	$322,095	$346,964	$284,176	$199,333	$21,848
South-South	Cross-River	$1,411,595	$69,315	$546,287	$536,632	$0	$202,846	$19,409
South-South	Delta	$2,043,766	$154,582	$790,938	$763,715	$625,883	$440,534	$42,919
South-South	Edo	$1,551,258	$85,080	$600,337	$710,352	$507,820	$352,950	$21,330
South-South	Rivers	$2,621,115	$89,265	$1,014,371	$1,092,690	$885,727	$514,761	$25,884
South South Subtotal		**$10,441,607**	**$500,656**	**$4,040,902**	**$4,197,252**	**$2,791,869**	**$1,909,751**	**$147,242**
South-Western	Ekiti	$1,180,907	$26,655	$457,011	$505,050	$307,603	$135,757	$18,747
South-Western	Lagos	$4,494,827	$200,245	$1,739,498	$1,800,987	$1,423,961	$1,022,685	$61,804
South-Western	Ogun	$1,871,757	$120,077	$724,370	$640,815	$632,504	$443,803	$58,258
South-Western	Ondo	$1,692,810	$61,672	$655,118	$669,134	$494,571	$381,102	$11,426
South-Western	Osun	$1,707,232	$29,747	$660,699	$709,867	$492,776	$408,882	$22,834
South-Western	Oyo	$2,826,435	$146,624	$1,093,830	$985,974	$507,402	$453,544	$47,696
South Western Subtotal		**$13,773,968**	**$585,020**	**$5,330,526**	**$5,311,827**	**$3,858,817**	**$2,845,774**	**$220,766**
GRAND TOTAL		**$69,776,969**	**$4,639,887**	**$27,003,687**	**$18,781,763**	**$17,552,952**	**$11,724,919**	**$1,937,853**

		Intervention Costs						
Region	State	CMAM for SAM	Comp Food for Prevention of Moderate Malnutrition	TOTAL COST OF ALL INTERVENTIONS Comp Food for Prevention of MM and BCC for U2s	Cost of capacity development (9% of total cost of interventions)	Cost of M&E and Operations Research (2% of total cost of interventions divided into three steps)	GRAND TOTAL including CD and M&E	Household Contributions
North-Central	FCT Abuja	$3,016,700	$2,023,263	$7,831,848	**$704,866**	**$156,637**	**$8,693,351**	**$1,625,477**
North-Central	Benue	$1,673,808	$3,595,637	$11,063,522	**$995,717**	**$221,270**	**$12,280,510**	**$1,463,910**
North-Central	Kogi	$2,601,205	$3,609,849	$10,591,450	**$953,231**	**$211,829**	**$11,756,510**	**$1,655,316**
North-Central	Kwara	$940,630	$4,935,369	$9,285,945	**$835,735**	**$185,719**	**$10,307,399**	**$1,674,083**
North-Central	Nasarawa	$1,847,941	$2,936,878	$7,317,587	**$658,583**	**$146,352**	**$8,122,522**	**$801,478**
North-Central	Niger	$9,201,120	$15,917,459	$30,045,985	**$2,704,139**	**$600,920**	**$33,351,043**	**$8,604,377**
North-Central	Plateau	$3,883,108	$4,674,116	$12,894,426	**$1,160,498**	**$257,889**	**$14,312,813**	**$1,649,852**
North Central Subtotal		**$23,164,512**	**$37,692,571**	**$89,030,762**			**$98,824,146**	
North-Eastern	Adamawa	$4,026,667	$5,481,769	$13,744,560	**$1,237,010**	**$274,891**	**$15,256,462**	**$1,498,669**
North-Eastern	Bauchi	$10,882,921	$14,712,607	$31,198,366	**$2,807,853**	**$623,967**	**$34,630,187**	**$2,596,462**
North-Eastern	Borno	$19,402,638	$14,990,108	$40,006,632	**$3,600,597**	**$800,133**	**$44,407,362**	**$6,568,005**
North-Eastern	Gombe	$3,057,786	$11,516,596	$17,807,695	**$1,602,693**	**$356,154**	**$19,766,541**	**$2,279,994**
North-Eastern	Taraba	$1,540,381	$4,185,070	$8,922,164	**$802,995**	**$178,443**	**$9,903,602**	**$1,622,150**
North-Eastern	Yobe	$8,027,055	$13,258,103	$24,298,842	**$2,186,896**	**$485,977**	**$26,971,715**	**$2,571,007**
North Eastern Subtotal		**$46,937,449**	**$64,144,253**	**$135,978,260**			**$150,935,868**	
North-Western	Jigawa	$7,369,811	$28,729,807	$40,825,945	**$3,674,335**	**$816,519**	**$45,316,799**	**$3,454,595**
North-Western	Kaduna	$47,445,472	$52,705,731	$106,714,171	**$9,604,275**	**$2,134,283**	**$118,452,729**	**$19,456,651**
North-Western	Kano	$63,844,086	$41,889,548	$117,120,393	**$10,540,835**	**$2,342,408**	**$130,003,636**	**$13,023,323**
North-Western	Katsina	$17,900,471	$40,190,410	$65,018,404	**$5,851,656**	**$1,300,368**	**$72,170,428**	**$9,374,762**
North-Western	Kebbi	$7,421,245	$19,180,878	$30,952,433	**$2,785,719**	**$619,049**	**$34,357,200**	**$5,570,705**
North-Western	Sokoto	$6,065,982	$21,022,453	$31,453,681	**$2,830,831**	**$629,074**	**$34,913,585**	**$3,102,962**
North-Western	Zamfara	$4,622,957	$18,441,185	$26,840,115	**$2,415,610**	**$536,802**	**$29,792,527**	**$6,368,573**
North Western Subtotal		**$154,670,023**	**$222,160,012**	**$418,925,140**				
South-Eastern	Abia	$3,776,735	$4,858,284	$12,473,733	**$1,122,636**	**$249,475**	**$13,845,843**	**$3,052,568**
South-Eastern	Anambra	$10,754,976	$4,386,927	$20,927,588	**$1,883,483**	**$418,552**	**$23,229,623**	**$2,874,365**
South-Eastern	Ebonyi	$1,944,214	$2,005,097	$6,961,315	**$626,518**	**$139,226**	**$7,727,060**	**$508,941**
South-Eastern	Enugu	$1,845,995	$1,744,129	$8,281,873	**$745,369**	**$165,637**	**$9,192,879**	**$1,305,328**
South-Eastern	Imo	$3,955,870	$3,489,407	$13,194,533	**$1,187,508**	**$263,891**	**$14,645,932**	**$3,214,774**
South Eastern Subtotal		**$22,277,790**	**$16,483,844**	**$61,839,042**			**$68,641,336**	
South-South	Akwa-Ibom	$3,081,762	$4,587,034	$12,914,498	**$1,162,305**	**$258,290**	**$14,335,092**	**$3,106,884**
South-South	Bayelsa	$623,217	$1,454,523	$4,546,895	**$409,221**	**$90,938**	**$5,047,053**	**$1,254,108**
South-South	Cross-River	$2,520,544	$3,202,683	$9,215,108	**$829,360**	**$184,302**	**$10,228,770**	**$1,767,950**
South-South	Delta	$8,475,908	$9,649,929	$24,010,058	**$2,160,905**	**$480,201**	**$26,651,164**	**$5,303,042**
South-South	Edo	$3,216,688	$1,807,339	$9,628,782	**$866,590**	**$192,576**	**$10,687,948**	**$1,189,959**
South-South	Rivers	$4,227,334	$4,580,712	$16,362,416	**$1,472,617**	**$327,248**	**$18,162,282**	**$3,701,197**
South South Subtotal		**$22,145,453**	**$25,282,221**	**$76,677,756**			**$85,112,310**	
South-Western	Ekiti	$1,564,465	$1,882,743	$6,669,390	**$600,245**	**$133,388**	**$7,403,023**	**$1,321,674**
South-Western	Lagos	$9,838,277	$17,777,670	$40,607,368	**$3,654,663**	**$812,147**	**$45,074,178**	**$13,067,061**
South-Western	Ogun	$4,959,408	$5,251,010	$15,637,882	**$1,407,409**	**$312,758**	**$17,358,049**	**$2,919,648**
South-Western	Ondo	$1,657,600	$3,477,405	$9,947,244	**$895,252**	**$198,945**	**$11,041,441**	**$2,116,849**
South-Western	Osun	$3,245,107	$3,009,765	$11,140,526	**$1,002,647**	**$222,811**	**$12,365,984**	**$2,872,552**
South-Western	Oyo	$3,093,250	$15,338,554	$25,906,527	**$2,331,587**	**$518,131**	**$28,756,245**	**$8,750,437**
South Western Subtotal		**$24,358,108**	**$46,737,146**	**$109,908,937**			**$121,998,920**	
GRAND TOTAL		**$293,553,335**	**$412,500,048**	**$892,359,897**	**$80,312,391**	**$17,847,198**	**$990,519,485**	**$153,289,686**

			BENEFITS		
Region	**State**	**Annual Public Investment Required**	**DALYs Saved**	**Lives Saved**	**Cases of Stunting Averted**
North-Central	FCT Abuja	$ 4,054,345.00	61,134	1,042	36,843
North-Central	Benue	$ 6,225,220.00	139,869	2,536	94,717
North-Central	Kogi	$ 5,414,105.00	95,843	1,843	71,360
North-Central	Kwara	$ 3,774,728.00	72,240	1,704	78,638
North-Central	Nasarawa	$ 3,767,046.00	52,536	1,099	44,765
North-Central	Niger	$ 11,100,147.00	147,505	3,431	157,508
North-Central	Plateau	$ 7,911,189.00	86,306	1,755	69,495
North Central Subtotal		**$ 42,246,780.00**	**655,433**	**13,409**	**553,327**
North-Eastern	Adamawa	$ 8,065,568.00	86,554	1,702	64,804
North-Eastern	Bauchi	$ 13,663,113.00	142,287	3,262	138,613
North-Eastern	Borno	$ 13,285,009.00	141,535	3,924	190,676
North-Eastern	Gombe	$ 5,062,981.00	72,219	1,807	83,725
North-Eastern	Taraba	$ 4,326,340.00	66,854	1,519	65,693
North-Eastern	Yobe	$ 9,599,948.00	76,926	2,044	96,610
North Eastern Subtotal		**$ 54,002,959.00**	**586,374**	**14,258**	**640,122**
North-Western	Jigawa	$ 15,211,657.00	166,531	4,260	206,699
North-Western	Kaduna	$ 33,857,310.00	200,701	4,195	176,909
North-Western	Kano	$ 46,356,488.00	272,406	6,616	289,423
North-Western	Katsina	$ 18,534,774.00	197,333	4,921	231,504
North-Western	Kebbi	$ 8,615,081.00	103,333	2,855	140,007
North-Western	Sokoto	$ 10,572,566.00	146,591	3,771	181,721
North-Western	Zamfara	$ 8,943,700.00	123,773	3,359	164,301
North Western Subtotal		**$ 142,091,577.00**	**1,210,668**	**29,977**	**1,390,564**
South-Eastern	Abia	$ 5,472,679.00	85,312	1,747	73,927
South-Eastern	Anambra	$ 10,265,662.00	119,018	2,098	77,712
South-Eastern	Ebonyi	$ 3,971,693.00	62,020	1,265	51,427
South-Eastern	Enugu	$ 4,702,636.00	98,171	2,037	87,469
South-Eastern	Imo	$ 6,347,482.00	106,873	1,942	71,273
South Eastern Subtotal		**$ 30,760,152.00**	**471,393**	**9,089**	**361,808**
South-South	Akwa-Ibom	$ 6,960,856.00	119,005	2,007	70,895
South-South	Bayelsa	$ 2,258,387.00	45,746	865	32,638
South-South	Cross-River	$ 4,333,959.00	85,324	1,583	60,679
South-South	Delta	$ 9,358,653.00	125,650	2,760	119,431
South-South	Edo	$ 5,423,803.00	89,706	1,734	68,490
South-South	Rivers	$ 9,048,647.00	162,807	3,355	143,554
South South Subtotal		**$ 37,384,305.00**	**628,238**	**12,304**	**495,688**
South-Western	Ekiti	$ 3,832,535.00	70,221	1,145	39,422
South-Western	Lagos	$ 14,973,298.00	272,248	5,778	248,925
South-Western	Ogun	$ 7,592,819.00	116,066	2,625	117,158
South-Western	Ondo	$ 5,057,529.00	104,722	2,286	101,254
South-Western	Osun	$ 5,240,210.00	92,287	1,652	60,984
South-Western	Oyo	$ 9,792,834.00	180,754	3,940	172,359
South Western Subtotal		**$ 46,489,225.00**	**836,298**	**17,426**	**740,100**
GRAND TOTAL		**$ 352,974,998.00**	**4,388,404**	**96,463**	**4,181,609**

Appendix 9: Sensitivity Analysis

Full National coverage

Assumption Changed	Effect on Total Cost
Iron fortification of staple foods costs double	Increase from $837.2 million to $862.9 million
All micronutrient and deworming unit cost doubles	Increase from $837.2 million to $944.9 million
Community nutrition program unit cost doubles	Increase from $837.2 million to $914.7 million
Complementary food unit cost doubles	Increase from $837.2 million to $1,163.5 million
CMAM for SAM unit cost doubles	Increase from $837.2 million to $1,163.1 million
Iron fortification of staple foods costs reduced by 50%	Decrease from $837.2 million to $824.4 million
All micronutrient and deworming unit cost reduced by 50%	Decrease from $837.2 million to $783.4 million
Community nutrition program unit cost reduced by 50%	Decrease from $837.2 million to $798.5 million
Complementary food unit cost reduced by 50%	Decrease from $837.2 million to $674.1 million
CMAM for SAM unit cost reduced by 50%	Decrease from $837.2 million to $674.3 million

Scenario 5a

Assumption Changed	Effect on Total Cost
Iron fortification of staple foods costs double	Increase from $352.98 million to $391.7 million
All micronutrient and deworming unit cost doubles	Increase from $352.98 million to $447.8 million
Community nutrition program unit cost doubles	Increase from $352.98 million to $378.6 million
Complementary food unit cost doubles	Increase from $352.98 million to $447.4 million
CMAM for SAM unit cost doubles	Increase from $352.98 million to $478.1 million
Iron fortification of staple foods costs reduced by 50%	Decrease from $352.98 million to $340.1 million
All micronutrient and deworming unit cost reduced by 50%	Decrease from $352.98 million to $305.6 million
Community nutrition program unit cost reduced by 50%	Decrease from $352.98 million to $333.6 million

Complementary food unit cost reduced by 50%	Decrease from $352.98 million to $305.8 million
CMAM for SAM unit cost reduced by 50%	Decrease from $352.98 million to $290.4 million

REFERENCES

Abt Associates. 2014. *Country Assessment for Aflatoxin Contamination and Control in Nigeria*. January 8. Bethesda, MD: Abt Associates.

Arimond M, C. Hawkes, M.T. Ruel et al. 2011. "Agricultural interventions and nutrition: Lessons from the past and new evidence". In *Combating Micronutrient Deficiencies: Food-based Approaches*. Rome: FAO.

Asare-Marfo, D,, E. Birol, C. Gonzalez, M. Moursi, S. Perez, J. Schwarz and M. Zeller. 2013. "Prioritizing Countries for Biofortification Interventions Using Country-Level Data." HarvestPlus Working Paper No. 11(October 2013). Washington, DC: HarvestPlus.

Awasthi, S. et al. 2013. "Population deworming every 6 months with albendazole in 1 million pre-school children in north India: DEVTA, a cluster-randomized trial." *Lancet*. 381(9876):1478-86.

Baird, S., J.H. Hicks, M. Kremer and E. Miguel. 2011. *Worms at work: long run impacts of child health gains.* Working paper. Harvard University

Bandyopadhyay, R. (IITA plant pathologist). 2013. Personal communication (Nigeria).

Bandyopadhyay, R. and J. Cotty. 2013. "Biological Controls for Aflatoxin Reduction." in Unnevehr, L. and D. Grace, eds. "Aflatoxins: Finding Solutions for Improved Food Safety." *2020 Focus Brief #20 (16)*. Washington, DC: International Food Policy Research Institute.

Behrman, J.R., M.C. Calderon, S.H. Preston, J. Hoddinott, R. Martorell and A.D. Stein. 2009. "Nutritional supplementation in girls influences the growth of their children: Prospective study in Guatemala." *American Journal of Clinical Nutrition* 90(1):1372-9.

Bhutta, Z., T. Ahmed, R. Black, S. Cousens, K. Dewey, E. Giugliani, B. Haider, B. Kirkwood, S. Morris, H. Sachdev and M. Shekar. 2008. "What works? Interventions for maternal and child undernutrition and survival." *The Lancet* 371:417-440.

Bhutta Z.A., et al., 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*; Maternal and Child Nutrition series.

Birol et al. 2014. *Cost-effectiveness of biofortification revisited*. Washington, DC: HarvestPlus, Preliminary results as cited in HarvestPlus Biofortification Progress Brief #25. Washington, DC:HarvestPlus.
http://www.harvestplus.org/sites/default/files/Biofortification_Progress_Briefs_August2014_WEB_0.pdf

Black R.E., et al., for the Maternal and Child Undernutrition Study Group. 2008. "Maternal and child undernutrition: global and regional exposures and health consequences." *Lancet*; 371: 243-60

Black R.E., et al., for the Maternal and Child Under nutrition Study Group. 2013. "Maternal and child undernutrition and overweight in low-income and middle-income countries." *Lancet*; 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

Bloom D., J. Finlay, S. Humair et al. 2010. "Prospects for economic growth in Nigeria: A demographic perspective." Paper presented at the IUSSP Seminar on Demographics and Macroeconomic Performance held at Novotel, Gare de Lyon, Paris, France 4-5 June 2010.

Bolt, E. and S. Cairncross. 2004. "Sustainability of Hygiene Behaviour and the Effectiveness of Change Interventions: Lessons learned on research methodologies and research implementation from a multi-country research study." IRC International Water and Sanitation Centre, Delft, the Netherlands.

Caulfield, L.E., M. de Onis, M. Blossner, and R.E. Black. 2004. "Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles." *American Journal of Clinical Nutrition*. 80(1): 193-198.

DCP2 (Disease Control Priorities Project). 2008. Deworming Children Brings Huge Health and Development Gains in Low-Income Countries. Seattle, WA: University of Washington.

Ejemot, R, et al. 2008. "Hand-washing for Preventing Diarrhoea," *Cochrane Database of Systematic Reviews.* Issue 1.

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

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.

Fiedler, J. 2010. *The Cost of Micronutrient Interventions*. Washington DC: HarvestPlus.

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

Goodman C., P. Coleman and A. Mills. 2000. *Economic analysis of malaria control in Sub-Saharan Africa*. Geneva: Global Forum for Health Research.

Government of Nigeria. 2013. *National Strategic Plan of Action for Nutrition (2014-2018)*. Abuja, Nigeria.

Guyatt, H.L. 2003 "The Cost of delivering and sustaining a control programme for schistosomiasis and soil-transmitted helmithiasis." *Acta Tropica* 86:267-74.

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., 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.

Hoddinott, J. M. Rosegrant, M. Torero. 2012. "Investments to reduce hunger and undernutrition." Challenge Paper prepared for the 2012 Copenhagen Consensus.

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(Suppl. 2):69-82.

Horton S. 1999. "Opportunities for Investment in nutrition in low-income Asia.' *Asia Development Review*, 17:246-73.

Horton S. and J. Ross. 2003. "The economics of iron deficiency." *Food Policy*. 28(1)51-75.

*Horton S. and R. Steckel. 2013. "*Global economic losses attributable to malnutrition 1900–2000 and projections to 2050." *In The Economics of Human Challenges, ed B. Lomborg Cambridge, U.K.: Cambridge University Press.*

Hotez, P. P.J. Brindley, J.M. Bethony et al. 2008. "Helminth infections: the great neglected tropical disease." *The Journal of Clinical Investigation* 118 (4): 1312

Hotz C, Loechl C, De Brauw A, et al. 2012a. « A large scale intervention to introduce orange sweet potato in Mozambique increases vitamin A intakes among child and women*." British Journal of Nutrition*. 108: 163-76.

Hotz C, Loechl C, Lubowa A, et al. 2012b. « Introduction of B carotene-rich orange sweet potato in rural Uganda resulted in creased vitamin A intakes among children and women and improved vitamin A status among children." *Journal of Nutrition*. 142: 1871-80

J-PAL (Abdul Latif Jameel Poverty Action Lab). 2012. *Deworming: A Best Buy For Development*. J-PAL Policy Bulletin. March, 2012. Boston, MA: Massachusetts Institute of Technology.

Khlangwiset, P. 2011. “Reducing the Risks of Aflatoxin Through Public Health Interventions.” Doctoral dissertation. University of Pittsburg.

Khlangwiset, P and Wu F. 2011. “Cost and efficacy of public health interventions to reduce aflatoxin-induced human diseases.” Food Addit Contam Part A Chem Anal Control Expo Risk Assess. July; 27 (7): 998-1014

Kuniholm, M. H., O.A. Lesi, M. Mendy, et al. 2008. “Aflatoxin exposure and viral hepatitis in the etiology of liver cirrhosis in the Gambia, West Africa.” *Environ Health Perspect,* 116(11), 1553-1557.

Liu Y., and F. Wu. 2010. “Global Burden of Aflatoxin-Induced Hepatocellular Carcinoma: A Risk Assessment.” *Environmental Health Perspectives* 118:818-824.

Lorntz B. et al. 2006. “Early Childhood Diarrhea Predicts Impaired School Performance.” *The Pediatric Infectious Disease Journal*, vol. 25, no. 6, June 2006, pp. 513–520.

Masset E, L. Haddad, A. Cornelius and J. Isaza-Castro. 2011, “A systematic review of agricultural interventions that aim to improve nutritional status of children.” London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Maziya-Dixon B.B. et al. 2006. “Vitamin A deficiency is prevalence in children less than 5 years-old.” *Journal of Nutrition.* Aug 136 (8): 2255-61

Menakshi J. et.al. 2010. “How cost-effective is biofortification in combating micronutrient malnutrition? An ex-ante assessment.” *World Development* 38(1): 64-75.

Miguel, E and M. Kremer. 2004. “Worms: identifying impacts on education and health in the presence of treatment externalities.” *Econometrica* 72(1): 159-217

Murray C.J. et al. 2013. “Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study.” *Lancet* 380 (9859): 2197–223.

Nigeria Multiple Indicators Cluster Survey (MICS). 2011. National Bureau of Statistics (NBS).

Nigeria Demographic and Health Survey (NDHS). 2008. http://microdata.worldbank.org/index.php/catalog/1459

Results for Development (R4D). 2014. *Saving One Million Lives Fiscal Space Analysis*. (Preliminary Results March 2014).

Ruel M., et al., for the Maternal and Child Undernutrition Study Group. 2013: Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? *Lancet*; Maternal and Child Nutrition series.

Seddoh, A. et al. 2013. "Towards Investment Case for Neglected Tropical Diseases." Working paper for Lancet Commission on Investing in Health. *Draft*

Shephard GS, P. Khlangsiwet and Wu F. 2011. "Aflotoxin and growth impairment: A review." *Critical Review of Toxicology.* October. 41(9):740-55.

Spears, D. 2013. "How much international variation in child height can sanitation explain?" World Bank Policy Research Working Paper 6351. Washington, DC: World Bank

Stenberg K. et al. 2013. "Advancing social and economic development by investing in women's and children's health: a new Global Investment Framework." *The Lancet Health Policy*, Published Online November 19, 2013 http://dx.doi.org/10.1016/50140-6736(13)62231-x. p.8.

Strauss, J. and D. Thomas. 1998. "Heath, Nutrition and Economic Development." *Journal of Economic Literature*. 36(1):766-817.

UNICEF. 2012. *Water, sanitation and hygiene (WASH) in schools.* New York: UNICEF.

Unnevehr, L. and D. Grace, eds. 2013. "Aflatoxins: Finding Solutions for Improved Food Safety." *2020 Focus Brief #20*. Washington, DC: International Food Policy Research Institute.

World Bank. 2006. *Repositioning nutrition as central to development: A strategy for large-scale action.* Washington, DC: World Bank.

World Bank. 2010a. *Scaling Up Nutrition. What Will It Cost?* Washington, DC: The World Bank.

World Bank. 2010b. *Nigeria: Country Nutrition Profiles*. Washington, DC: World Bank.

World Bank. 2012. *Nigeria: economic impacts of poor sanitation*. Water and Sanitation Program. Washington, DC: World Bank.

World Bank. 2013a. *Where has all the growth gone? A poverty update for Nigeria*. Washington, DC: World Bank

World Bank. 2013b. *Improving Nutrition Through Multisectoral Approaches*. Washington, DC: World Bank.

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

WHO. 2014. Cost-effectiveness and strategic planning: threshold values for intervention cost-effectiveness by region. Geneva, Switzerland: WHO-CHOICE (Choosing Interventions that are cost-effective) Program. http://www.who.int/choice/costs/CER_levels/en/

This paper estimates country-specific costs and benefits of scaling up key nutrition investments in Nigeria. Building on the methodology established in the global report—Scaling Up Nutrition: What will it cost?—the authors estimate the costs and benefits of a nationwide scale up of ten effective nutrition-specific interventions. This would require an annual public investment of $837 million and would yield enormous benefits: over 8.7 million DALYs and 183,000 lives would be saved annually, while more than 3 million cases of stunting among children under five would be averted. As it is unlikely that the Government of Nigeria or its partners will find the $837 million necessary to reach full national coverage, the authors consider five potential scale-up scenarios based on considerations of burden of stunting, potential for impact, resource requirements and capacity for implementation in Nigeria. Using cost-benefit analyses, they propose scale-up scenarios that represent a compromise between the need to move to full coverage and the constraints imposed by limited resources and capacities. This analysis takes an innovative approach to nutrition costing by not only estimating the costs and benefits of nutrition-specific interventions, but also exploring costs for a selected number of nutrition-sensitive interventions implemented outside of the health sector. The authors identify and cost four candidate nutrition-sensitive interventions with impact potential in Nigeria, including biofortification of cassava, aflatoxin control, school-based deworming, and school-based promotion of good hygiene. Overall, these findings point to a candidate list of nutrition-sensitive approaches that represent a cost-effective approach to reducing child malnutrition in Nigeria. Moving forward, these results are intended to help guide decision makers as they plan future efforts to scale-up action against malnutrition in Nigeria and develop nutrition financing plans that bring to bear resources from the health, social protection, education, and agriculture sectors.
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