THE CO$T OF HUNGER IN AFRICA

Social and Economic Impact of Child Undernutrition in Egypt, Ethiopia, Swaziland and Uganda

Implications for the Social and Economic Transformation of Africa

African Union

NEPAD
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The depiction and use of boundaries, geographic names and related data shown on maps and included in lists, tables, documents, and databases on this report are not warranted to be error free nor do they necessarily imply official endorsement or acceptance by the United Nations.

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Foreword

The time for Africa is now. As the continent experiences its most important economic expansion period in the last 30 years, it faces the challenge and the opportunity to reorient the drivers of growth towards the structural transformation required for inclusive economic and social development.

The current economic growth rate on the continent is not yet sufficient to allow for change towards equity and human development in most nations. As such, Africa's decision-makers must continue to shift gears towards policies that focus on both short-term and medium-term results to reduce the structural barriers that constrain its social and economic development.

From an economic perspective, there is an important opportunity to shift from a commodity-driven growth strategy to a more diversified production base through industrialization of commodities and further integration of products into national and regional value chains. This shift can be a key element in providing young people with decent labour opportunities in economic activities that will also help Africa move toward a more industrialized and urbanized society that builds on the continent's comparative advantages.

The Cost of Hunger in Africa study provides policy makers with information on how economic growth is affected by undernutrition. The study also provides a picture of what the continent stands to lose if undernutrition is not addressed.

A critical element of the social transformation agenda must focus on ensuring human capital growth through improved health, education and labour productivity. The gap in access to health services between the rural and urban population must be reduced to provide the most vulnerable populations with proper health care, and reduce child and maternal mortalities. The continent cannot afford the losses in human capital associated with poor health and its consequences to society.

Moreover, as urbanization continues to grow in the coming years, economies are likely to shift from ones based on manual labour to ones based on skilled labour. Africa, having the world's highest percentage of youth, with over 40 percent of the population in sub-Saharan Africa under the age of 15, stands to gain important human capital by reducing drop-out rates in schools and increasing educational levels. The continent must work to reduce the barriers that affect human development in order to maximize the benefits of this transformation.

The Cost of Hunger in Africa study demonstrates that child nutrition can be a determinant factor in achieving Africa's transformation agenda.

The African Union Commission and its NEPAD Planning and Coordinating Agency have partnered with the World Food Programme and the United Nations Economic Commission for Africa to analyse the crippling effects of child undernutrition. This study has been implemented in an effort to understand the implications of child undernutrition on the continent's economic and social transformation agenda.

Children and women in Africa are faced with a series of cultural, economic and social challenges throughout their lives. This study illustrates the additional barriers faced by undernourished children in health, school performance and labour markets. These additional disadvantages limit their ability to contribute to social and economic development on the continent.

The results of the study also provide a compelling case to support the concept that human capital gain, particularly in pre-school nutrition, will help consolidate the economic expansion of Africa. The cost borne by Africa's economies as a consequence of food and nutritional insecurity in the past and present has hindered the continent's full economic and social potential. The study's conclusions also call for actions directed at reducing the current levels of child stunting and ensuring that social protection programmes address the physical and cognitive consequences that affect the school-age and working-age populations that are currently at the centre of Africa's development.

There is a growing consensus and understanding of the consequences of child undernutrition at the individual and community levels, specifically the losses in individual physical and cognitive capacity. Nevertheless, there is less understanding of the aggregate effect to the economy and society as a whole. The Cost of Hunger in Africa study provides policy makers with information on how economic growth is affected by undernutrition. The study also provides a picture of what the continent stands to lose if undernutrition is not addressed.

As conclusions are drawn from this study, it must be made clear that reducing stunting alone will not be sufficient to ignite inclusive growth on the continent. However, a reduction of stunting would be an indication that social policies are taking a significant step forward, as well as being evidence that social protection mechanisms effectively reach the most vulnerable. It is clear that alongside a reduction in the number of undernourished children, increased investments in education, innovation and technology must be made to complete the gains in human capital, and opportunities in the labour market must be created, emphasizing the role and empowerment of women as driver for positive change. Nevertheless, a healthy childhood is an important, and sometimes vital, precondition to this development, and as such, addressing stunting would be a first and crucial investment to build the foundation of the economic and social transformation of Africa.

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African Union Commission
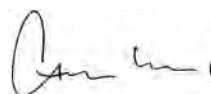
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Acknowledgements

Acronyms

ADS	Acute Diarrhoeal Syndrome
AfDB	African Development Bank
ARNS	African Regional Nutrition Strategy
ARI	Acute Respiratory Infection
ATFFND	African Task Force on Food and Nutrition Development
AU	African Union
AUC	Africa Union Commission
CAADP	Comprehensive Africa Agriculture Development Programme
CAPMAS	Central Agency for Public Mobilization and Statistics
CEN-SAD	Community of Sahel-Saharan States
COHA	Cost of Hunger in Africa
COMESA	Common Market for Eastern and Southern Africa
CSA	Central Statistics Agency
DHS	Demographic and Health Survey
ECA	United Nations Economic Commission for Africa
ECCAS	Economic Community of Central African States
ECLAC	Economic Commission for Latin America and the Caribbean
ECOWAS	Economic Community of West African States
EGP	Egyptian Pound
EHICES	Ethiopia Household Income, Consumption and Expenditure Survey
EHNRI	Ethiopian Health and Nutrition Research Institute
EMIS	Education Management Information Systems Unit
ETB	Ethiopian Birr
FAFS	Framework for African Food Security
FAO	Food and Agriculture Organization
FMoH	Federal Ministry of Health
GDP	Gross Domestic Product
GNI	Gross National Income
HIECS	Household Income, Expenditure and Consumption Survey
ICU	Intensive Care Unit
IPD	Inpatient Department
IDSC	Information and Decision Support Center
IGAD	Intergovernmental Authority for Development
ILO	International Labour Organization
IMAM	Integrated Management of Acute Malnutrition
IMCI	Integrated Management of Childhood Illness
ISIC	International Standard Industrial Classification
IUGR	Intra Uterine Growth Retardation
LAC	Latin America and the Caribbean
LBW	Low Birth Weight
LFS	Labour Force Survey

MDGs	Millennium Development Goals
MENA	Middle East and North Africa
MICS	Multiple Indicator Cluster Survey
MoE	Ministry of Education
MoFED	Ministry of Finance and Economic Development
MoH	Ministry of Health
NCHS	National Center for Health Statistics
NEPAD	The New Partnership for Africa's Development
NIT	National Implementation Team
NPCA	NEPAD Planning and Coordinating Agency
NPA	National Planning Authority
OPD	Outpatient Department
OPM	Office of the Prime Minister
OR	Odds Ratio
REACH	Renewed Efforts Against Child Hunger
SADC	Southern African Development Community
SAM	Severe Acute Malnutrition
SCU	Special Care Unit
SHIES	Swaziland Household Income and Expenditure Survey
SNNC	Swaziland National Nutrition Council
SUN	Scaling Up Nutrition Initiative
SZL	Swazi Lilangeni
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Health Survey
UNHS	Uganda National Household Survey
UGX	Ugandan Shillings
UMA	Union du Maghreb Arabe
USD	United States Dollar
UNECA	United Nations Economic Commission for Africa
WAP	Working Age Population
WFP	World Food Programme

Guidance for Reading this Report

The authors wish to provide initial clarification on several points found in this report:

1. This report is the first instalment of a larger project, the Cost of Hunger in Africa. This report highlights the results of four countries that have completed the study process. Thus, all results only reflect the results of these four countries. These countries were selected to be diverse, and represent various characteristics of the continent; however, these countries cannot yet be identified as continentally representative.

2. The report refers to "children" to highlight data on health, nutrition and additional demographic information. In all cases, when the word "child" or "children" is used, the authors are referring to children under 5 years, unless explicitly stated otherwise.

3. As highlighted in the methodology section of the report, the study is based on the concept of differential probabilities (see Annex 2). Given this approach, the authors refer to various affects as being "associated with undernutrition." This terminology highlights the greater risk of various negative consequences for people who were stunted as children, without attributing definitive causality.

4. Data in this report is collected at national level, from nationally representative data. Data sources and assumptions are catalogued in Annex 5: Assumptions by Country.

EXECUTIVE SUMMARY

Overview of the Cost of Hunger in Africa

1. Cost of Hunger in Africa Executive Summary

1.1 Introduction

The Cost of Hunger in Africa (COHA) Study is a project led by the African Union Commission (AUC) and the New Partnership of Africa's Development (NEPAD) Planning and Coordinating Agency and supported by the UN Economic Commission for Africa (ECA) and the UN World Food Programme (WFP). COHA is a multi-country study aimed at estimating the economic and social impacts of child undernutrition in Africa.

This continent-wide initiative is being led by the Department of Social Affairs, AUC, within the framework of the Revised African Regional Nutrition Strategy (2005-2015), the objectives of the African Task Force on Food and Nutrition Development (ATFFND) and the principles of the AU/NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) Pillar 3.

In March 2012, the COHA study was presented to African Ministers of Finance, Planning and Economic Development, who met in Addis Ababa, Ethiopia. The ministers issued Resolution 898 (Annex 1), confirming the importance of the study and recommending it continue beyond the initial stage.

The core implementers of the study are national teams organized in each participating country, drawn from relevant governmental institutions, such as the Ministry of Health, Ministry of Education, Ministry of Social Development, Ministry of Planning, Ministry of Finance, and the National Statistics Institution.

The COHA study is a watershed initiative that highlights a new understanding by African governments of child undernutrition as not only a health or social issue, but also as an economic issue. The initiative also highlights the African Union's strong leadership in addressing development issues, as well as the collaboration among governments and agencies within the continent.

The COHA study is being carried out in 12 countries, namely Botswana, Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Malawi, Mauritania, Rwanda, Swaziland and Uganda. The data in this document are the results collected from the COHA initiative in the four first-phase countries: Egypt, Ethiopia, Swaziland and Uganda.

1.2 Background

Africa has experienced a recent period of economic growth that has positioned the continent as a key area for global investment and trade. The pace of real gross domestic product (GDP) growth on the continent has doubled in the last decade, and six of the world's fastest growing economies are in Africa. All this has occurred despite some of the highest rates of child undernutrition in the world.

The vast and rising numbers of food insecure and undernourished people continue to pose very serious concerns in Africa. Over the past two years, global food price increases, followed by economic and

financial crises, have pushed more people into poverty and hunger. Globally, as many as 868 million people are affected by food insecurity, with Africa contributing to nearly one third of the world's hungry people.[1]

Child undernutrition is one of the most critical negative effects of hunger. When a child is undernourished before the age of five, his or her body and brain cannot develop at its potential, and they are at risk of cognitive delays. Seventeen countries on the continent have stunting rates above 40 percent, and 36 countries have rates above 30 percent.[2]

COHA also provides a useful opportunity to compare the nutritional situations of several countries across the continent. The countries were selected based on availability of data, geographic distribution, and socio-economic diversity. These differences allow stakeholders to consider the contextual factors that impact the economic burden of child undernutrition.

1.3 Brief Description of the Methodology

COHA is based on a model originally developed in Latin America by the Economic Commission for Latin America and the Caribbean (ECLAC). With support from ECLAC and the African Task Force for Food and Nutrition Security, the model has been adapted for use on the African continent.

The COHA model is used to estimate the additional cases of morbidities, mortalities, school repetitions, school dropouts and reduced physical capacity that can be directly associated to a person's undernutrition before the age of 5.

In order to estimate social impacts for a single year, the model focuses on the current population, identifies the proportion of that population that were undernourished before the age of 5, and then estimates the associated negative impacts experienced by the population in the current year.

Estimates on health, education and productivity are based on the concept of the relative (or differential) risk experienced by individuals who suffer from undernutrition.

Using these risk factors, alongside economic, demographic, nutritional, health and educational data provided by each country team, the model then estimates the associated economic losses incurred by the economy in health, education and potential productivity in a single year.

With the support of experts and representatives from the National Implementation Teams (NITs) of the

Effects of Child Undernourishment through Life	
0-5 years	Undernourished children are at higher risk of anaemia, diarrhoea, fever and respiratory infections. These additional cases of illness are costly to the health system and to families. Undernourished children are at a higher risk of dying.
6-18 years	Stunted children are at a higher risk of repeating grades in school and dropping out of school. Grade repetitions are costly to the education system and to families.
15-64 years	If a child has dropped out of school early and has entered the workforce, he or she may be less productive, particularly in the non-manual labour market. If engaged in manual labour, he or she is likely to have reduced physical capacity and will tend to be less productive. People who are absent from the workforce as a result of undernutrition-related child mortality represent lost economic productivity.

participating countries, a conceptual framework was adapted to the context of Africa. This framework establishes clear linkages between the direct consequences of undernutrition, taking into account the particular structures of the labour market on the continent, as well as the limitations in available data. The result allows the model to clearly define boundaries in the cost analysis, both from a public and individual perspectives, as well as to define a clear differentiation between direct costs and opportunity costs in the results.

The COHA model utilizes a two-dimensional analysis to estimate the costs arising from the consequences of child undernutrition in health, education and productivity. The incidental retrospective dimension analyses the history of child undernutrition in the country in order to estimate the current economic and social consequences. To complement this analysis, a prospective dimension is used to project and generate scenarios for analysis.

1.4 Social and Economic Impact of Child Undernutrition in Four Countries

According to the initial results generated by the COHA study, the equivalent losses shown in Table 1.1 are incurred by each studied country annually as a result of child undernutrition. These losses summarize costs to health, education and productivity, as discussed in more detail below.

**TABLE 1.1
SUMMARY OF COSTS OF CHILD UNDERNUTRITION**

Country	Losses in local currency	Losses in USD	Equivalent % of GDP
Egypt	EGP20.3 billion	3.7 billion	1.9%
Ethiopia	ETB55.5 billion	4.7 billion	16.5%
Swaziland	SZL783 million	92 million	3.1%
Uganda	UGX1.8 trillion	899 million	5.6%

Source: COHA Study.

1.5 Social and Economic Impact of Child Undernutrition on Health

When a child is undernourished, he or she will have an increased chance of experiencing specific health problems.[3] Research shows that undernourished children under five are more likely to experience

**TABLE 1.2
ECONOMIC IMPACT OF CHILD UNDERNUTRITION ON HEALTH**

Country	Underweight children	Annual additional morbidity episodes	Economic Cost		Proportion covered by the families
			National currency	USD (millions)	
Egypt	658,516	901,440	EGP1.1 billion	213	73%
Ethiopia	3.0 million	4.4 million	ETB1.8 billion	155	90%
Swaziland	9,645	25,446	SZL60.7 million	7	88%
Uganda	975,450	1.6 million	UGX525.8 billion	254	87%

Source: COHA Study.

cases of anaemia, acute diarrhoeal syndrome (ADS), acute respiratory infection (ARI) and fever. The treatment of undernutrition and related illnesses is a critical, recurrent cost for the health system. For example, treating a severely underweight child requires a comprehensive protocol that is often more costly than the monetary value and effort needed to prevent undernutrition, especially when other diseases are present in parallel. Table 1.2 summarizes the total costs incurred by each country as a result of additional morbidities.

Research shows that undernourished children under five have an increased risk of dying.[4] In this case, the costs associated with mortality are identified in losses to national productivity. If these children were able to reach adulthood, they could have contributed to the economy. Table 1.3 highlights the number of children who died from causes associated with undernutrition and the percent of child mortalities that can be attributed to undernutrition.

| | TABLE 1.3 | |
	CHILD MORTALITIES ASSOCIATED WITH UNDERNUTRITION	
	Number of mortalities associated with undernutrition (last 5 years)	**% total child mortalities associated with undernutrition**
Egypt	28,102	11%
Ethiopia	378,591	28%
Swaziland	1,351	8%
Uganda	110,220	15%

Source: COHA Study.

1.6 Social and Economic Impact of Child Undernutrition in Education

1.6.A Impact of Undernutrition on Repetition

There is no single cause for students to repeat grades and dropout of school; however, there is substantive research that shows that students who were stunted before the age of five will have reduced cognitive capacity and are more likely to underperform in school and to repeat grades.[5] Figure 1.1 illustrates the repetition rates for stunted children as compared to non-stunted children in each of the countries.

FIGURE 1.1
REPETITION RATES BY NUTRITIONAL STATUS
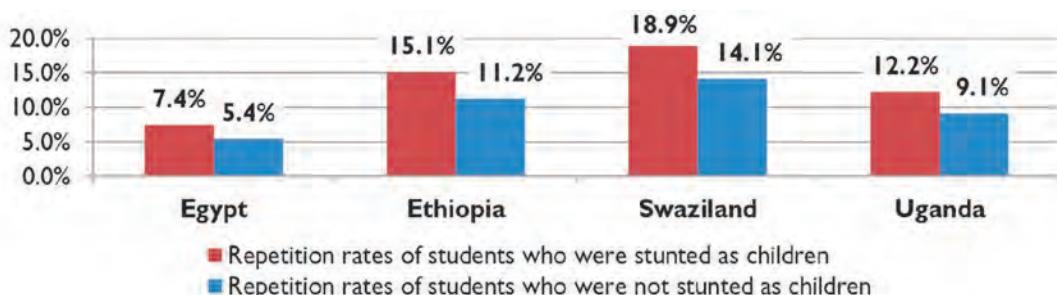
Egypt: 7.4% / 5.4%
Ethiopia: 15.1% / 11.2%
Swaziland: 18.9% / 14.1%
Uganda: 12.2% / 9.1%

■ Repetition rates of students who were stunted as children
■ Repetition rates of students who were not stunted as children

Source: COHA Study.

Repetitions are costly both to the family of the student and to the education system, as both need to invest resources for an additional year of schooling. Table 1.4 highlights the economic costs of additional repetitions associated with students' childhood undernutrition. A more detailed analysis shows that the cost of a repetition in secondary school is significantly higher than in primary school; however, the majority of repetitions occur during primary school years.

TABLE 1.4
ECONOMIC COSTS OF GRADE REPETITIONS ASSOCIATED WITH CHILD UNDERNUTRITION

| Country | Number of stunted children of school age | % of repetitions associated with stunting | Economic Cost | | Proportion covered by the education system |
			Local currency	USD	
Egypt	7.9 million	10%	EGP271 million	49 million	61%
Ethiopia	17.5 million	15.8%	ETB93 million*	8 million*	36%
Swaziland	168,228	10.1%	SZL6 million	0.7 million	70%
Uganda	5.8 million	7.3%	UGX20 billion	9.5 million	46%

Source: COHA Study.
*Only considers primary school

1.6.B Impact of Undernutrition on Retention

Students who are undernourished are also more likely to drop out of school than those who experience healthy childhoods.[6] The data from the first-phase countries indicates that the expected number of schooling years achieved by a student who was stunted is as much as 1.2 years lower than the expected schooling for a student who was never undernourished. The graph in Figure 1.2 illustrates these levels of expected schooling achievement. As shown, countries with low overall schooling achievement also illustrate a higher differential achievement between children who were stunted and those who were never undernourished.

FIGURE 1.2
EXPECTED SCHOOLING YEARS BY NUTRITIONAL STATUS
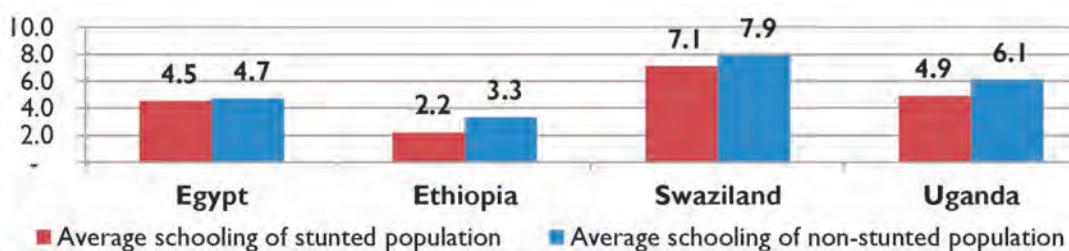
Source: COHA Study.

The economic impact of school dropout does not, however, incur while a person is of school age. Rather, the economic costs are incurred when the population is of working age, as people may be less productive and earn less income, as a result of fewer years of schooling achieved.[7] Thus, considerations of losses associated to lower schooling are described in the following section.

1.7 Social and Economic Impact of Child Undernutrition in Productivity

1.7.A Losses in Potential Productivity

The COHA model estimated that between 40 to 67 percent of the working-age population in the four countries were stunted as children. Research shows that adults who suffered from stunting as children are less productive than non-stunted workers and are less able to contribute to the economy.[8]

The impact of this lower productivity varies depending on the particular labour structure of the country and the type of economic achievement in which the individual is engaged. For people engaged in non-manual sectors, the lower educational levels achieved by those affected by stunting is reflected in a lower income.[9] As for stunted workers engaged in manual activities, research shows that they tend to have less lean body mass[10] and are more likely to be less productive in manual activities than those who were never affected by growth retardation.[11] As a result, losses in productivity are classified as losses in potential productivity in manual and non-manual activities, which are summarized in Table 1.5.

	TABLE 1.5					
	LOSSES IN PRODUCTIVITY ASSOCIATED WITH CHILD UNDERNUTRITION					
Country	**Stunted population of working age (15-64)**		**Lost productivity in manual activities**		**Lost productivity in non-manual activities**	
	Number	Estimated Prevalence	National Currency	USD	National Currency	USD
Egypt	21 million	41%	EGP10.7 billion	2.0 billion	EGP2.7 billion	484 million
Ethiopia	26 million	67%	ETB12.9 billion	1.1 billion	ETB625 million	53 million
Swaziland	283 618	40%	SZL126 million	15 million	SZL251 million	30 million
Uganda	8 million	54%	UGX417 billion	201.5 million	UGX241 billion	116.5 million

Source: COHA Study.

1.7.B Losses in Productivity due to Working Hours Lost as a Result of Mortality

As mentioned in the health section of this report, undernourished children have a higher risk of dying compared to children who are not underweight. In addition to the clear social problems associated with increased mortality, there is also a related economic cost. The COHA model estimates the proportion of child mortalities that is associated with undernutrition and then estimates the potential productivity of those individuals, had they lived and been part of the workforce (15-64) in 2009. The model uses current income data to estimate this lost productivity in terms of both lost income and lost working hours. According to these estimates, the working hours lost are equivalent to between 0.7 to

8.3 percent of the current workforce as a result of undernutrition-related mortalities. Considering the present value of these working hours lost, in many countries, this is the most significant productivity cost associated with undernutrition.

TABLE 1.6
LOSSES IN PRODUCTIVITY DUE TO MORTALITY ASSOCIATED
WITH CHILD UNDERNUTRITION

	Total annual working hours lost	Percentage of Current Workforce	Cost in national currency	Cost in USD
Egypt	857 million	0.7%	EGP5.4 billion	988 million
Ethiopia	4.7 billion	8.3%	ETB40.1 billion	3.4 billion
Swaziland	37 million	2.4%	SZL340 million	40 million
Uganda	943 million	3.8%	UGX657billion	317 million

Source: COHA Study.

1.8 Scenarios

The model generates a baseline, to be compared to the nutritional goals established in each country. These scenarios are constructed based on the estimated costs of the children born in each year, from 2009 to 2025 (net present value). While the previous sections calculated the costs incurred in a single year by historical undernutrition, these values represent the projected costs and savings generated by children born during and after 2009.

Baseline Scenario. The Cost of Inaction. Progress in reduction of stunting and underweight child stops. In this scenario, the progress of reduction of the prevalence of undernutrition stops at the level achieved in 2009. Although highly unlikely, it serves as a basis for estimating the saving for other scenarios.

Scenario #1. Cutting by Half the Prevalence of Child Undernutrition by 2025. In this scenario, the prevalence of underweight and stunted children would be reduced to half of the value of the reference year of 2009.

Scenario #2. The Goal Scenario. Reduce Stunting to 10 percent and Underweight children to 5 percent, by 2025. In this scenario, the prevalence of stunted children would be reduced to 10 percent and underweight children with less than five years to 5 percent.

As presented in Table 1.7, the potential economic benefits illustrate an opportunity to help build a case for increased investment in nutrition. With this information countries can have a benchmark for increasing investment, while at the same time, being able to compare this with the potential economic gains of reduced stunting rates.

	TABLE 1.7 **COMPARISON OF PROJECTED COSTS AND SAVINGS OF REDUCED STUNTING RATES IN TWO SCENARIOS**					
	Scenario #1: Halving the Prevalence of Child Undernutrition by 2025			**Scenario #2: The Goal Scenario: "10 and 5 by 2025"**		
Country	% Annual reduction of stunting required*	Total savings to be achieved	Average annual savings	% Annual reduction of stunting required*	Total savings to be achieved	Average annual savings
Egypt	0.9%	EGP11.7 billion	EGP732 million (USD133 million)	1.2%	EGP14.5 billion	EGP907 million (USD165 million)
Ethiopia	1.5%	ETB71 billion	ETB4.4 billion (USD376 million)	2.3%	ETB148 billion	ETB9.2 billion (USD784 million)
Swaziland	0.9%	SZL402 million	SZL25 million (USD3 million)	1.2%	SZL511 million	SZL32 million (USD4 million)
Uganda	1.1%	UGX2.8 trillion	UGX179 billion (USD88 million)	1.6%	UGX4.3 trillion	UGX267 billion (USD132 million)

Source: COHA Study.
*Percentage points

1.9 Conclusions

The COHA study is an important step forward to better understand the role that child nutrition and human development can play as a catalyser, or as a constraint, in the social and economic transformation of Africa.

Health Sector

- Child undernutrition generates health costs equivalent to between 1 and 11 percent of the total public budget allocated to health. These costs are due to episodes directly associated with the incremental quantity and intensity of illnesses that affect underweight children and the protocols necessary for their treatment.
- In the larger proportion of these episodes, 69 to 82 percent, do not seek medical attention or are treated at home, increasing the risk for complications and evidencing an unmet demand for health care.

Eliminating the inequality in access to health care is a key element of the social transformation agenda in Africa, which requires, as a precondition, a reduction of the rural/urban coverage gap. As health coverage expands to rural areas, there will be an increase of people seeking medical attention; this can potentially affect the efficiency of the system to provide proper care services. This study illustrates that a reduction of child undernutrition could facilitate the effectiveness of this expansion by reducing the incremental burden generated by the health requirements of underweight children.

Education Sector

- Children who were stunted experienced higher repetition rates in school ranging from 2 to 4.9 percent.
- Moreover, 7 to 16 percent of all grade repetitions in school are associated with the higher incidence of repetition among stunted children, the majority (90 percent) of which occurs in primary school.
- These numbers suggest that a reduction in stunting prevalence could support an improvement in school quality, as it would reduce preventable burdens to the education system.

Increasing the educational levels of a population, and maximizing the productive capacity of Africa's population dividend, is a key element in increasing competitiveness and innovation on the continent. This represents a particular opportunity in sub-Saharan Africa, where the population under 15 years is estimated to be 40 percent of the total population. Children and youth must be equipped with the skills necessary for competitive labour. Thus, underlying causes for low school performance and early dropout must be addressed. As there is no single cause for this phenomenon, a comprehensive strategy must be put in place that considers improving the quality of education and the conditions required for school attendance. This study demonstrates that stunting is one barrier to attendance and retention that must be removed to effectively elevate educational levels and improve individuals' labour opportunities in the future.

Labour Productivity

- 52 percent of the working age population in the analysed countries is currently stunted.
- This population has achieved, on average, lower school levels than those who did not experience growth retardation, ranging from 0.2 to 1.2 years of less schooling.
- The working-age population has been diminished by 1 to 8 percent due to child mortality associated with undernutrition.

On the continent, more than half of the population is expected to live in cities by 2035.[12] An important component to prepare for this shift is to ensure that the workforce is ready to make a transition towards a more skilled labour, and economies are able to produce new jobs to reduce youth unemployment. By preventing child stunting, thus avoiding the associated loss in physical and cognitive capacity that hinders individual productivity, people can be provided with a more equal opportunity for success.

Potential Economic Benefits

- The model estimated that a reduction of the prevalence of undernutrition to half of the 2009 level by the year 2025 can generate annual average savings from USD3 million to USD376 million for the analysed countries.

This economic benefit, which would result from a decrease in morbidities, lower repetition rates and an increase in manual and non-manual productivity, presents an important economic argument for the incremental investments in child nutrition. This does not only impact those people affected by undernutrition, but the society as a whole.

Evidence-Based Policy and South-South Collaboration

- COHA is an important example of how South-South collaboration can work to implement cost-effective activities in development and knowledge sharing. It demonstrated that developing and implementing tools that are sensitive to the particular conditions of the continent is feasible.

- It illustrates the valuable role that data and government-endorsed research can play in shedding light on pertinent issues on the continent. Although the availability of uniform and readily available data in Africa is limited, the COHA results have shown that analysis has the potential to bring the issue of child nutrition to the forefront of the development arena.

1.10 Policy Recommendations

Stunting is a useful indicator to evaluate effective social policies

The causes of and solutions for chronic hunger are linked to social policies across numerous sectors. As such, stunting reduction will require interventions from the health, education, social protection and social infrastructure perspectives. Stunting can be an effective indicator of success in larger social programmes.

Strong political will can be reflected in aggressive goals

This study encourages countries not to be content with "acceptable" levels of stunting; equal opportunity should be the aspiration of the continent. In this sense, it is recommended that aggressive targets are set in Africa for the reduction of stunting that go beyond proportional reduction, to establish an absolute value as the goal for the region at 10%. Countries with high and very high levels of stunting, of over 35%, might pursue an interim goal of reduction to 20%, but for countries that have been able to achieve progress enough to reduce stunting to below 35%, the establishment this target would be acceptable and desirable.

A multi-causal problem requires a multi-sectoral response

The achievement of this aggressive goal cannot be reached from just the health sector. To have a decisive impact on improving child nutrition, a comprehensive multi-sectoral policy must be put in place, with strong political commitment and allocation of adequate resources for its implementation.

Efficient rural economies and effective social protection schemes are key drivers for the sustained reduction of child undernutrition

Fostering rural economies, by enhancing the productivity of agricultural activities and expanding the non-agricultural activities, is a key element is accelerating the reduction rate of malnutrition. Efforts carried-out by CAADP and the development of value chains of strategic agricultural commodities can be key elements to focus efforts on in the coming years. Additionally, it is important to consider the role of social protection programmes in reducing hunger and malnutrition, in order to achieve the appropriate combination of transfers and services that is adequate for each context.

Sustainability requires strong national capacity

To ensure sustainability of these actions, whenever possible, the role of international aid must be complementary to nationally led investments, and further efforts have to be made in ensuring the strengthening of national capacity to address child undernutrition.

Monitoring is needed for progress

To measure short-term results in the prevention of stunting, a more systematic approach with shorter periodicity is recommended, such as two years between each assessment. As prevention of child undernutrition should target children before two years of age, these results would provide information to policy makers and practitioners on effectiveness of social protection and nutrition programmes.

Long-term commitment is necessary to achieve results

The COHA initiative represents a valuable opportunity to place nutrition within a strategy to ensure Africa's sustainable development. As the deadline for Millennium Development Goals nears, new priorities and targets will be set that will serve as a guide for development policies in years to come. It is recommended that the prioritization of the elimination of stunting be not only presented in the traditional forums, but also included in the wider discussions of development, as a concern for the economic transformation of Africa.

1.11 Pending questions and research opportunities

The COHA represents an important step forward in shedding light on the importance of nutritional investments, as a fundamental basis for human development. Nevertheless, the process also served as an important exercise to identify gaps in knowledge that can help increase the dimensions of the analysis, that include:

- **Sub-national differences in the social and economic impacts of child undernutrition.** There is an opportunity to raise the advocacy on sub-regional and local actions by developing a model to distribute the cost of hunger by region and further engage local governments and communities in the implementation of local actions to improve nutrition.

- **The impact of early child malnutrition on women's contributions to the household.** As most women in Africa are responsible for household chores and caring activities, their contributions are not accurately measured by proxy of labour productivity, rather, by their capacity to provide wellbeing in the household. Nevertheless, the intensity in which this capacity is affected as a consequence of child malnutrition in not comprehensibly address in current literature.

- **There are still gaps of region-specific risk analysis in Africa, particularly in educational outcomes and labour productivity.** A comprehensive analysis of a longitudinal study in Africa, can also serve as an important source of information to update further the relative risks faced by undernourished children, in different aspects of their lives.

- **Complementary analysis could be carried out to further understand the sectoral consequences of undernutrition.** Additional multi-variable analysis could also help to explain variations across countries.

1.12 COHA Countries and 1st Phase Results — Social and Economic Impact of Child Undernutrition

According to the initial results generated by the COHA study, the equivalent losses above are incurred by each country annually as a result of child undernutrition.
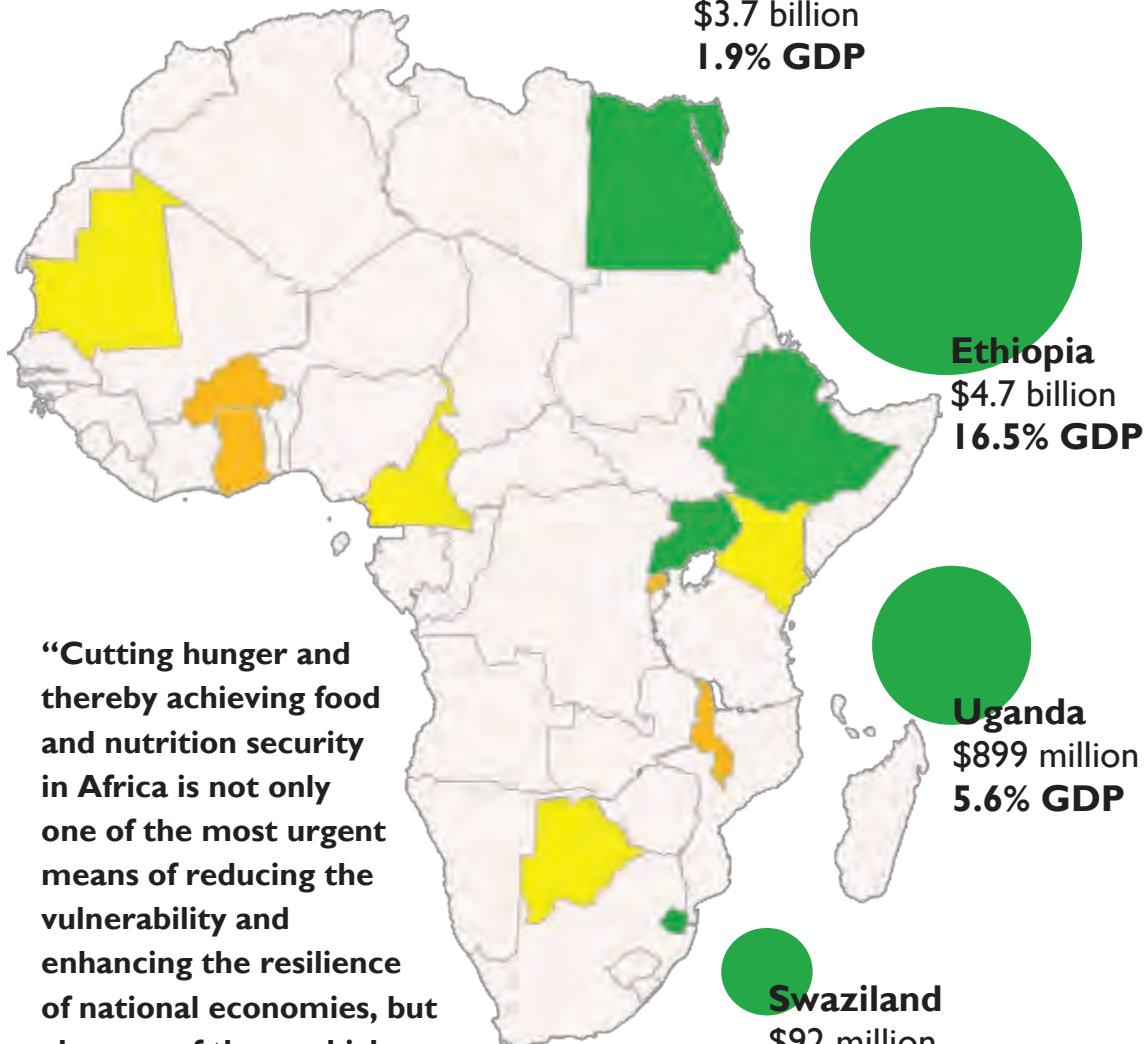
Egypt
$3.7 billion
1.9% GDP

Ethiopia
$4.7 billion
16.5% GDP

Uganda
$899 million
5.6% GDP

Swaziland
$92 million
3.1% GDP

"Cutting hunger and thereby achieving food and nutrition security in Africa is not only one of the most urgent means of reducing the vulnerability and enhancing the resilience of national economies, but also one of those which produces the highest returns for broader social and economic development."

- 5th AU Conference of Ministers of Finance, Planning and Economic Development Resolution 898[13]

Phase-one countries

Phase-two countries

Phase-three countries

Citations

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PART I:

A Model for Africa:
Methodology &
Conceptual Foundations

2. Introduction

2.1 Why is Child Undernutrition Important?

Recently, Africa has been experiencing a steady economic growth that has positioned the continent as a key region for global investment and trade. The pace of real gross domestic product (GDP) growth on the continent has doubled in the last decade, and six of the world's fastest growing economies are in Africa.[1]

While this growth has been recorded despite some of the highest rates of child undernutrition in the world, the continent is still short of its full potential.

Human capital is the foundation of economic development. The improved nutritional status of people has a direct impact on economic performance through increased productivity and enhanced national comparative advantage. In order for Africa to maximize its present and future economic growth opportunities, increased efforts are needed for cost-effective interventions that address the nutritional situation of the most vulnerable members of the society.

Achieving nutrition and food security would generate immediate impact on the achievement of the Millennium Development Goals (MDGs). If child undernutrition were reduced, there would be a direct improvement in child mortality rates, as undernutrition is the single most important contributor to child mortality.[2] If girls were not undernourished, they would be less likely to bear underweight children. Further, healthy children would be more productive as adults and would have a higher chance of breaking the cycle of poverty for their families.

Undernutrition leads to a significant loss in human and economic potential. Studies carried out in Zimbabwe show that lost schooling equivalent to 0.7 grades corresponds to a 12 percent loss in wealth throughout a lifetime.[3] In Ghana, studies show that for every year of delayed school entry, there was a 3 percent loss of wealth throughout the lifetime.[4] Additionally, studies in Brazil indicated that working stunted people have less lean body than their non-stunted counterparts.[5] This can correspond to reduced ability to earn income.[6]

Recently, a panel of expert economists at a Copenhagen Consensus Conference concluded that fighting malnutrition should be the top priority for policy makers and philanthropists. At that conference, Nobel Laureate economist, Vernon Smith declared, "One of the most compelling investments is to get nutrients to the world's undernourished. The benefits from doing so – in terms of increased health, schooling, and productivity – are tremendous."[7] Improving the nutrition status is therefore a priority area that needs urgent policy attention to accelerate socio-economic progress and development in Africa.

However, despite a compelling economic case for nutrition, investments with apparent shorter-term returns are often prioritized in social budgets. This is in part due to a lack of credible country-specific

data on potential returns in nutrition investments, which could be seen in school performance and in labour productivity in the medium-term. Further, nutrition is often looked at as a health issue, without considering the rippling social impact it has on other areas of development

Hence, stronger efforts are required to sensitize the general population, policy makers, and development partners on the high cost of undernutrition, in order to strengthen national and international political and financial commitments and to ensure that young children, as wells as entire societies, do not continue to suffer from the consequences of child undernutrition in Africa.

Despite the aforementioned challenges, efforts continue, both at continental and global levels, to address the issues of undernutrition and hunger. At the regional level, these efforts include initiatives and strategies such as the *African Regional Nutrition Strategy*,[8] the *Comprehensive Africa Agriculture Development Programme* (CAADP), especially CAADP Pillar III, which focuses on reducing hunger and improving food and nutrition security,[9] the *Pan African Nutrition Initiative* (PANI),[10] *Framework for African Food Security* (FAFS),[11] *Africa Ten Year Strategy for the Reduction of Vitamin and Mineral Deficiencies* (ATYS-VMD)[12] and African Day for Food and Nutrition Security (ADFNS).[13] At the global level, initiatives include *REACH*,[14] *Purchase for Progress* (P4P),[15] *Scaling Up Nutrition* (SUN),[16] *Feed the Future* (FTF),[17] the "1,000 Days" partnership,[18] as well as the *Abuja Food Security Summit* of 2006.[19] All these efforts are designed to reduce hunger, malnutrition and vulnerability, in a bid to also achieve the MDGs.

Within the framework of the African Regional Nutrition Strategy (ARNS 2005-2015), the objectives of the African Task Force on Food and Nutrition Security (ATFFND) and CAADP, the African Union and the New Partnership for Africa's Development (NEPAD) Planning and Coordinating Agency (NPCA), the United Nations Economic Commission for Africa (ECA), and the World Food Programme (WFP) undertook efforts to conduct the *Cost of Hunger Study on the Social and Economic Impact of Child Undernutrition in Africa*. This study is built on a model developed by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). Through a South-South collaboration agreement, ECLAC has supported the adaptation of the model to the African context.

This study aims at generating evidence to inform key decision makers and the general public about the cost African societies are already paying for not addressing the problem of child undernutrition. The results provide compelling evidence to guide policy dialogue and advocacy around the importance of preventing child undernutrition. Ultimately, it is expected that the study will encourage revision of current allocation practices in each participating country to ensure provision of the human and financial resources needed to effectively combat child undernutrition, specifically during the first 1,000 days of life, when most of the damage occurs.[20]

2.2 Current Food and Nutrition Situation in Africa

Globally, there has been progress in reducing both stunting (low height-for-age) rates and the number of stunted children in the last 20 years. In Africa, the proportion of stunted children reported has decreased from 41.6 percent (1990) to 35.6 percent (2011) (see Table 2.1). Nevertheless, for that same period, the number of stunted children has increased from 45.7 million to 56.3 million,[21] evidencing that stronger efforts must be put in place to have a decisive impact. The biggest proportion of these children are located in East Africa., where 22.8 million represent more than 40 percent of all stunted children on the continent. Together with West Africa, they account for three out of every four stunted children on the continent.[22]

TABLE 2.1
ESTIMATED PREVALENCE AND NUMBER OF STUNTED CHILDREN UNDER FIVE
YEARS OF AGE (MODERATE OR SEVERE), BY UN REGION: 1990, 2010, 2011

Region	Prevalence estimate (%)			Number (million)		
	1990	2010	2011	1990	2010	2011
Africa	**41.6**	**35.9**	**35.6**	**45.7**	**55.8**	**56.3**
Eastern	50.6	42.5	42.1	18.0	22.6	22.8
Middle	47.2	35.6	35.0	6.4	7.8	7.8
Northern	28.6	21.3	21.0	6.3	5.0	5.0
Southern	36.2	31.1	30.8	2.2	1.9	1.8
Western	39.1	36.5	36.4	12.8	18.6	18.9

Source: United Nations Children's Fund, World Health Organization, The World Bank. UNICEF-WHO-World Bank Joint Child Malnutrition Estimates.[23]

The vast and rising numbers of food insecure and undernourished people continue to pose very serious concerns in Africa. Over the past few years, global food price increases, followed by economic and financial crises, have pushed more people into poverty and hunger. Even though the number of undernourished people has reduced globally from 1 billion to 868 million in the last 20 years, Africa has fallen back, reporting an increase in the number of undernourished people from 175 million to 239 million (see Figure 2.2).[24] Africa's share in the world's undernourished population has also increased from 18 percent to 28 percent,[25] evidence the need for stronger efforts in improving food security.

Severe food insecurity and malnutrition have been recurrent in Africa, particularly in the Horn of Africa and the Sahel. The current food and nutrition crisis in the Horn of Africa is the most severe food security emergency in the world today. More than 12 million people in that region require emergency assistance to save lives, support livelihoods, prevent further deterioration in food security and build resilience to mitigate the impact of future crises. Similarly in 2012, several Sahel countries were once again at high risk of food insecurity and malnutrition.[26]

Figure 2.1 illustrates the rates of stunting (low height-for-age) in Africa. According to these data, 17 countries on the continent have stunting rates above 40 percent and 36 countries have rates above 30 percent. Furthermore, a large proportion of Africa's population often does not access diets containing

TABLE 2.2
NUMBER OF UNDERNOURISHED PEOPLE, BY REGION
(in millions)

Region	1990-1992	Proportion	2010-2012	Proportion
Africa	175	18%	239	28%
Asia	739	74%	563	65%
Latin America & Caribbean	65	7%	49	6%
Oceania	1	0%	1	0%
World	1000		868	

Source: *The state of food insecurity in the world 2012*, Report, Food and Agriculture Organization (FAO).[27]

the essential vitamins and minerals required for optimum health and productivity.[28]

Erratic rains in 2011 negatively affected cereal and pasture production through much of Africa. Localized cereal deficits for the 2011/2012 season and sustained high food prices place 10 million people at risk of food insecurity.[29]

FIGURE 2.1
STUNTING RATES BY COUNTRY

Legend:
- >50%
- 40-50%
- 30-40%
- 20-30%
- 10-20%
- >10%
- Data not available
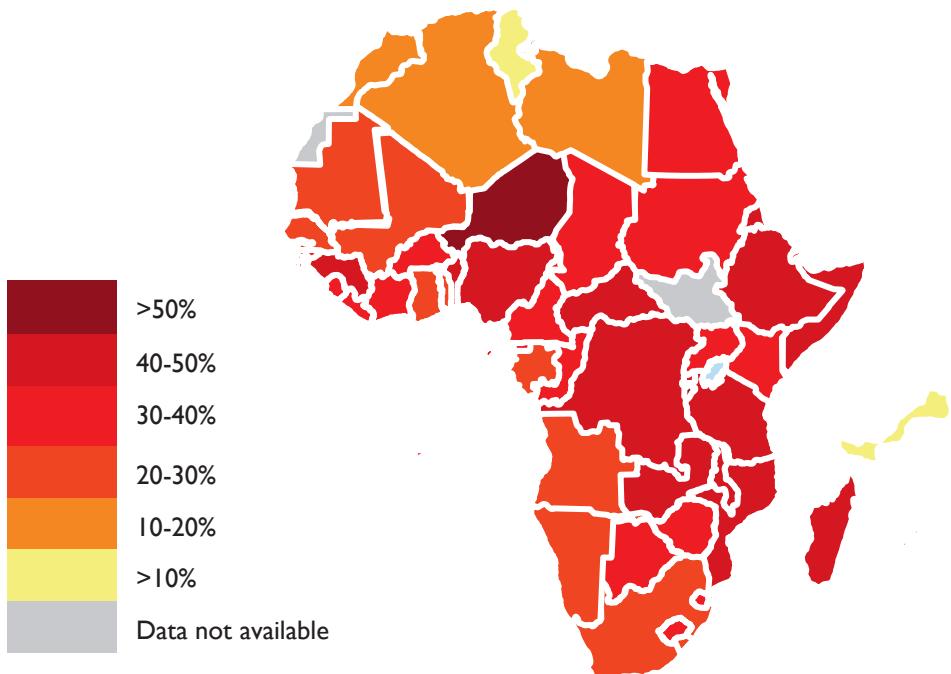
Source: Data from "WHO Global Database on Child Growth and Malnutrition," WHO.[30]

The first Millennium Development Goal (MDG 1) calls for the eradication of extreme poverty and hunger.[31] The nutrition status of children under five years of age is one of the key indicators used to assess progress towards MDG 1. Latest data show that only nine of the world's 63 developing countries are on track to reaching Target 1C, MDG 1, i.e. to reduce by halve the prevalence of underweight children. Only three of these are from Africa.[32] Unless coherent national strategies are urgently put into place and fully supported to orchestrate well-coordinated and decisive priority actions, any small gains are likely to be reversed.

Achievement of MDG 1 is crucial for national socio-economic progress and development. Failure to achieve it jeopardizes the realization of all the other MDGs, including goals to reach universal primary education (MDG 2), promote gender equality and empower women (MDG 3), reduce child mortality (MDG 4) and improve maternal health (MDG 5).[33]

2.3 Mandate to Advocate for Nutrition in Africa

At the 4th Joint Meeting of the AU Conference of Ministers of Economy and Finance and the ECA Conference of African Ministers of Finance, Planning and Economic Development held in 2011, the African Union (AU) recognized the growing evidence from across Africa that despite vibrant economic growth in many countries, equitable social growth has not improved as much, particularly with regards to poverty reduction and job creation.

Experience from other parts of the world – most notably Latin America and Asia – confirmed that cutting hunger and thereby achieving food and nutrition security in Africa is not only one of the most urgent needs for reducing vulnerability and enhancing resilience, but also one of the highest return outcomes for broader social and economic development. This suggests that, had more progress been made against hunger in Africa, the continent's recent growth performance would have been even more impressive with potentially strong impacts on poverty reduction.

Nevertheless, advocating for nutrition investments has been a challenge for development stakeholders. Often, child nutrition is perceived as a long-term investment, which will take several years to generate social returns, thus short-term investments are prioritized in budget allocations. Further, food security and response to emergency hunger situations often take most of the attention associated to nutrition investments.

Recognizing these challenges, the African Union Commission (AUC), strongly supported by WFP, NEPAD and other partners, proposed the development of the COHA study at the 5th Joint Meeting of the AU Conference of Ministers of Economy and Finance and the ECA Conference of African Ministers of Finance, Planning and Economic Development in March 2012. The purpose of this multi-country study was to provide strong evidence on the social and economic consequences of child nutrition, in order to inform, raise awareness, build consensus and catalyse action towards increasing the attention on this issue.

As a result, *Resolution 898 (XLV) the Cost of Hunger in Africa: Social and Economic Impacts of Child Undernutrition* was adopted, confirming the importance of the study and recommending it to continue beyond the initial stage. [34]

"The Conference of Ministers...

Welcomes the multi-country study on the Cost of Hunger in Africa being led by the African Union Commission and the Economic Commission for Africa, in collaboration with the World Food Programme, to quantify the aggregate social and economic impacts of chronic hunger in Africa;

Anticipates that the study will lead to increased understanding among key national and regional policymakers of the depth and breadth of child undernutrition on the continent, and its aggregate social and economic consequences, and thereby establish a firmer foundation for policies and investments to cut hunger in Africa; [and requests partners] to expedite the successful completion of the study, including wide dissemination of the results at country and regional levels."

**- Extract from Resolution 898 (XLV) the Cost of Hunger in Africa:
Social and Economic Impacts of Child Undernutrition**

This mandate was a clear guideline for the AUC to integrate the COHA study into the advocacy efforts of the ARNS (2005-2015)[35] and use the results of the study as a tool to help mainstream nutrition in the development context. The resolution also promoted a dialogue with political actors at the country level, motivated consideration of nutrition issues within the economic and planning sectors and repositioned child nutrition in the context of economic development. This report is the result of the commitment from the AUC, NEPAD, ECA, WFP and other partners to report on the tangible consequences of child undernutrition in Africa.

2.4 Adapting a Methodology for Africa: a Consultative Process

The model for the COHA study represents a step forward in estimating the social and economic consequences of child nutrition in Africa. Several national and regional efforts have been implemented globally and in the region. Notable past initiatives at the regional level include those led by ECLAC, carried out jointly with WFP in Latin America and the Caribbean (LAC) and the PROFILES initiatives,[36] which developed similar country-level estimations in selected countries world-wide. COHA, however, represents the only effort constructed for the African continent, involving regional nutritional experts, who with the support of country teams, provided recommendations during the adaptation process. The model developed by ECLAC to estimate the social and economic consequences on child undernutrition in LAC[37], presented the most appropriate base to develop a model for Africa. In the development of the model for LAC, the authors focused on the consequences of child undernutrition from a life cycle approach, avoiding the potential overlaps with other nutritional deficiencies. This approach proved to be an important political instrument to mobilize stakeholders around nutrition in LAC and was considered by many to be state-of-the-art knowledge in this field.

The development of the COHA model proved to be a good practice of South-South collaboration between two regional UN economic commissions. ECLAC and ECA worked together in a series of joint technical activities and consultations to transfer knowledge and generate the adjustments for the development of the new model for Africa. An interdivisional working group was created within ECA that included the African Centre for Statistics, the African Centre for Gender and Social Development, the Economic Development and NEPAD Division of the ECA and UN partners, namely WFP, UNICEF, the International Labour Organization (ILO) and WHO, to ensure multidisciplinary contributions in the development of the model.

At the regional level, the technical validation of the COHA model was provided by the African Task Force of Food and Nutrition Development (ATFFND). The Task Force, which brings together regional nutrition experts and practitioners, was the ideal body to provide guidance in the development of the model. In consecutive meetings, the ATFFND provided key recommendations, thus laying out a roadmap for the adaptation process, and finally expressed its satisfaction with the proposed COHA model.

To facilitate the implementation of the project, leadership roles were identified: the AUC Department of Social Affairs and the NEPAD Planning and Coordinating Agency lead the initiative, ECA/ECLAC coordinated its implementation and WFP and other partners supported the capacity building process, both at regional and country levels. Further, the following governing structures were established:

1. The Steering Committee/ATFFDN: A high-level Steering Committee chaired by the AUC. The Steering Committee is charged with convening partner organizations, approving the study design

and action plan and overseeing the implementation of the study and dissemination of results. The Steering Committee also provides political support to the initiative.

2. The Regional Secretariat: The Regional Secretariat, based at ECA, worked through a small technical team, drawn from ECA, NEPAD, AUC, WFP, ECLAC and other relevant organizations, to support the preparation, implementation and dissemination of the study, as well as to facilitate smooth and quality work of the national implementation teams and expert committees. The Secretariat reported to the Steering Committee and executed the study budget.

3. The National Implementation Team (NIT): The core implementation of the study was carried out by a national team in each participating country, drawn from relevant governmental institutions, such as the Ministry of Health, Ministry of Education, Ministry of Social Development, Ministry of Planning, Ministry of Finance and the National Statistics Institution. In certain situations, a broader reference group was also created to include other actors and United Nations agencies, such as WFP, UNICEF and WHO. The WFP country offices facilitated the process according to specific country situations and supported coordination of the NIT as required.

For the initial phase of the project, criteria were agreed upon to select the initial countries. The requirements were as follows:

1. Data availability: The availability of at least two recent, nationally representative survey data sets on fertility, family planning, maternal and child health, gender, malaria and nutrition, preferably the Demographic and Health Survey (DHS).

2. Sub-regional coverage: At least one country selected from each AU region: Community of Sahel-Saharan States (CEN-SAD), Common Market for Eastern and Southern Africa (COMESA), Economic Community of Central African States (ECCAS), Economic Community of Western African States (ECOWAS), Intergovernmental Authority for Development (IGAD), Southern African Development Community (SADC) and Union du Maghreb Arabe (UMA). Overlapping membership to various Regional Economic Communities was also taken into account in the final selection of countries.

3. Socio-economic representation: Prevalence of poverty and undernourishment in the overall population and occurrence of episodes of drought or other natural disasters.

4. Existence of a national platform on malnutrition and hunger.

Based on these criteria, 12 initial countries were selected (see Table 2.3). Four of these countries, namely Egypt, Ethiopia, Swaziland and Uganda, participated as first-phase countries. Contributions from the NITs in these countries helped in the adaptation of the model. Four countries represent the second -phase: Burkina Faso, Ghana, Malawi, and Rwanda. Four countries have also been selected for the third-phase: Botswana, Cameroon, Kenya, and Mauritania.

2.5 Guiding Principles

Throughout the adaption, implementation and utilization of the COHA, four guiding principles were developed. With the overall goal to improve the nutritional situation in Africa, these principles allowed the team to approach the study in a holistic way, considering the necessary steps for its implementation. The four guiding principles are described below.

TABLE 2.3
COUNTRY SELECTION CRITERIA

Country	AU Region	Data availability (Survey Dates)[38]	Proportion of under-nourishment in total pop. (%)[39]	Crude birth rate (births per 1,000 pop.)[40]	<5 mortality rate, (per 1,000 live births)[41]	UN HDI value ranking[42]	Prevalence of Stunting in children <5 years[43]
Botswana	SADC	# CSO/UNICEF.	27.9	24	30	118	31.4
Burkina Faso	ECOWAS	2010, 2003, 1998-99 Standard DHS	25.9	43	152	181	35.1
Cameroon	ECCAS	2004, 1998, 1991 Standard DHS	15.7	37	131	150	32.5
Egypt	CEN-SAD, COMESA	2008, 2005, 2000 Standard DHS	<5	23	24	113	44.2
Ethiopia	IGAD, COMESA	2010, 2005, 2000 Standard DHS	40.2	32	86	174	28.6
Ghana	ECOWAS	2008, 2006, 1998 Standard DHS 2006 MICS	<5	32	81	135	35.2
Kenya	IGAD, COMESA	2008-09, 2003, 1998 Standard DHS	30.4	38	79	143	47.8
Malawi	SADC, COMESA	2010, 2004, 2000 Standard DHS	23.1	44	95	171	23
Mauritania	UMA	2003-04 Special 2000-01 Standard DHS	...	34	113	159	44.2
Rwanda	COMESA	2010, 2005, 2000 Standard DHS	28.9	41	68	166	40.4
Swaziland	SADC, COMESA	2006-07 Standard DHS 2002 MICS	...	30	115	140	33.4
Uganda	IGAD, COMESA	2010 Standard AIS 2006, 2000-01 Standard DHS	34.6	46	98	161	30.7

2.5.A National ownership of the process

One of the guiding principles in the development of the COHA is to engage regional experts and policy makers as the main actors of the process. To this purpose, a feasibility workshop was carried out in the early stages of the process, bringing together practitioners across various sectors in order to analyse the challenge ahead and jointly produce a roadmap. Representatives from the 12 initial countries and major partners met to assess the process ahead and provided key recommendations for the adaptation of the ECLAC model. Some of these elements included capacity building, strong communication strategies and synergies with other on-going costing initiatives.

As a result of this feasibility workshop, NITs were established in each of the four first-phase countries, and an initial training on the model and data requirements was carried out. A key milestone of the adaptation process was a regional technical meeting held in Entebbe, Uganda, where NITs presented a series of specific recommendations to the process based on the constraints and lessons learned. This feedback allowed the Regional Secretariat to develop a final roadmap for methodological adaptation, adjust the data collection instruments and develop a final proposal for the COHA model.

2.5.B Building national capacity to advocate for child nutrition

A second guiding principle for the COHA is to ensure that national capacity is strengthened during the implementation of the study. Similar costing initiatives have had limited impact due, in part, to the lack of national ownership and limited understanding by the stakeholders of the technical aspects. These elements hinder the national stakeholders' capacities to effectively communicate the results, which could limit the policy impact of the study.

The main implementing actors of COHA in each country are specialists from the key government institutions, academics and practitioners, often led by the Ministry of Economy and/or Planning or the Ministry of Health. Once a team of eight to ten specialists was established, a training workshop was held to review all technical aspects of the model, establish a task force for data collection and develop an initial communication strategy. In this workshop, a plan was developed by the NIT that served as a guide for future activities.

The Regional Secretariat supported the capacity building process of the NIT by holding regular teleconferences with representatives from each team and by providing technical assistance in the analysis of the data and initial results. The national ownership of the study was emphasized by creating a NIT-led approach and relying on nationally validated information. Once a country report was drafted, a national validation workshop of the results was held by the NIT and specific advocacy documents were prepared for key stakeholders.

One of the advantages of this process was the integration of the COHA by the NITs within their national nutritional strategies. This was possible as the actors participating in the study were the same professionals shaping national nutritional strategies. This ensured alignment within the processes and maximized the potential contribution and sustainability of the initiative.

2.5.C Engagement of COHA with global nutrition initiatives and movements

The third guiding principle for the COHA is to generate synergies with partners and global initiatives to maximize contributions. To achieve this, strong efforts were made to link the COHA with the relevant initiatives that contribute to reducing child undernutrition.

The Scaling Up Nutrition (SUN) Movement was launched in 2010 and includes selected countries with high burdens of malnutrition. The purpose of the movement is described as follows:

> *It unites people - governments, civil society, the United Nations, donors, businesses and scientists – in a collective effort to improve nutrition. The Movement recognizes that good nutrition in the 1,000 days of a mother's pregnancy until her child's second birthday is an essential requirement and right for each world citizen to earn, learn, stay healthy and achieve his or her lifetime potential. The SUN Movement is founded on the compelling evidence that investment in nutrition yields major economic returns.[44]*

COHA contributes to the SUN Movement by presenting strong arguments for investing in child nutrition in specific country contexts. By doing so, countries have developed the capacity to generate change in the nutritional situation of their populations.

Another important global actor in the nutrition context is represented by the Renewed Efforts Against Child Hunger (REACH) initiative. This joint initiative proposed by WFP, WHO, UNICEF and FAO provides technical assistance to national governments in developing plans and strategies to scale up nutrition investments. An important part of their advocacy actions at the country level includes engaging non-traditional actors in discussions on nutrition, in order to mainstream nutrition in their planning and activities. The COHA also represents an opportunity for joint collaboration, as it provides strong evidence on the consequences of stunting in educational performance, the loss of working hours by working age populations and the loss in manual and non-manual productivity, helping thus, to position nutrition in the wider development agenda. REACH facilitators are also typically members of the NIT in each country where REACH is present.

2.5.D Strategic advocacy for change

The fourth guiding principle of the COHA is to ensure that the results reach stakeholders with the capacity to make change. The communication component of the COHA is a basic element of the project. As a result, strong efforts are carried out by each NIT to reach decision makers with the appropriate information in order to increase their interest and understanding on the consequences of child undernutrition. Thus, a six-step approach has been developed, as follows:

1. Familiarize the team with the problems contributing to undernutrition and proven nutrition interventions;
2. Identify and categorize key actors;
3. Develop objectives for each actor;
4. Produce informational materials and brief stakeholders;
5. Adapt results and present them to target decision makers; and
6. Follow up and provide support.

Each NIT was provided detailed information on the six steps. Additionally, the NIT held communication and advocacy sessions at each of the technical workshops to discuss the implementation of the six step approach.

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3. Brief Description of the Model

The following text is adapted from Rodrigo Martínez and Andrés Fernández, Model for analysing the social and economic impact of child undernutrition in Latin America, Naciones Unidas, CEPAL, Social Development Division, Santiago De Chile, 2007, in collaboration with the authors.

3.1 Conceptual Framework

Hunger is caused and affected by a set of contextual factors. "Hunger" is an overarching term that reflects an individual's food and nutrition insecurity. Food and nutrition insecurity occur when part of the population does not have assured physical, social and economic access to safe and nutritional food to satisfy dietary needs.[1]

Nutrition security, therefore, depends on a person's food security or insecurity. Specifically, nutrition security can be described as the appropriate quantity and combination of food, nutrition, health

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KEY TERMS AND CONCEPTS FOR COHA MODEL*

Chronic hunger: The status of people whose food intake regularly provides less than their minimum energy requirements leading to undernutrition.[2]

Child undernutrition: The result of prolonged low levels of food intake (hunger) and/or low absorption of food consumed. It is generally applied to energy or protein deficiency, but it may also relate to vitamin and mineral deficiencies. Anthropometric measurements (stunting, underweight and wasting) are the most widely used indicators of undernutrition.[3]

Intrauterine growth restriction (IUGR): An infant suffering from IUGR is defined as being below the 10 percent percentile of the recommended gender-specific birth weight for gestational age reference curves.[4]

Low birth weight (LBW): A new-born is considered to have low birth weight when he or she weighs less than 2,500 grams.[5]

Malnutrition: A broad term for a range of conditions that hinder good health caused by inadequate or unbalanced food intake or by poor absorption of the food consumed. It refers to both undernutrition (food deprivation) and obesity (excessive food intake in relation to energy requirements).[6]

Stunting: Reflects shortness-for-age; an indicator of chronic malnutrition, calculated by comparing the height-for-age of a child with a reference population of well-nourished and healthy children. The model uses it as the indicator to analyse the impact on educational performance and productivity.[7]

Underweight: Measured by comparing the weight-for-age of a child with a reference population of well-nourished and healthy children. The model utilizes it to analyse the impact of child undernutrition on health.[8]

*All terms adapted for COHA based on sources indicated.

services and care taker's time needed to ensure adequate nutrition status for an active and healthy life at all times for all people.[9] A direct and measurable consequence of nutrition insecurity is low birth weight, underweight (low weight-for-age) and/or stunting (low height-for-age).

Levels of nutrition security in a country are related to epidemiological and nutritional transitions, which can be evaluated to assess the population's nutritional situation. Further, a person's nutritional situation is part of a process that is expressed differently depending on the stage of the life cycle: intrauterine and neonatal, infancy and pre-school, school years or adult life. This is because the nutrient requirements and the needs are different for each stage.[10]

The following section explains central elements, considered in the model, to estimate the effects and costs of child undernutrition based on the concepts mentioned above, along with a brief description of the causes and consequences of undernutrition. The discussion also describes the dimension of analysis and the principal methodological aspects used to interpret the results.[11]

3.2 Causes of Undernutrition

The main factors associated with undernutrition as a public health problem can be grouped into the following: environmental (natural or entropic causes), sociocultural-economic (linked to poverty and inequality) and political-institutional. Together, these factors increase or decrease biomedical access and productivity abilities, through which they determine the quantity and quality of dietary intake and the absorption capacity, which constitute the elements of undernutrition.[12]

Each of these factors increases or decreases the likelihood of a person to suffer from undernutrition (see Figure 3.1). Further, the importance of each of these factors depends on the level of the country's demographic and epidemiological transition as well as on the person's current stage in the life cycle. Together these factors determine the intensity of the resulting level of undernutrition.[13]

FIGURE 3.1
CAUSES OF UNDERNUTRITION

Source: Modified from Rodrigo Martinez and Andrés Fernández, *Model for analysing the social and economic impact of child undernutrition in Latin America,* based on consultations carried out by authors.[14]
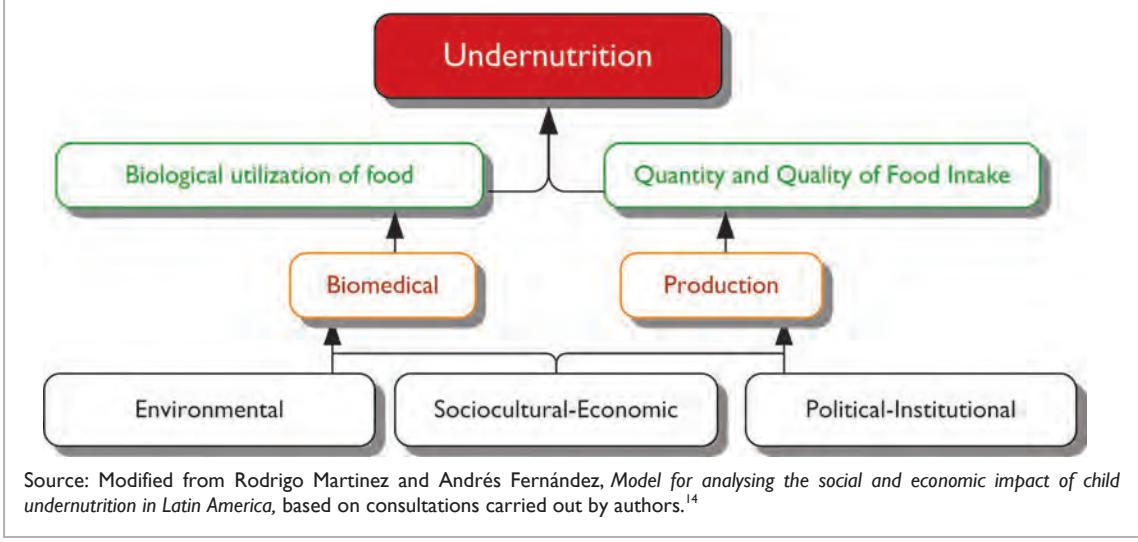
Environmental factors define the surroundings in which the subject and his or her family live. These include the risks stemming from the natural environment itself and its cycles (floods, droughts, frosts, earthquakes and other phenomena), as well as those produced by humans themselves (such as water and air pollution, contamination of food, expansion of agriculture, etc.). The sociocultural-economic determinants include elements associated with poverty and inequality, education and cultural norms, employment and wages, access to social security and coverage of aid programmes. The political-institutional factors encompass government policies and programmes aimed specifically at solving the population's food and nutritional problems[15]

Production factors include those directly associated with the production and access to food by the population at risk. The availability and autonomy of each country's dietary energy supply depend directly on the characteristics of production processes, the degree to which they utilize natural resources, and the extent to which these processes mitigate or aggravate environmental risks.[16]

Finally, biomedical factors take into account the individual's susceptibility to undernutrition, insofar as deficiencies in certain elements limit the capacity to make biological use of the food consumed (regardless of quantity and quality).[17]

3.3 Consequences of Undernutrition

Child undernutrition has long-term negative effects on a person's life, most notably in the aspects of health, education, and productivity (see Figure 3.2).[18] These elements are quantifiable as costs and expenditures to both the public sector and to individuals. Consequently, these effects exacerbate problems in social integration and increase or intensify poverty. A vicious cycle is perpetuated as vulnerability to undernutrition grows.

Undernutrition may have immediate or evolving impacts throughout a person's lifetime; individuals who suffered from undernutrition during early years of their life cycle (including intrauterine) are more likely to be undernourished later in life.[19] Health studies have shown that undernutrition leads to increased appearance or intensified severity of specific pathologies and increases the chance of death during specific stages of the life cycle.[20] The nature and intensity of the impact of undernutrition on pathologies depends, in part, on the epidemiological profile of a given country.

In education, undernutrition affects student performance through disease-related weaknesses and results in limited learning capacity associated with deficient cognitive development.[21] This translates into a greater probability of starting school at a later age, repeating grades, dropping out of school and ultimately obtaining a lower level of education.[22]

Later in life, individuals may experience lower physical capacity as a result of stunting. Stunting, which is caused by food deprivation and nutrient deficiencies, is established by low height-for-age measurements during childhood. In adulthood, it leads to an overall reduced body mass when compared to the full adult potential.[23]

Undernutrition and each of its negative impacts on health, education and productivity, as described above, lead to a social, as well as an economic, loss to the individual and society as a whole (see Figure 3.2). Thus, the total cost of undernutrition (TC^U) is a function of higher health-care spending (HC^U), inefficiencies in education (EC^U) and lower productivity (PC^U). As a result, to account for the total cost (TC^U), the function can be written as:

FIGURE 3.2
THE COHA FRAMEWORK OF SOCIAL AND ECONOMIC CONSEQUENCES OF CHILD UNDERNUTRITION IN AFRICA
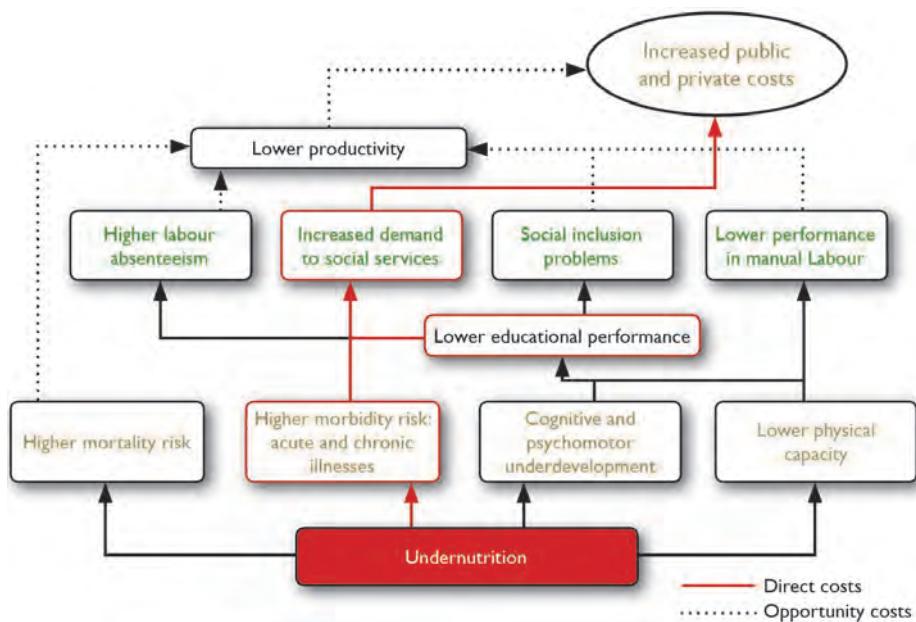
Source: Rodrigo Martinez and Andrés Fernández, *Model for analysing the social and economic impact of child undernutrition in Latin America[24],* based on consultations carried out by authors.

Note: The COHA Framework of Consequences of Undernutrition, proposed in the ECLAC model, was adapted for the African context. This framework provides the basis for the conceptual elements which define the COHA model. It was agreed upon in the first-phase phase of the study by a continental steering committee and has been validated by the ATFFND.

$$TC^U = f(HC^U, EC^U, PC^U)$$

In the area of health, the high probability resulting from the epidemiological profile of individuals suffering from undernutrition proportionally increases the costs in the health care sector (HSC^U). In aggregate, this is equal to the sum of the interactions between the probability of undernutrition in each age group, the probability that a particular group will suffer from diseases because of undernutrition, and the costs of treating the pathology (HSC^U) that typically includes diagnosis, treatment and control. To these are added the costs paid by individuals and their families as a result of lost time and quality of life (IHC^U) and cases treated at home. Thus, to study the variables associated with the health cost (HC^U) the formula is:

$$HC^U = f(HSC^U, IHC^U)$$

In education, the reduced attention and learning capacity of those who have suffered from child undernutrition increase costs to the educational system (ESC^U), considering only the differential risk between repeating rates of the undernourished and the overall repeating rates. Repeating one or more grades commensurately increases the demand that the educational system must meet, with the

resulting extra costs in infrastructure, equipment, human resources and educational inputs. In addition, the private costs (incurred by students and their families) derived from the larger quantity of inputs, external educational supplementation and more time devoted to solving or mitigating low performance problems (IEC^U) are added to the above costs. Thus, in the case of the education cost (EC^U), the formula is

$$EC^U = f(ESC^U, IEC^U)$$

The productivity cost associated with undernutrition is equal to the loss in human capital (HK) incurred by a society, stemming from a lower educational level achieved by stunted individuals (ELC^U), a lower productivity in manual labour experienced by individuals who suffered from stunting (MLC^U) and the loss of productive capacity resulting from a higher number of child deaths caused by undernutrition (MMC^U), based on the recorded levels of productivity in the study year. In the model these costs are reflected as losses in potential productivity (PC^U).

Thus,

$$PC^U = f(ELC^U, MLC^U, MMC^U)$$

As a result, in order to comprehensively analyse the phenomenon of undernutrition, the model considers its consequences on health, education and productivity by translating them into costs. For more detailed information on the model and the functions, see Annex 2, Supplemental Methodological Information.

3.4 Dimensions of Analysis

Considering that a country's undernutrition situation and the consequences thereof reflect a specific epidemiological and nutritional transition process, a comprehensive analysis involves estimates of the current situation. This can be extrapolated from previous transitional stages.

On this basis, a two-dimensional analysis model was developed to estimate the costs of child undernutrition in health, education and productivity:

1. *Incidental retrospective dimension* focuses on the population in the study year, including those who would have been alive in the study year. they had not died of undernutrition related causes. The retrospective dimension estimates the nutritional situation of individuals before they reached 5 years of age to identify the related economic costs in the study year. Thus, using detailed economic and demographic data, it is possible to estimate the health costs of pre-school boys and girls who suffer from undernutrition during the year of analysis; the education costs stemming from the children currently in school who suffered from undernutrition during the first five years of life; and the economic costs due to lost productivity by working-age individuals who were exposed to undernutrition before the age of five. For detailed information on the data used, see Annex 5: Assumptions by Country.

2. *Prospective or potential savings dimension.* This dimension focuses on a single cohort of children under 5 in a the study base year and allows analysis of the present and future losses incurred as a result of medical treatment, repetition of grades in school and lower productivity of that cohort of children. Based on this analysis, potential savings derived from actions taken to achieve nutritional objectives can be estimated.

As shown in Figure 3.3, the incidental retrospective dimension includes the social and economic consequences of undernutrition in a specific year (for the purposes of this report 2009 was set as the base year) for cohorts that have been affected (0 to 4 years of age for health, 6 to 18 years for education and 15 to 64 years for productivity). The prospective dimension on the other hand, projects the costs and effects of undernutrition recorded in the reference year of the study. These are based on the number of children born during the period selected in the analysis and, with the application of a discount rate, on the present value estimates of future costs to be incurred due to the consequences of undernutrition. The prospective dimension is the basis for establishing scenarios to estimate the economic and social savings of an improved nutritional situation.

FIGURE 3.3
DIMENSIONS OF ANALYSIS,
BY POPULATION AGE AND YEAR WHEN EFFECTS OCCUR
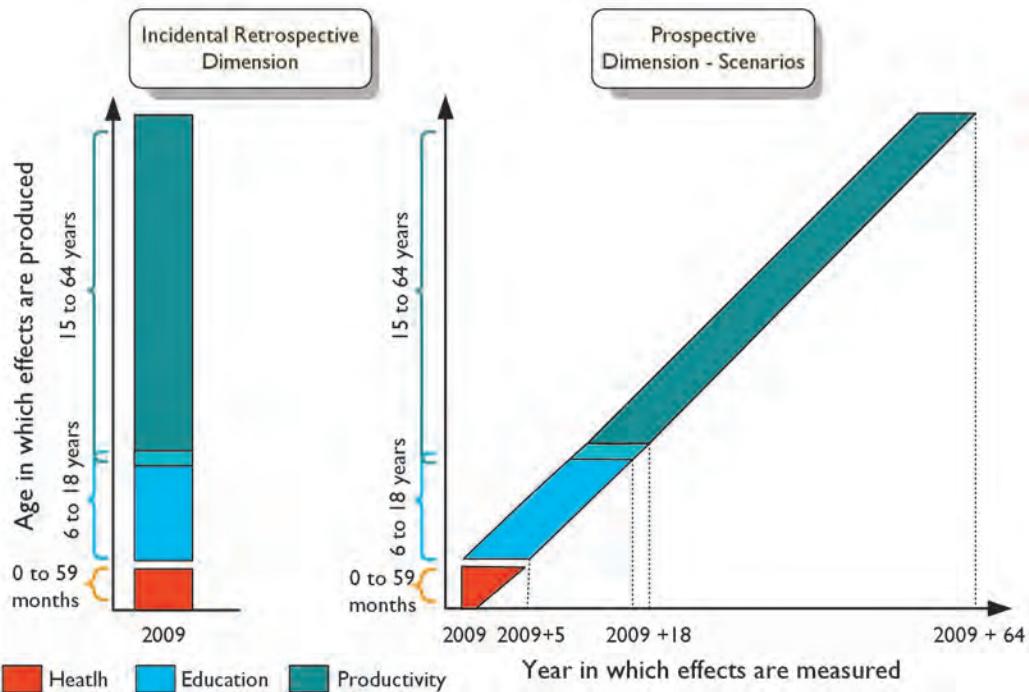
Source: Based on Rodrigo Martinez and Andrés Fernández, *Model for analysing the social and economic impact of child undernutrition in Latin America.*[26]

3.5 Methodological Aspects

The analysis focuses on undernutrition during the initial stages of the life cycle and its consequences throughout life. This limits the study to the health of the foetus, the infant and the pre-schooler, i.e. those aged 0 to 59 months.[25] Similarly, the effects on education and productivity are analysed in the other demographic groups, i.e. 6-18 years old and 15-64 years old, respectively.

The population of children suffering from undernutrition was divided into sub-cohorts (0 to 28 days, 1 to 11 months, 12 to 23 months and 24 to 59 months) in order to highlight the specificity of certain effects during each stage of the life cycle.

The study uses undernutrition indicators that are measurable and appropriate to the different stages of an individual's life cycle. For intrauterine undernutrition, low birth weight (LBW) due to intrauterine growth restriction (IUGR, defined as a weight below the tenth percentile for gestational age) is estimated. For the pre-school stage, moderate and severe stunting categories (height-for-age scores below-2 standard deviations) are used, with reference, where possible, to WHO distribution for comparison purpose.[27]

Estimates of the impacts of undernutrition on health, education and productivity are based on the concept of the relative (or differential) risk run by individuals who suffer from undernutrition during the first stages of life as compared to a healthy child. This is valid both for the incidental-retrospective analysis and for the prospective-savings analysis; however, its application has specific characteristics in each case. To estimate the costs for the incidental retrospective dimension, the values occurring in the year of analysis are totalled based on estimates of differential risks undergone by the different cohorts of the population. In the prospective analysis on the other hand, a future cost flow is estimated and updated (to present value).

3.6 Methodological Adaptations: Integrating the Context of Africa in the Analysis

The consequences of child undernutrition are profound, far-reaching and often irreversible. Undernutrition weakens the immune system, making children more susceptible to diseases and reducing their chances of surviving illnesses such as diarrhoea,[28] pneumonia,[29] and malaria.[30] It is estimated that undernutrition is the underlying cause of over 30 percent of all child deaths.[31] This combination of recurring illnesses often manifests in growth faltering, irreversibly damaging physical development and mental capacity. As a result, undernourished children are less likely to attend school, may perform more poorly when in school, and are more likely to drop out early, as compared to their well-nourished counterparts.[32] Their capacity to earn a decent living is diminished, and they are less able to care for their children. Thus, the vicious cycle of undernutrition and poverty often continues across generations.

Despite the common impacts of undernutrition on children across regions, the same consequences can be heightened or reduced based on particular contexts. Therefore, the application of a model to estimate the impact of child undernutrition in Africa required an in-depth analysis of the nature of undernutrition on the continent, the particular pathologies that are commonly associated with undernourished children and labour market considerations to correctly access the productivity aspects of the region.

Some of the key elements that have been revised in the COHA model from the model utilized in LAC are described below:

- The utilization of WHO curves and updated research to estimate the mortality risk of the undernourished. Historical underweight rates were adjusted to consider the impact of mortality on undernourished children.

- Given the difficulties in accessing public health systems on the continent, variables that consider the distribution between public and private health costs were included in the model, to better estimate the burden carried by the families. These values were collected from

various sources, including national health data, DHS, and through consultations with experts at national level. For detailed information on the data used, see Annex 5: Assumptions by Country.

- The relationship between undernutrition and educational performance was revised to establish the relationship between stunting (rather than underweight) and school performance. Specific analysis was undertaken for the COHA study to determine the relative risk of stunted children repeating grades or dropping out of school.

- Given the specific structure of African economies, the productivity associated with manual labour was analysed in the model. The model applied in LAC focused on the phenomenon of underweight and its relationship to grade repetition and school dropout, as well as the consequential impacts on income. In addition to this dimension, COHA examines the effects of stunting on earning potential in manual labour. This was a key element of the adaptation, as it allowed the study to highlight the particularities of the agricultural sector and rural production. The revised model used data on the proportion of the working-age population in manual versus non-manual labour and estimated impacts of stunting on each of these groups separately.

- For the analysis of scenarios developed under the prospective dimension of the COHA model, a discount rate was applied to establish the present value of the future cost of child undernutrition. A key element in this analysis is ensuring that the investment rate reflects the multisectoral perspective of the investments required to address child malnutrition, beyond just the health sector, which typically applies a 3 percent rate for prospective analysis, as is the case for Disability Adjusted Life Years. In consultation with partners in the region, various options were analyzed, including, discount rates applied by the African Development Bank to assess investment in the social sector; discount rates applied by the pilot countries in analysis investment of public funds; and discount rates applied in analyzing social investment in other sectors.

This section will summarize the main elements that were adapted in the COHA model. Further methodological details are available in Annex 2.

3.6.A Risk of Mortality for Undernourished Children

Undernourished children have a higher risk of dying due to their condition; this is a key element in addressing the relationship between undernutrition and productivity. The model utilizes risk factors associated to mortality to define the attribution of mortality to undernutrition and to avoid over-attribution.

In the LAC model, this higher risk was based on research carried out by Fishman et al., where the model derived a higher relative risk of mortality for underweight children at a factor of 3.95.[33] Since this report was published, updated information has been made available to estimate this risk relationship. New analysis of the odds ratio (OR) for mortality for clinically underweight, stunted and wasted children were presented by Black et al in *The Lancet* (see Table 3.1).[34] The COHA model utilized these odds ratios, which were based on updated underweight curves from WHO,[35] to determine the proportions of mortalities that associated with undernutrition. More details are

provided in Annex 2. Estimations that indicated ORs by specific pathologies, such as diarrhoea, pneumonia, malaria and measles, were carried out, but were not used in the COHA methodology.

TABLE 3.1
ODDS RATIO FOR MORTALITY BY WEIGHT-FOR-AGE, HEIGHT-FOR-AGE AND WEIGHT-FOR-HEIGHT, BY CAUSE OF DEATH

Cause of Death	Severe <–3 (95% CI[a])	Moderate –3 to <–2 (95% CI)	–2 to <–1 (95% CI)	More than –1
Weight-for-age (Z score)				
Overall	9.7 (5.2–17.9)	2.5 (1.8–3.6)	1.8 (1.2–2.7)	1.0
Diarrhoea	9.5 (5.5–16.5)	3.4 (2.7–4.4)	2.1 (1.6–2.7)	1.0
Pneumonia	6.4 (3.9–10.4)	1.3 (0.9–2.0)	1.2 (0.7–1.9)	1.0
Malaria	1.6 (1.0–2.7)	1.2 (0.5–3.5)	0.8 (0.2–3.2)	1.0
Measles	6.4 (4.6–9.1)	2.3 (1.7–3.2)	1.3 (1.1–1.5)	1.0
Height-for-age (Z score)				
Overall	4.1 (2.6–6.4)	1.6 (1.3–2.2)	1.2 (0.9–1.5)	1.0
Diarrhoea	4.6 (2.7–8.1)	1.6 (1.1–2.5)	1.2 (0.9–1.7)	1.0
Pneumonia	3.2 (1.5–6.7)	1.3 (0.9–2.1)	1 (0.6–1.6)	1.0
Malaria	2.1 (0.9–4.9)	1.0 (0.4–2.4)	0.7 (0.5–0.9)	1.0
Measles	2.8 (1.4–5.8)	1.7 (0.8–3.6)	0.7 (0.5–0.9)	1.0
Weight-for-height (Z score)				
Overall	9.4 (5.3–16.8)	3.0 (2.0–4.5)	1.5 (1.2–1.9)	1.0
Diarrhoea	6.3 (2.7–14.7)	2.9 (1.8–4.5)	1.2 (0.7–1.9)	1.0
Pneumonia	8.7 (4.8–15.6)	4.2 (3.2–5.5)	1.6 (1.1–2.4)	1.0
Malaria	2.3 (1.6–3.2)	3.0 (1.0–8.9)	0.9 (0.3–2.6)	1.0
Measles	6.0 (4.3–8.2)	3.7 (2.5–5.5)	1.8 (0.9–3.6)	1.0

a/ Confidence Interval
Source: Robert E. Black et al., "Maternal and child undernutrition: global and regional exposures and health consequences."[36]

As the model was designed to work based on relative risk differential and not odds ratio, the COHA technical team derived these factors in order to estimate relative risk values that could be used in the model. Relative risk are advantageous as they establish the differential probability of having a problem (in health, education, productivity) between different populations (those that do or do not suffer from undernutrition). The OR are more commonly used to reflect the effectiveness of an intervention in the affected population (that is, those who have those problems), compared to the population for which no intervention has been made.

3.6.B Access to Health Services

One of the important development challenges for Africa is the expansion of health services to the population. The region has the second lowest level of public investment in health and coverage of pre-natal health care in the world, ranking higher than only that of South Asia (Table 3.2).[37] Often, cases of common illness such as diarrhoea, ARI and malaria can generate complications if untreated, increasing the intensity of the episode and heightening the risks for recurrence and mortality, especially in undernourished children. These cases that go untreated can generate higher private cost to the family when compared to the treatment that the child should have received.

TABLE 3.2
HEALTH COVERAGE INFORMATION. BY REGION

Region	Health expenditure per capita[a]	Pregnant women receiving prenatal care (%)[b]
Arab World	296	--
Caribbean small states	536	97.9
East Asia & Pacific*	226	92
Europe & Central Asia*	436	…
Latin America & Caribbean*	715	96
Middle East & North Africa*	233	--
North America	8,311	--
South Asia	53	70.1
Sub-Saharan Africa*	94	76.3
World		80.6

* Developing only
[a] Total health expenditure is the sum of public and private health expenditures as a ratio of total population. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation. Data are in current U.S. dollars. (2011). Source: World Bank statistical database.[38]
[b] UNICEF, *State of the World's Children*,[39] and Demographic and Health Surveys by ICF International (2009).[40]

In order to address this important contextual element in the COHA model, a series of variables were created, allowing each NIT to determine the different coverage rates particular to every pathology and country context. The data collected in this section frequently came from proxy indicators based on the information gathered by DHS. For a detailed list of these variables and proxy variables. by country, see Annex 5. As there is no element to estimate the costs of untreated cases, the model utilizes the cost of a case treated in the health system as a shadow price, and assigns the total value as a private cost to the caretakers. This illustrates the opportunity costs borne by families as a result of low levels of health care coverage. In this way, the model avoids overestimating these untreated cases, while it generates a public-private distribution of costs and thus, better reflects the reality of each country.

3.6.C Stunting and Educational Performance

The relationship between child nutrition and school performance has been the focus of many research papers.[41,42] Although it is clear that grade repetition and dropout are a consequence of multiple elements, such as remoteness of schools, the need to work, quality of schooling[43] and lower parental education, there seems to be strong evidence that undernutrition also plays an important role in low school performance, grade repetition, and high dropout rates.

In order to best capture the effect of undernutrition on school performance, it is optimal to analyse this relationship with a long-term, chronic undernutrition indicator. As such, stunting is a strong predictor for the effect of undernutrition on school performance (as compared to weight-for-height).

Several specific country-based studies have been carried out in Africa to analyse the relationship between nutrition and educational performance. Most of this research has highlighted the effect of stunting on late enrolment[44] or the nutritional status of school age children and their school performance,[45] but no specific longitudinal studies on stunting, as a predictor of schooling trajectories, were identified within the African continent.

Particular research was undertaken utilizing data from the Cebu Longitudinal Health and Nutrition Survey in the Philippines that analysed the higher risk of stunted children to repeat grades and to drop out earlier from school than children with normal height-for-age.[46] To carry out their analysis, the research team adjusted for confounding factors, such as parity, parental education, maternal height, household assets, environmental cleanliness, presence of electricity and household income, and followed the schooling trajectory of over 2,000 children. As Table 3.3 shows, the results indicated that stunted children were 1.35 times more likely to repeat grades and 1.61 times more likely to drop out of school than children who have never been stunted. Given the data limitations in the African continent, these relative risk ratios were utilized in the COHA model.

TABLE 3.3 **RELATIVE RISK RATIOS FOR STUNTED CHILDREN:** **GRADE REPETITION AND DROPOUTS**								
Condition	**Stunted as Children**	**Non-Stunted as Children**	**Total**		**Condition**	**Stunted as Children**	**Non-Stunted as Children**	**Total**
Repeated grades (RG)	668	233	901		Dropped out of school (DO)	680	201	881
Did not repeat grades	644	387	1031		Did not drop out	649	433	1082
Total	1312	620	1932		Total	1329	634	1963
Risk Factor	0.50915	0.37581	0.46636		Risk Factor	0.51166	0.31703	0.44880
Differential Risk – RG	0.1333	Relative Risk Ratio	1.3548		Differential Risk – DO	0.1946	Relative Risk Ratio	1.6139

Source: Calculated based on data from Cebu Longitudinal Health and Nutrition Survey.[47]

3.6.D Stunting and Manual Productivity

Manual activities are one of the key drivers of production in Africa. Currently, more than 60 percent of the population on the continent lives in rural areas,[48] and almost half of every geographical region on the continent is covered by agricultural land (see Table 3.4).[49]

The agricultural sector is an extremely important contributor to the GDPs of African countries. Further, 57 percent of the population in Africa is engaged in agricultural activities, including forestry and fisheries, as compared to 11 percent who work in industry, such as manufacturing and construction (see Figure 3.4).[50] Specific data on distribution of labour between manual and non-manual labour is outlined in the sections of this report dedicated to each participating country. This particular context makes it necessary for COHA to explore the differential impact that child undernutrition has on physical productivity of adults.

Substantial research has been carried out indicating that stunted children would have reduced stature and body mass as adults, which influences their productive capacity in physical work.[51] Given the ethical imperatives of analysing human conditions, most of the available research is based on causal linkages

<table>
<tr><th colspan="4">TABLE 3.4
RURAL DEVELOPMENT INFORMATION, BY REGION (2007-2010)*</th></tr>
</table>

Region	Rural population (% of total population)[52]	Agricultural land (% of land area)[53]	Agriculture, value added (% of GDP)[54]
Arab World	43.63	40.15	6.88
East Asia & Pacific	48.30	49.26	3.39
Europe & Central Asia	29.98	29.38	1.88
Latin America & Caribbean	21.19	35.80	6.24
Middle East & North Africa	37.75	33.41	7.35
North America	18.01	25.82	1.18
South Asia	69.44	54.64	18.28
Sub-Saharan Africa	63.96	44.63	11.16
World	48.48	37.66	2.81

Source: World Bank Development Indicators. *Last years available*

that are logically inferred, without proving a definitive causal relationship. Ultimately, the context in which an individual is situated is the major determinant for his/her production levels and his/her capacity to convert that production into income.

There is a lack of region-specific research on the impact of child undernutrition on adult manual productivity in Africa. However, a study carried out in an agricultural context in Asia analysed this link by utilizing adult height as a determinant of income in agricultural productivity, while controlling for other contextual elements . It determined that for each percentage point lost in height due to child undernutrition, a person would earn 1.38 percent less income compared to non-stunted individuals.[55]

FIGURE 3.4
DISTRIBUTION OF ECONOMIC ACTIVITIES IN AFRICA
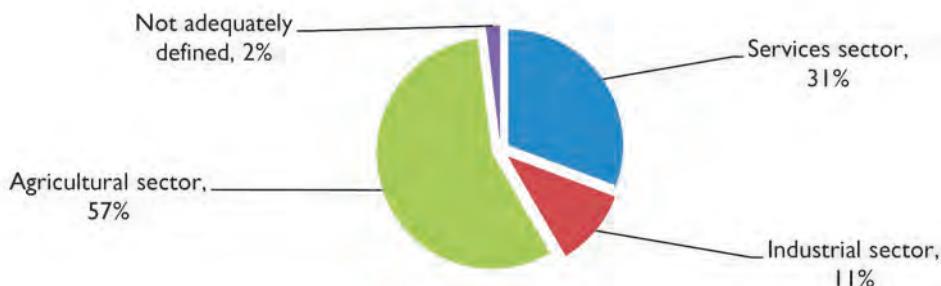
Source: Key Indicators from the Labour Market (KILM) report, Seventh Edition (International Labour Organization, 2011).[56]

On the other hand, some specific research has been undertaken in Africa to determine the impact that stunting has on adult height. One study analysed the catch-up capacity of stunted girls and boys as they grew into adulthood; it determined that even though there is some catch-up capacity prior to reaching adulthood, it does not substantially decrease the difference in height between the formerly stunted and non-stunted children.[57] These elements constitute the base for the model developed to estimate the potential losses in income of the adult population affected by childhood stunting.

In order to estimate losses in income associated with stunting, it is necessary to determine the distribution of manual and non-manual labour, as well as the estimated production capacity in each country. Household Consumption, Income and Expenditure Surveys (HCIES) contain income and expenditure information by age, educational level and economic activity. Due to the fact that each category of economic activities considered in the survey included a mix of both manual and non-manual labour, the COHA study utilized a distribution based on 'mostly manual' and 'mostly non-manual' activities, using the International Standard Industrial Classification (ISIC) of economic activities.[58] Labour productively is calculated based on the estimated income or expenditure among the working-age population on an individual basis.

TABLE 3.5
DISTRIBUTION OF MANUAL AND NON-MANUAL ACTIVITIES

Manual activities	Non-Manual activities
Agriculture, forestry and fishing	Wholesale and retail trade, repair of motor vehicles and motorcycles
Mining and quarrying	Transportation and storage
Manufacturing	Accommodation and food service activities
Construction	Information and communication
Electricity, gas, steam and air conditioning supply	Financial and insurance activities
	Real estate activities
Water supply, sewerage, waste management and remediation activities	Professional, scientific and technical activities
	Administrative and support service activities
	Public administration and defence, compulsory social security
	Education
	Human health and social work activities
	Arts, entertainment and recreation
	Other service activities
	Activities of households as employers, undifferentiated goods- and service-producing activities of households for own use
	Activities of extraterritorial organizations and bodies

Source: Authors' proposal based on International Standard Industrial Classification (ISIC) of economic activities.[59]

3.6.E Limitations to the COHA model

The framework to estimate the social and economic cost of undernutrition was constructed based on a thorough review of the consequences of child undernutrition in Africa. Nevertheless, there are also methodological limitations to establishing a social or economic value to these elements. Challenges are partly due to the lack of available research, difficulties in establishing attributions or managing potential overlaps. These limitations will be pending elements in future work of this model, as more research is made available on each topic.

(1) Limitations in integrating social aspects

Women's role in reducing child undernutrition is critical. Women are often the primary caregivers for infants, and it is important that they have sufficient information on nutrition to make informed choices. An undernourished woman is also more likely to bear a low-birth-weight child and continue the cycle of poverty and malnutrition.[60]

Nevertheless, when the authors of this study attempted to disaggregate the results of the COHA model based on gender, several challenges were encountered. From a biological perspective, undernutrition seems to have a similar impact on all children before the age of five, regardless of gender. Undernourished children are more affected by illness, as compared to healthy children; however, no apparent difference can be attributed to gender. Additionally, there are no protocol differences in terms of attention given to girls and boys in the public health system for the common pathologies associated to undernutrition.

Similarly, for school-age children, there is no conclusive evidence to prove that the effect of child undernutrition on cognitive development and educational performance has a higher impact on students of either gender. Further, there is no substantial difference of costs incurred to the public system or the families of girls or boys in school.

A more complicated scenario was faced when researchers attempted to disaggregate the gender aspects of productivity. The COHA model utilizes official information available in HCIES to estimate the potential productivity of an individual, given his or her particular socio-economic context, economic activity and age. Nevertheless, these surveys often focus on consumption, income or expenditure capacity within the households and fail to consider the in-kind contribution provided by mothers in terms of care and time use. As a result, women's contribution to the household economy is often estimated at a lower value than that of men. When analysing this situation from a cost perspective, it would seem that since women's productivity is proportionally less, the losses in their productivity are also lower in absolute terms In this scenario, it would seem then that improving the nutritional status of men would generate more savings to the economy, which is inaccurate.

Research indicates that exposure to severe undernutrition during pregnancy impacts the future capacity of the born child to develop literacy skills, compete in the labour market and create wealth. It has not been able to establish however, the specific ratios to determine the dimension of this impact. Given these methodological constraints, the COHA research team and advisory panel opted to maintain the results aggregated and to enhance the gender aspects of nutrition as part of the advocacy efforts and interventions that are put in place to reduce child undernutrition.

(2) Limitations in integrating biological aspects

HIV has been an issue of concern in Africa for several decades. According to UNAIDS, the sub-Saharan region is the most affected area in the world, with 1 out of 20 adults living with HIV. HIV-positive people in sub-Saharan Africa account for 69 percent of the people and 90 percent of children living with HIV worldwide. Although the level of new infections is currently declining, the Sub-Saharan region accounted for 71 percent of new infections in 2011.[61]

The relationship between nutrition and HIV has been explored in many studies. Undernutrition is a major complication in HIV-positive patients and early nutritional interventions are recommended in order for these patients to gain lean body mass.[62] However, there is no research that attributes a higher risk of infection as a causal or direct logical relationship to child undernutrition; an undernourished child does not have an increased incremental probability of becoming infected with HIV compared to a child who is not undernourished, other conditions being equal.

However, the nutritional condition of a child does have an important impact on the child already living with HIV. Undernourished children, who are HIV positive, are at a higher risk of becoming ill.[63] These children will have increased incremental episodes of common illnesses such as diarrhoea, anaemia and pneumonia, which are associated with undernutrition. In countries with high HIV prevalence, this will be reflected in a higher number of average episodes per child. Based on this, the model integrates the impact of undernutrition on children living with HIV and the incremental cost that this generates to their families and to the public health system.

(3) Limitations in integrating environmental aspects

The linkages between nutrition and climate change are often highlighted in the analysis of child undernutrition. Environmental shocks impact heavily on the availability of food and clean water and can also generate migration that has a toll in the nutritional situation of a population. Often, the most affected are the elderly and the children, due to their particular vulnerabilities and nutritional requirements. This is of particular concern in Africa, which is becoming the most exposed region in the world to the effects of climate change[64].

The ability to cope with climate-related challenges is strongly based on the resilience of the individuals and household. However, the existing social policies and community interaction are also critical coping elements. In this sense, it is difficult to establish a long-term differential consequence of climate change on child nutrition at the individual level, as the dynamics of this system are often in constant evolution.

Famine has also been a particular threat to the nutritional situation of individuals in the region, with several events occurring in Africa in the 20th century and particularly in the last 10 years. The impact of famine on mortality is reflected in the mortality and survival rate projections that the model utilizes for each particular country. Further, some research suggests that the effect of famine might even have consequences on ensuing generations.[65] Nevertheless, increased research defining relative risks ratios, especially in undernourished children, would enrich the analysis of this study.

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PART II:

First-Phase Country Results

4. Country Results: Egypt

4.1 Brief Socio-Economic and Nutritional Background

The Arab Republic of Egypt (hereafter referred to as Egypt), with a population of 82 million, is the largest Arab country and the third largest African country by population. Egypt has a Gross Domestic Product (GDP) estimated at EGP1.042 trillion (2009) and a per capita Gross National Income (GNI) of approximately USD2,600, which has grown considerably in the last decade (see Table 4.1).[1] Further, inequality and extreme poverty rates have maintained relatively low levels in the country, with a Gini index of 30.[2] Less than 2 percent of the population living on under USD1.25 a day; however estimates for people living on under USD2.00 a day are as high as 18 percent.[3]

One of Egypt's main socioeconomic challenges centres on youth employment. The national unemployment level is estimated at 12 percent; nevertheless, youth unemployment is two times higher, and nearly half of all women 15-24 are unemployed.[4]

Egypt has experienced an important period of economic expansion in the last decade, with average growth rates higher than those reported for both the African continent and the North Africa region (see Figure 4.1). Nevertheless, this performance has slowed in recent years due in part to political and civil unrest. According to estimates from the African Economic Outlook, the real GDP growth rates will range from 0.8 percent to 2.8 percent in the next two years.[5]

**TABLE 4.1
SOCIO-ECONOMIC INDICATORS, EGYPT**

Indicators	2000-2002	2005-2007	2009-2011
GDP, total in billions of EGP[a]	378.9	744.8	1042.2 (08/09)
GNI per capita (Atlas method, current USD)	1,370	1,560	2,600
Poverty - $1.25 a day (PPP) (% of population)[a]	1.81	1.99	1.69
Population below the national poverty line (% of population)[b]	16.7	19.6	25.2
Gini Index	32.8	32.1	30.8
Unemployment, % of total labour force	10.2%	8.9%	12%
Unemployment, youth total (% of total labour force ages 15-24)	27.1%	24.8%	…
Unemployment, youth female (% of female labour force ages 15-24)	40%	47.9%	…
Population growth (annual %)	1.85%	1.80%	1.73%
Life expectancy at birth, total (years)	70	72	73

Source if not otherwise noted: World Bank Database.[6]
[a] "World Economic Outlook Database October 2012.[7]

FIGURE 4.1
TRENDS IN REAL GDP GROWTH, EGYPT 2003-2013
(In percentages)
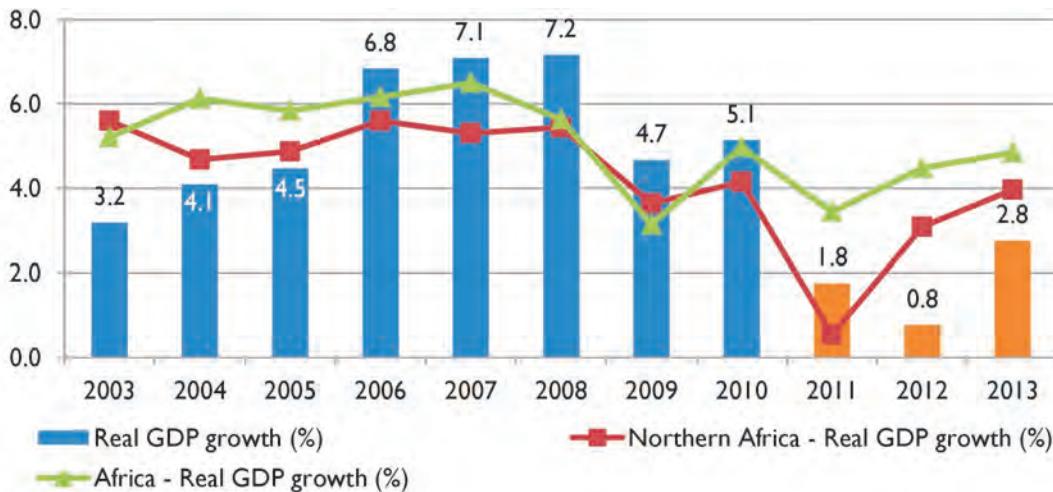
Source: World Economic Outlook Database October 2012.[9] Figures for 2010 are estimates; Orange bars for 2011 and later are projections.

Public investment in the social sector has also been maintained in the last decade, but is still below the average, by proportion, compared to the Middle East and North Africa (MENA) region (see Table 4.2). Public spending in education is estimated at 11.9 percent, which ranks below the regional average of 19.9 percent. Health expenditures are also low compared to the rest of the region, both from a per capita perspective and as a proportion of GDP.[10]

TABLE 4.2
SOCIAL INVESTMENT INDICATORS, EGYPT

Indicators	2005-06	2007-08	2009-10	Middle East & North Africa*
Public spending on education (% of government expenditure)	11.9%	11.9%	...	19.9%
Public spending on education, total (% of GDP)	4.0%	3.8%	...	4.8%
Health expenditure per capita (current USD)	75.2	101.2	123.2	203.2
Health expenditure, total (% of GDP)	5.3%	4.8%	4.6%	5.3%
Health expenditure, public (% of total health expenditure)	44.2%	42.2%	37.4%	50.1%

Source: World Bank Database, most recent year available.[11]
* Developing countries only - Latest data available

From a nutritional perspective, Egypt has maintained low levels of underweight children for the past decade. Nevertheless, the stunting rates have increased in the same period from 20.3 percent to 28.9 percent, as reported in DHS reports (see Table 4.2).[12, 13]

FIGURE 4.2
ESTIMATED UNDERNUTRITION TRENDS IN CHILDREN UNDER-FIVE, EGYPT, 1990-2010
(In percentages)
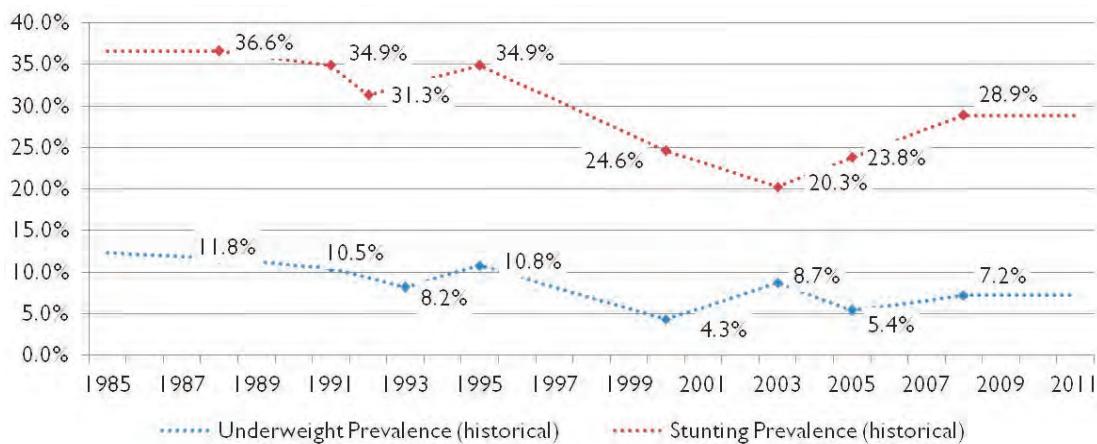
Source: Prepared in-house based on information from Egypt DHS 2008[14] and National Surveys.[15] Data prior to 2006 has been updated in line with new Child Growth Standards[16] introduced by WHO in 2006 to replace the 1977 International Growth Reference, formulated by the National Center for Health Statistics (NCHS).[17]

The current levels of child undernutrition illustrate the challenges in reducing child hunger. It is estimated that 2.7 million of the 9.2 million children under the age of 5 were affected by growth retardation, and 658,515 children were underweight in 2009 (see Table 4.3). This situation is especially critical for children between 12 months and 24 months, where one out of every three children is affected by growth retardation.[18]

TABLE 4.3
POPULATION AND CHILD UNDERNUTRITION, EGYPT, 2009
(Population in thousands)

Age groups	Population size[a]	Low Birth Weight		Underweight		Stunting	
		Population affected	Prevalence[b]	Population affected	Prevalence	Population affected	Prevalence
New-born (IUGR)[b]	1,876	117	6.2%				
0-11 months				163	8.7%	370	19.7%
12-23 months	1,858			124	6.7%	641	34.5%
24-59 months	5,453			371	6.8%	1,734	31.8%
Total	**9,187**	**117**	**6.2%**	**658**	**7.2%**	**2,744**	**28.9%**

Source: Estimated based on DHS surveys 2008[19] and demographic projections.
[a] In a given year, the new-born population is the same as the 0-11 month's age group.
[b] Estimated on the basis of the equation of De Onis et al, 2003.[20]

4.2 Effects and Costs of Child Undernutrition

Undernutrition is mainly characterized by wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age). In early childhood, undernutrition has negative life-long and intergenerational consequences; undernourished children are more likely to require medical care as a result of undernutrition-related diseases and deficiencies.[21] This increases the burden on public social services and health costs incurred by the government and the affected families. Without proper care, underweight and wasting in children results in a higher risk of mortality.[22] During schooling years, stunted children are more likely to repeat grades[23] and drop out of school,[24] thus reducing their income-earning capability later in life.[25] Furthermore, adults who were stunted as children are less likely to achieve their expected physical and cognitive development, thereby impacting on their productivity.[26]

4.2.A Social and Economic Cost of Child Undernutrition in the Health Sector

Undernutrition at an early age predisposes children to higher morbidity[27] and mortality risks.[28] The risk of becoming ill due to undernutrition has been estimated using probability differentials, as described in the methodology. Specifically, the study has examined medical costs associated with treating low birth weight (LBW), underweight, anaemia, acute respiratory infections (ARI), and acute diarrhoeal syndrome (ADS) associated with undernutrition in children under the age of five.

(1) Effects on morbidity

Undernourished children are more susceptible to recurring illness.[29] Based on the differential probability analysis undertaken with DHS data in Egypt, underweight children between 28 days and 11 months are more affected by anaemia (increase of 13.4 percentage points), and children between 12 and 24 months have a higher risk of diarrhoea (increase of 1.42 percentage points).[30]

The COHA study estimated that in Egypt in 2009, there were 901,440 incremental episodes of illness related to diseases associated with underweight (see Table 4.4). In addition, pathologies related to calorie and protein deficiencies and low birth weight associated with intrauterine growth restriction (IUGR), totalled more than 775,218 episodes in 2009.

TABLE 4.4
MORBIDITIES FOR CHILDREN UNDER-FIVE ASSOCIATED WITH UNDERWEIGHT, BY PATHOLOGY, EGYPT, 2009

Pathology	Number of episodes	Percentage of episodes
Anaemia	102,965	82%
ADS	18,342	15%
ARI	4,915	4%
Subtotal	126,222	
LBW	116,702	15%
Underweight	658,516	85%
Subtotal	775,218	
Total	**901,440**	

Source: Model estimations based on DHS 2008, and demographic information.[31]

(2) Stunting levels of the working age population

Undernutrition leads to stunting in children, which can impact on their productivity at later stages in life. Egypt has made important historical progress in reducing stunting in children; nevertheless, there has been a reported recent increase in the prevalence of chronic undernutrition.[32] As illustrated in Figure 4.3, the model estimated that 20.5 million adults in the working-age population suffered from growth retardation before reaching five years. In 2009, this represented 41 percent of the population aged 15-64 who were in a disadvantaged position as compared to those who were not undernourished as children.

FIGURE 4.3
WORKING AGE POPULATION AFFECTED BY CHILDHOOD STUNTING, BY AGE GROUP, EGYPT
(In millions of people)
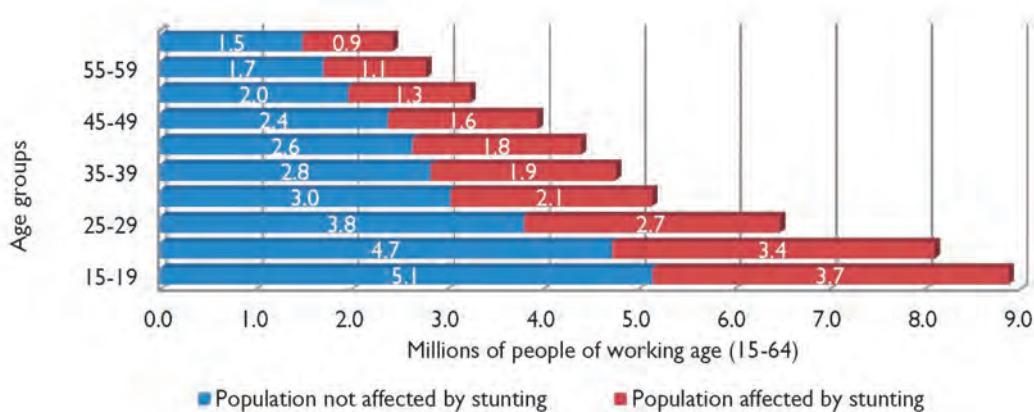
Source: Model estimations based on demographic information and WHO/NCHS database.[33]

(3) Effects on mortality

Child undernutrition can lead to increased cases of mortality most often associated with incidences of diarrhoea and pneumonia and malaria.[34] Nevertheless, when the cause of death is determined, it is rarely attributed to the nutritional deficit of the child, but rather to the related illnesses. Given this limitation in attribution, the model utilizes relative risk factors[35] to estimate the risk of increased child mortality as a result of child undernutrition. Mortality risk associated with undernutrition was calculated using these relative risk factors, historical survival and mortality rates,[36] and historical nutrition information.

TABLE 4.5
IMPACT OF UNDERNUTRITION ON CHILD MORTALITY, EGYPT, ADJUSTED BY SURVIVAL RATE, 1945-2009
(In number of mortalities)

Period	Number of child mortalities associated with undernutrition
1945-1994	352,813
1995-2004	79,932
2005-2009	28,102
Total	**460,847**

Source: ECA, on the basis of life tables provided by UN Population Division[37] and population data provided by CAPMAS.[38]

In the last 5 years alone, it is estimated that 28,102 child deaths in Egypt were directly associated with undernutrition (see Table 4.5). These deaths represent 11 percent of all child mortalities for this period. Thus, it is evident that undernutrition significantly exacerbates the rates of death among children and limits the country's capacity to achieve the MDGs, especially the goal to reduce child mortality.

These historical mortality rates will also have an impact on national productivity. The model estimates that an equivalent of 0.92 percent of the current workforce has been lost due to the impact of undernutrition in increasing child mortality rates. This represents 352,813 people who would have between 15-64 years old, and part of the working age population of the country.

(4) Estimation of public and private health costs

The treatment of undernutrition and related illnesses is a critical recurrent cost for the health system. Treating a severely underweight child, for example, requires a comprehensive protocol[39] that is often more costly than the monetary value and effort needed to prevent undernutrition. The economic cost of each episode is often increased by inefficiencies when such cases are treated without proper guidance from a health-care professional or due to lack of access to proper health services. These costs generate a significant important burden not just to the public sector but to society as a whole. It is estimated that 901,440 clinical episodes in Egypt in 2009 were associated with the higher risk present in underweight children. As indicated in Table 4.6, these episodes generated an estimated cost of EGP1.17 billion.

TABLE 4.6
HEALTH COSTS OF UNDERNUTRITION-RELATED PATHOLOGIES, EGYPT, 2009

Pathology	Number of episodes	Cost in EGP (millions)	Cost in USD (millions)
Underweight	658,516	149	27.2
Low birth weight (IUGR)	116,702	516	93.8
Anaemia	102,965	470	85.4
Acute diarrhoeal syndrome (ADS)	18,342	32	5.8
Acute respiratory infection (ARI)	4,915	3	0.5
Total	**901,440**	**1,170**	**212.7**

Source: Model estimations based on DHS 2008.[40]

Most of these costs incurred were associated with the protocol required to bring an underweight child back to a proper nutritional status, which often requires therapeutic feeding.[41] An important element to highlight is the particular costs generated by the treatment of low birth weight children. These cases represented 14 percent of all the episodes but generated 45 percent of the total cost, making it the highest per capita element analysed. This is due to the special management protocol required by LBW children, which often includes hospitalization and time in intensive care.[42]

A large proportion of costs related to undernutrition are borne by families, as these children are often not provided with proper health care. Based on the information collected by the NIT and DHS surveys[43], the model estimated that only 20 percent of these episodes presented receive proper health care.[44] As explained in the methodology section of this report, medical costs incurred in a treatment facility are used as shadow costs to estimate the burden borne by families. Figure 4.5 summarizes the institutional (public system) costs and costs to caretakers of treating pathologies associated with undernutrition. In Egypt, it is estimated that families bear around 73 percent of the costs associated

with undernutrition, EGP849 million, while the cost to the health system was EGP321 million, or 27 percent.

FIGURE 4.4
DISTRIBUTION OF INCREMENTAL EPISODES AND COSTS OF ILLNESS ASSOCIATED WITH UNDERNUTRITION BY AGE GROUP, EGYPT

% of Cases	0 to 11 months 33%	12 to 23 months 16%	24 to 35 months 17%	36 to 47 months 17%	48 to 59 months 17%
% of Costs	51%	7%	14%	14%	14%

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
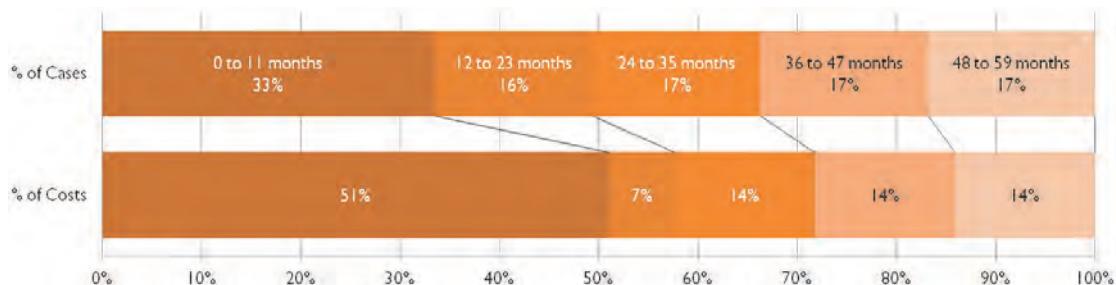
Source: Model estimations based on DHS 2008[45], and demographic information.

Although the families of undernourished children incur most of the health costs related to undernutrition, the burden of this phenomenon is still an important expenditure component in the public sector. In 2009-2010, the annual estimated cost to the public sector was equivalent to 1.62 percent of the total budget allocated to health.[46] On the whole, the economic impact of undernutrition in health-related aspects was equivalent to 0.11 percent of the GDP of that year.

FIGURE 4.5
DISTRIBUTION OF PRIVATE AND PUBLIC HEALTH COSTS, EGYPT
(In percentages and millions of EGP)

EGP 849	EGP 321

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

■ Cost to families   ■ Cost to system
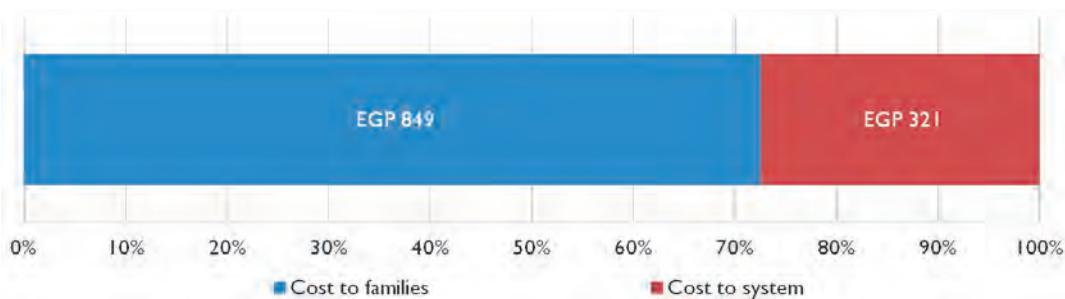
Source: Model estimations based on demographic information and WHO/DHS nutritional surveys.[45]

4.2.B Social and Economic Cost of Child Undernutrition in the Education Sector

There is no single cause for repetition and dropout; however, there is substantive research that shows that students who were stunted before the age of 5 are more likely to underperform in school.[47] The number of repetition and dropout cases considered in this section results from applying a differential risk factor associated to stunted children to the official government information on grade repetition and dropouts in 2009. The cost estimations are based on information provided by the Ministry of Education on the average cost of a child to attend primary and secondary school in Egypt in 2009, as well as estimations of costs incurred by families to support schooling.[48]

(1) Effects on repetition

Children who suffered from undernutrition before 5 years of age are more likely to repeat grades, compared to those were not afflicted by undernutrition.[49] In Egypt in 2009, enrolment rates were relatively high, with 95 percent enrolment in primary education and 68 percent enrolment in secondary education.[50]

Based on official information provided by the Ministry of Education, over 830,603 children repeated grades in 2009.[51] Using data on increased risk of repetition among stunted students, the model estimated that the repetition rate for stunted children was 7.4 percent, while the repetition rate for non-stunted children was 5.4 percent (see Figure 4.6). Thus, given the proportion of stunted students, the model estimates that 79,396 students, or 10 percent of all repetitions in 2009 were associated with stunting.

FIGURE 4.6
REPETITION RATES IN EDUCATION BY NUTRITIONAL STATUS, EGYPT, 2009
(In percentages)
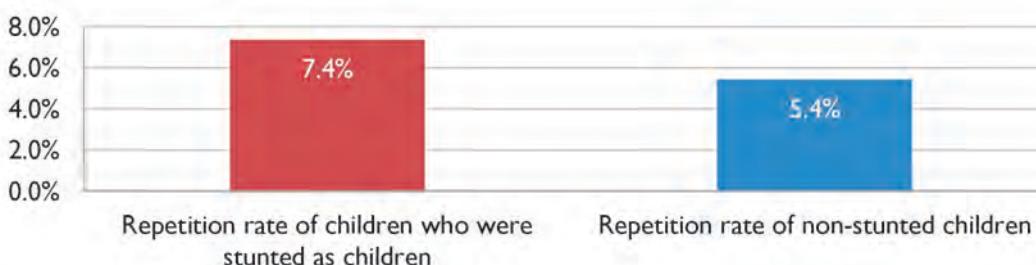
Source: Estimations based on data provided by NIT (Ministry of Education – Education Statistics Annual Abstract 2008/09).[52]

As shown in Figure 4.7, most of these grade repetitions happen during the primary and preparatory school. There are far fewer children who repeat grades during secondary school; this largely due to the fact that many underperforming students would have dropped out of school before reaching secondary education.

FIGURE 4.7
GRADE REPETITION OF STUNTED CHILDREN, BY GRADE, EGYPT, 2009
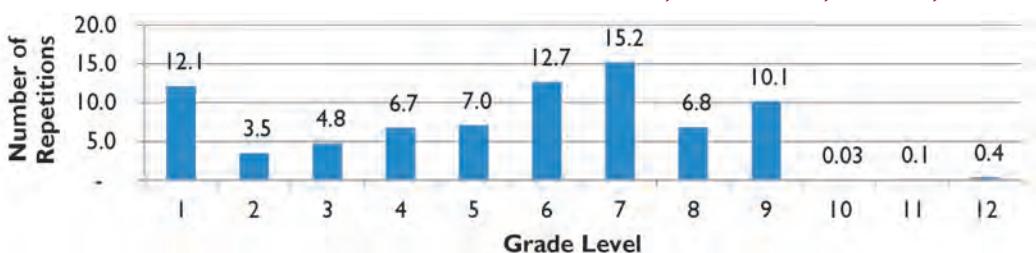
Source: Estimations based on data from Ministry of Education.[53]

(2) Effects on retention

Research shows that students who were stunted as children are more likely to drop out of school.[54] According to available data and taking into account relative risks relating to the consequences of stunting on education, it can be estimated that only 45 percent of non-stunted people (of working age) in Egypt completed lower secondary school, compared to 43 percent completion estimates for those who suffered from stunting. Further, only 3 percent of non-stunted people completed secondary school, while only 1 percent of stunted people did. Figure 4.8, below, shows the estimated grade achievement, based on nutritional status.

FIGURE 4.8
GRADE ACHIEVEMENT BY NUTRITIONAL STATUS, EGYPT, 2009
(In percentages)
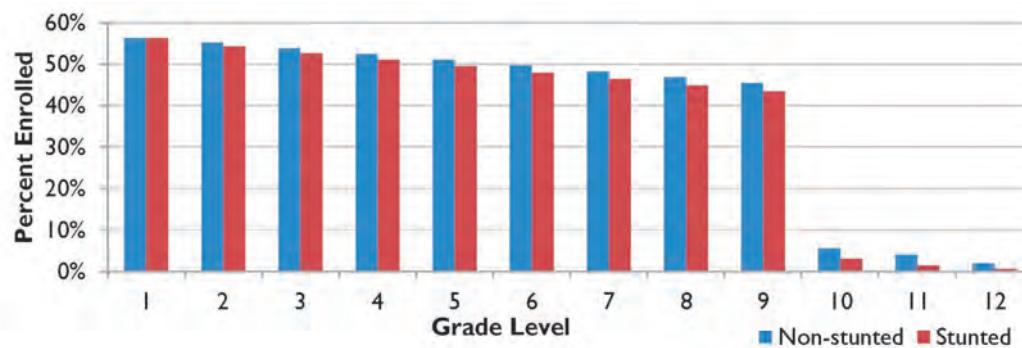
Source: Estimations based on data provided by NIT.[54]

The costs associated with school dropouts are reflected in the productivity losses experienced by individuals searching for opportunities in the labour market. As such, the impact is not reflected in the school age population, but in the working-age population. Hence, in order to assess the social and economic costs in 2009, the analysis focuses on the differential in schooling levels achieved by the population who suffered from stunting as children and the schooling levels of the population who was never stunted.

(3) Estimation of public and private education costs

Repetition in schooling has direct cost implications for families and the school system. Students who repeat grades generate an incremental cost to the education system, as they require twice as many resources to repeat the year. In addition, the caretakers also have to pay for an additional year of education.

In 2009, the 79,396 students who repeated grades and whose repetitions are considered to be associated with undernutrition incurred a cost of EGP271 million. The largest proportion of repetitions occurred during primary school, where the cost burden falls mostly on the public education system. Table 4.7 summarizes the public and private education costs associated with stunting.

TABLE 4.7
COSTS OF GRADE REPETITIONS ASSOCIATED WITH STUNTING, EGYPT, 2009

	Primary	Secondary	Total
Number of repetitions associated with stunting	46,762	32,634	79,396
Total public costs (in millions EGP)	62.2	101.8	163.9
Total private costs (in millions EGP)	62.9	43.9	106.8
Total (in millions EGP)	125.1	145.7	270.7
Total public costs (in millions USD)	11.3	18.5	29.8
Total private costs (in millions USD)	11.4	8.0	19.4
Total (in millions USD)	22.7	26.5	49.2

Source: Model estimations based on costing data from the Ministry of Education.[55]

As in the case of health, the social cost of undernutrition in education is shared between the public sector and the families. Of the overall costs, a total of EGP107 million (39 percent) are being covered by the care takers, while EGP164 million (61 percent) is borne by the public education system (see Figure 4.9). Nevertheless, the distribution of this cost varies depending on whether the child repeated grades in primary or secondary education. In primary education, the families cover over 50 percent of the associated costs of repeating a year, whereas in secondary the burden on the families is reduced to 30 percent and the government carries the largest proportion of investment in education.

FIGURE 4.9
DISTRIBUTION OF COSTS IN EDUCATION, EGYPT
(In percentages and millions of EGP)
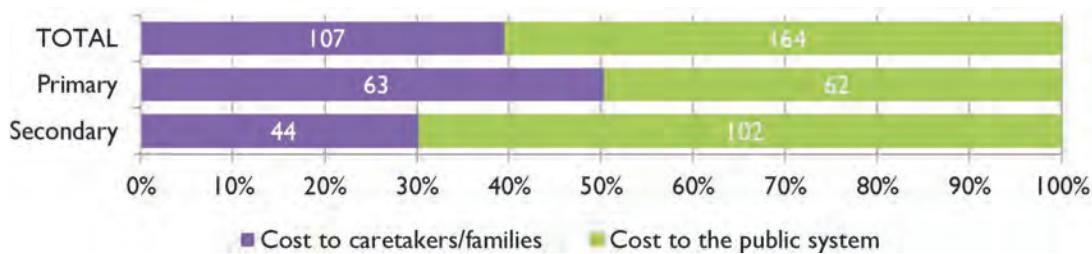
Source: Estimations based on data provided by NIT.[56]

4.2.C Social and Economic Cost of Child Undernutrition in Productivity

As described in the health section of this country report (4.2.A), the model estimated that 41 percent of the working-age population in Egypt were stunted as children. Research shows that adults who suffered from stunting as children are less productive than non-stunted workers and are less able to contribute to the economy. This represents more than 20.5 million people whose potential productivity is affected by undernutrition.

National productivity is significantly affected by historical rates of child undernutrition. Firstly, stunted people, on average, have achieved fewer years of schooling than non-stunted people.[57] In non-manual activities, higher academic achievement is directly correlated with higher income.[58] Research shows that stunted workers engaged in manual activities tend to have less lean body mass[59] and are more likely to be less productive in manual activities than those who were never affected by growth retardation.[60] Finally, the population lost due to child mortality hinders economic growth, as they could have been

healthy productive members of the society.

The model utilizes historical nutritional information, in-country demographic projections, adjusted mortality rates, and data reported in the Egypt Household Income, Expenditure and Consumption Survey (HIECS)[61] from 2009 to estimate the proportion of the population whose labour productivity is affected by childhood nutrition.

The cost estimates in labour productivity were calculated by identifying differential income associated with lower schooling in non-manual activities, as well as the lower productivity associated with stunted people in manual work, such as agriculture. The opportunity cost of productivity due to mortality is based on the expected income that a healthy person would have been earning, had he or she been part of the workforce in 2009.

The distribution of the labour market is an important contextual element in determining the impact of undernutrition on national productivity. As shown in Figure 4.10, 64 percent of the working age population is engaged in manual activities. The trend of manual labour seems to be higher at with the younger group from 15 to 24 years and non-manual activities seems to be more common from 25 to 59 years old; nevertheless, the proportion is consistently lower for non-manual activities. In 2009, 16.7 million people were involved in non-manual activities.[62]

FIGURE 4.10
MANUAL AND NON-MANUAL LABOUR DISTRIBUTION, BY AGE, EGYPT, 2009
(In percentages)
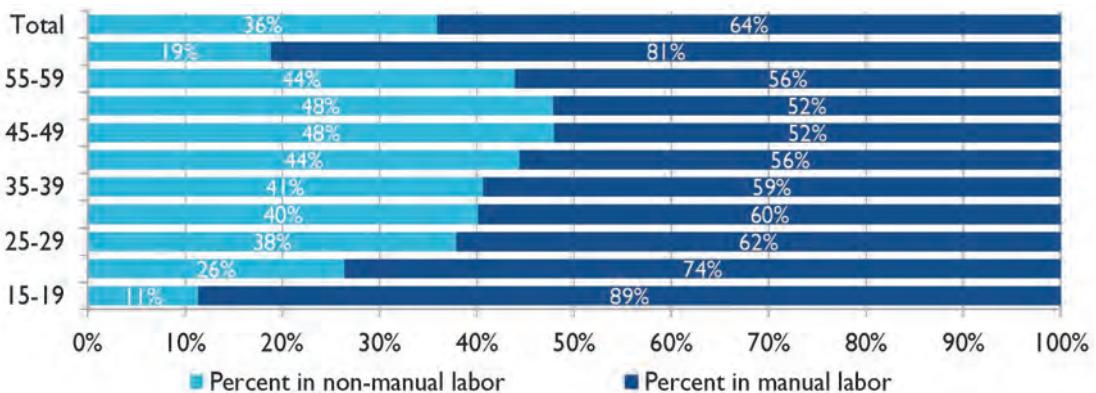
Source: Estimated from Egypt Labour Force Survey, 2009, CAPMAS.[63]

(1) Losses in non-manual activities

As described in the education section of this country report, students who were undernourished as children complete, on average, fewer years of schooling than students who were adequately nourished as children.[64] This loss in educational years has particular impact on people who are engaged in non-manual activities, in which a higher academic education represents a higher income.

Based on information from the HIECS, and as shown in Figure 4.11, it is estimated that the educational gap between the stunted and non-stunted population is 0.2 years. It is important to note that over time there has been an improvement in the average years of schooling among the working population. Whereas the cohort from 60-64 years show an average level of school education of 1.8 years, the cohort aged 20-24 shows an average of seven years of education.

FIGURE 4.11
AVERAGE SCHOOLING YEARS
FOR STUNTED AND NON-STUNTED POPULATION, EGYPT
(In years of education)
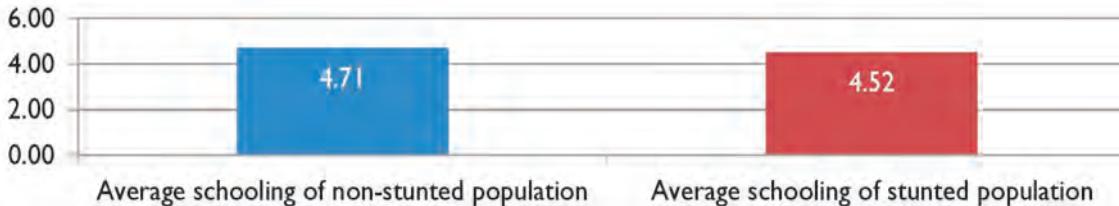
Source: Estimated from Egypt HIECS 2009,[65] CAPMAS[66] and relative risk ratios.

The lower educational achievement of the stunted population has an impact on the expected level of income a person would earn as an adult. As presented in Table 4.8, the model estimates that 7.2 million people engaged in non-manual activities suffered from childhood stunting. This represents 6.3 percent of the country's labour force that is currently less productive due to lower schooling levels associated to stunting. The estimated annual losses in productivity for this group are EGP2.7 billion, equivalent to 0.3 percent of the GDP in 2009.

TABLE 4.8
REDUCED INCOME IN NON-MANUAL ACTIVITIES
DUE TO STUNTING, EGYPT, 2009

Age in 2009	Population working in non-manual sectors who were stunted as children *(In thousands of people)*	Income losses in non-manual labour *(In millions of EGP)*
15-24	1,354	685
25-34	1,947	1,003
35-44	1,674	715
45-54	1,483	230
55-64	724	26
Total	**7,182**	**2,659**
% GDP		**0.3%**

Source: Model estimations based on HIECS 2009[67] CAPMAS[68] and DHS 2008.[69]

(2) Losses in manual activities

Manual activities are mainly observed in the agricultural, forestry and fishing subsectors, employing more than 64 percent of the Egyptian population.[70] Research shows that stunted workers engaged in manual activities tend to have less lean body mass[71] and are more likely to be less productive in manual activities than those who were never affected by growth retardation.[72] The model estimated that 33.5 million Egyptians are engaged in manual activities, of which 13.7 million were stunted as children. This represented an annual loss in potential income that surpasses EGP10.7 billion, equivalent to 1.03 percent of the GDP in potential income lost due to lower productivity.

TABLE 4.9
LOSSES IN POTENTIAL PRODUCTIVITY IN MANUAL ACTIVITIES DUE TO STUNTING, EGYPT, 2009

Age in 2009	Population working in manual labour who were stunted as children (In thousands)	Loss in productivity due to stunting (In millions of EGP)
15-24	5,791	4,793
25-34	2,928	2,719
35-44	2,128	1,594
45-54	1,481	964
55-64	1,372	662
Total	**13,700**	**10,732**
% GDP		**1.03%**

Source: Estimations based on data from CAPMAS[73] and WHO/NCHS Database information.[74]

(3) Opportunity cost due to mortality

As indicated in the health section of this country report, there is an increased risk of child mortality associated with undernutrition. The model estimated that 352,813 people of working age were absent from Egypt's workforce in 2009 due to child mortality associated with undernutrition. This represents a 1 percent reduction in the current workforce.

TABLE 4.10
LOSSES IN POTENTIAL PRODUCTIVITY DUE TO MORTALITY ASSOCIATED WITH UNDERNUTRITION, EGYPT, 2009

Age in 2009	Working hours lost due to higher mortality of underweight children (in millions of Working Hours)	Loss in productivity (in millions of EGP)
15-24	317	2,250
25-34	202	1,441
35-44	159	899
45-54	107	572
55-64	71	274
Total	**857**	**5,436**
% GDP		**0.52%**

Source: Estimations based on data from CAPMAS[75] and WHO/NCHS database information.[76]

Considering the productive levels of the population, by their age and sector of labour, the model estimated that in 2009, the economic losses (measured by working hours lost due to undernutrition-related child mortality) were EGP5.4 billion, which represented 0.52 percent of the country's GDP (see Table 4.10).

(4) Overall productivity losses

The total losses in productivity for 2009 are estimated at approximately EGP18.8 billion, which is equivalent to 1.8 percent of Egypt's GDP. As presented in Figure 4.12, the largest share of productivity loss is due to reduced productivity in manual activities, which represents 57 percent of the total cost. The lost working hours due to the higher mortality risk of underweight children represents 29 percent of the costs. The income differential in manual labour, due to the lower physical and cognitive capacity of people who suffered from growth retardation as children represents 14 percent of the total costs.

FIGURE 4.12
DISTRIBUTION OF LOSSES IN PRODUCTIVITY, BY SECTOR, EGYPT, 2009
(in percentage and millions of EGP)

2,659	10,732	5,436

0% 20% 40% 60% 80% 100%

- ■ Lower productivity in non-manual activities ■ Lower productivity in manual activites
- ■ Economic cost of lost working hours

Source: Estimated from Egypt HIECS 2009,[77] CAPMAS.[78]
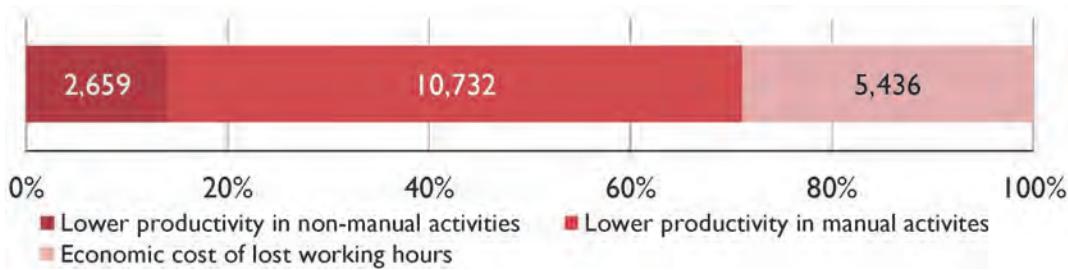
4.2.C Summary of Effects and Costs

The methodology is used to analyse the impact of child undernutrition in different stages of the life cycle, without generating overlaps. As a result, the individual sectoral costs can be aggregated to establish a total social and economic cost of child undernutrition.

For Egypt, the total losses associated with undernutrition are estimated at EGP20.3 billion, or USD3.7 billion for the year 2009. These losses are equivalent to 1.9 percent of GDP of that year (see Table 4.11) The highest element in this cost is the loss in potential productivity in manual activities associated with stunting.

TABLE 4.11
SUMMARY OF COSTS, EGYPT, 2009

	Episodes	Cost in millions of EGP	Cost in millions of USD	Percentage of GDP
Health Costs				
LBW and Underweight	775,217	665	120.9	
Increased Morbidity	126,223	505	91.8	
Total for Health	**901,440**	**1,170**	**213.0**	**0.11%**
Education Costs				
Increased Repetition - Primary	46,762	125	22.7	
Increased Repetition - Secondary	32,634	146	26.5	
Total for Education	**79,396**	**271**	**49.2**	**0.03%**
Productivity Costs				
Lower Productivity - Non-Manual Activities	7,182,482	2,659	483.5	
Lower Productivity - Manual Activities	13,700,990	10,732	1,951.3	
Lower Productivity - Mortality	352,813	5,436	988.4	
Total for Productivity	**21,236,285**	**18,827**	**3,423.0**	**1.81%**
TOTAL COSTS		**20,268**	**3,685.0**	**1.94%**

Source: COHA Model estimations.

Due to the multi-causal phenomenon of grade repetition, the direct costs in education tend to be the lowest of the three sectors. However, school retention is significant, as 13 percent of the losses recorded are due to lost income related to reduced schooling achievement.

4.3 Analysis of Scenarios

The previous section showed the social and economic costs that affect Egypt in 2009 due to high trends of child undernutrition. Most of these costs are already cemented in society and policies must be put in place to improve the lives of those already affected by childhood undernutrition. Nevertheless, there is still room to prevent these costs in the future. Currently, three of out every ten children under-5 in Egypt is stunted.

This section will analyse the impact that a reduction in child undernutrition can have on the socioeconomic context in the country. The results presented in this section project the additional costs in health and education and losses in productivity that Egyptian children would bear in the future,

The model can generate a baseline for various scenarios, based on nutritional goals established in each country. Scenarios, which were agreed upon with the national implementation team in Egypt, can then be used to advocate for increased investments in proven nutritional interventions.

Scenarios were constructed based on the estimated net present value of the costs of the children born in each year, from 2009 to 2025. While the previous section calculated the costs incurred in a single year by historical trends of undernutrition, these costs represent the present values and savings generated by children born during this period.

The scenarios developed for this report are as follows:

Baseline. The cost of inaction — Progress in reduction of stunting and underweight child stops

For the baseline, progress in the reduction of the prevalence of undernutrition stops at the level achieved in 2009. It also assumes that the population growth would maintain the pace reported in the year of the analysis, hence increasing the number of undernourished children and the estimated cost. As this scenario is highly unlikely, its main purpose is to establish a baseline to which any improvements in the nutritional situation are compared in order to determine the potential savings in economic costs.

Scenario #1: Cutting by half the prevalence of child undernutrition by 2025

In this scenario, the prevalence of underweight and stunted children would be reduced to half of the 2009 value. In the case of Egypt, this would mean a constant reduction of 0.9 percent points annually in the stunting rate, from 30.7 (estimate for 2009) to 15.4 percent in 2025. With the right combination of proven interventions, this scenario would be achievable, as the average rate of reduction for stunting between 2000 and 2008 is estimated at 0.76 percentage points, which is very close to the progress rate required in achieving these scenarios. Nevertheless, for the period 2005-2008, the country faced a setback in progress at a rate of -2.3 percentage points, which appears to indicate that stronger investments are required to return to a positive trend.

Scenario #2: The goal scenario — Reduce stunting to 10 percent and underweight children to 5 percent by 2025

In this scenario, the prevalence of stunted children under 5 would be reduced to 10 percent and the prevalence of underweight children under the age of 5, to 5 percent. Currently, the global stunting rate is estimated at 26 percent, with Africa having the highest prevalence at 36 percent. This goal scenario would require a true call for action and would represent an important continental challenge for which countries of the continent could collaborate to achieve. The progress rate required to achieve this scenario would be a 1.2 percentage point annual reduction for a period of 16 years, from 2009 to 2025.

As Figure 4.13 shows, the progressive reduction of child undernutrition generates a similar reduction in the cost associated with it. The distances between the trend lines indicate the savings that would be achieved in each scenario. Figure 4.14 indicates the differences in economic terms.
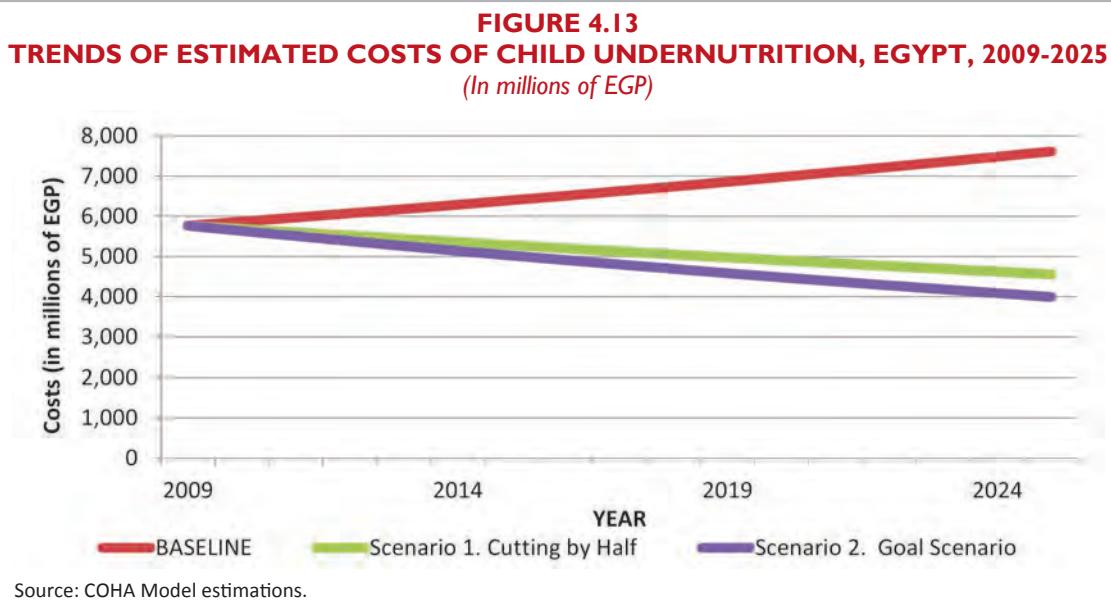
FIGURE 4.13
TRENDS OF ESTIMATED COSTS OF CHILD UNDERNUTRITION, EGYPT, 2009-2025
(In millions of EGP)

Source: COHA Model estimations.

In the baseline, where the progress of reduction of child undernutrition would stop at the level of 2009, the cost in 2025 would reach EGP7.6 billion (USD1.4 billion).

In Scenario #1 in which a reduction of half of the current prevalence is achieved, the cost in 2025 would reduce to EGP4.6 billion (USD828.5 million). For the full period between 2009 to 2025, this would represent a total savings of EGP11.7 billion (USD2.1 billion). Although the tendency of savings would not be linear, as they would increase over time as progress was achieved, a simple average of the annual savings would represent EGP732 million (USD133 million) per year.

TABLE 4.12
COSTS AND SAVINGS BY SCENARIO, EGYPT
(All values in millions)

	Baseline		S1. Cutting by Half		S2. Goal Scenario	
	EGP	USD	EGP	USD	EGP	USD
Projected cost in the year 2025	7,613.4	1,384.3	4,556.9	828.5	3,996.5	726.6
Total projected savings (2009-2025)	-	-	11,708.7	2,128.8	14,514.7	2,639.0
Annual projected savings (2009-2025)*	-	-	731.8	133.1	907.2	164.9
Annual percentage points reduction in stunting rates required achieve scenario (2009-2025)	Progress stops		0.90%		1.20%	

Source: COHA Model estimations.

In the case of the goal scenario, the cost in 2025 would be reduced to EGP3.9 billion (USD726.6 million). This translates into an increase in total savings to EGP14.5 billion (USD2.6 billion), which represents USD164.9 million per year for the same 16-year period.

The potential economic benefits of reducing undernutrition are a key element in making the investment case for nutrition investments. The reduction in clinical episodes for the health system, grade repetition, improvements in educational performance and physical capacity are elements that have a direct contribution in national productivity.

4.4 Conclusions and Recommendations

4.4.A Implications for Egypt's Social and Economic Development

The COHA study is an important step forward to better understand the role that child nutrition and human development can play as a catalyser, or as a constraint, in social and economic transformation. This report marks the first analysis on the social and economic impact of child undernutrition specific for Egypt, opening the way for increased understanding of its consequences.

Its results strongly suggest that in order for the country to achieve sustainable human and economic growth, special attention must be given to the early stages of life as the foundation of human capital. The results of the study are supported by a strong evidenced base, and a model of analysis specially adapted for Africa, which demonstrates the depth of the consequences of child undernutrition in health education and labour productivity. This study further quantifies the potential gains of addressing child undernutrition as a priority. Stakeholders in Egypt now have not only the ethical imperative to address child nutrition as a main concern, but a strong economic rationale to position stunting in the centre of the development agenda.

The study estimates that child undernutrition generated annual health costs in 2009 equivalent to EGP1.1 billion (USD213 million). These costs are due to episodes directly associated with the incremental quantity and intensity of illnesses that affect underweight children and the protocols necessary for their treatment. It is also important to note that only one of every five children is estimated to be receiving proper health attention. As the health coverage expands to rural areas, there will be an increase of people seeking medical attention; this can potentially affect the efficiency of the system to provide proper care services. This study illustrates that a reduction of child undernutrition could facilitate the effectiveness of this expansion by reducing the incremental burden generated by the health requirements of underweight children.

Furthermore, the study estimates that 11 percent of all cases of child mortality in Egypt are associated with the higher risk of undernutrition. Hence, a preventive approach to undernutrition can help reduce this preventable loss of human capital that has an impact on society and the economy.

Increasing the educational level of the population, and maximizing the productive capacity of the population dividend, is a key element to increase competitiveness and innovation. This represents an interesting opportunity in Egypt, where the population under 15 years is estimated to be 31 percent of the total. These children and youth must be equipped with the skills necessary for competitive labour. Thus, the underlying causes for low school performance and early desertion must be addressed. As there is no single cause for this phenomenon, a comprehensive strategy must be put in place that

considers improving the quality of education and the conditions required for school attendance. The study demonstrates that stunting is one of the major contributing factors to the impaired cognitive and physical development that negatively impacts academic performance, which when addressed efficiently can improve scholastic achievements and hence individuals' labour opportunities in the future.

The study estimated that children who were stunted experienced a 2 percent higher repetition rate in school. As a result, 10 percent of all grade repetitions in school are associated with the higher incidence of repetition that is experienced by stunted children. About 59 percent of these cases of grade repetition occur in primary school. These numbers suggest that a reduction in the stunting prevalence could also support an improvement in schooling results, as it would reduce preventable burdens to the education system.

On the African continent, more than half of the population is expected to live in cities by 2035.[79] An important component to prepare for this shift is to ensure that the workforce is ready to make a transition towards more skilled labour and economies are able to produce new jobs to reduce youth unemployment. By preventing child stunting and thus avoiding the associated loss in physical and cognitive capacity that hinders individual productivity, people can be provided with a more equal opportunity for success.

The study estimates that 41 percent of the working age population in Egypt is stunted. This population has achieved on average 0.2 years of lower schooling levels than those who did not experience growth retardation. As the country continues to urbanize, and an increasing number of people participate in skilled employment, this loss in human capital will be reflected in a reduced productive capacity of the population. Thus, it may be a particularly crucial time to address child undernutrition and prepare future youth for better employment by prioritizing the reduction of stunting in Africa's transformation agenda.

The COHA model also provides an important prospective analysis that sheds light on the potential economic benefits to be generated by a reduction in the prevalence of child undernutrition. The model estimates that, in the analysed countries, a reduction of the prevalence to half of the current levels of child undernutrition by the year 2025 can generate annual average savings of EGP732 million (USD133 million). An additional scenario shows that a reduction to 10 percent stunting and 5 percent underweight for that same period could yield annual average savings of EGP907 billion (USD165 million). The economic benefit that would result from a decrease in morbidities, lower repetition rates and an increase in manual and non-manual productivity presents an important economic argument for the incremental investments in child nutrition.

This study is also an important example of how South-South collaboration can work to implement cost effective activities in development and knowledge sharing. Egypt's participation as one of the first-phase countries of the study, and its feedback in challenges faced in collecting the data at national level was an important element in adapting the COHA methodology to Africa. The contributions of the Egypt NIT will serve to facilitate the expansion of this tool on the continent.

Although the COHA study is an important step forward in this type of analysis, there are still important questions left unanswered. Egypt is currently facing an increased prevalence of non-communicable diseases, such as strokes, heart attacks and diabetes (which is also affecting children), which in many cases are a consequence of malnutrition, particularly obesity, which is a type of

malnutrtion. These consequences have not been addressed as part of this analysis, which implies that the health cost of undernutrition could have been underestimated in this framework and that the actual impact is indeed higher than the values presented.

Lastly, this study illustrates the valuable role that data and government-endorsed research can play in shedding light on pertinent issues on the continent. This study will help the country engage within global nutrition movements, such as the Scaling Up Nutrition Initiative, as programmes and interventions are put in place to address stunting as a national priority.

4.4.B Recommendations of the Study

This study presents some key initial findings of the Cost of Hunger in Egypt study, as well as both challenges and opportunities to the country regarding the reduction of child undernutrition. The study estimates the economic and social cost of child undernutrition at EGP20.3 billion (USD3.7 billion) for the year 2009. Without measures to combat and eliminate malnutrition this cost is expected to increase by 32 percent by 2025 to reach to EGP26.8 billion. This means there is an additional cost of an estimated EGP6.5 billion if steps are not taken to address undernutrition among children under five, a situation that requires an urgent and systematic response, prioritizing malnutrition in the national health agenda and within the context of a broader development framework.

A clear recommendation of this study is that Egypt must review its national development frameworks to ensure that the reduction of stunting prevalence is a key outcome indicator for social and economic development policies. Chronic child undernutrition can no longer be considered a sectoral issue, as both its causes and solutions are linked to social policies across numerous sectors. As such, stunting reduction will require interventions from the health, education, social protection and social infrastructure perspectives. Stunting can be an effective indicator of success in larger social programmes This study encourages countries not to be content with "acceptable" levels of stunting; equal opportunity should be the aspiration of every country on the continent. In this sense, it is recommended that aggressive targets are set in Egypt for the reduction of stunting that go beyond proportional reduction, to establish an absolute value as the goal at 10 percent.

In order to address the multiple dimensions of child nutrition, a comprehensive response is needed. In this sense, a recommendation of the NIT is to propose a "National Social, Economic and Health Plan", directly under the Prime Minister and President's oversight, in a multi-sectoral effort that includes concerned public and private entities and builds on the National Nutrition Strategy (2007-2017). It is important to consider the role that the Food Security Advisory Board can play in the implementation and evaluation of this plan, expanding its approach to a more holistic nutritional security framework. This plan can be a tool to reallocate strategic funds to the different stakeholders for malnutrition prevention and elimination programmes and also identify redundant activities that can be gradually integrated as part of an articulated national nutritional response. A critical aspect of this plan is to assign specific institutional responsibilities of the involved institutions to ensure clear accountability and a framework of a limited number of nationally agreed indicators of food and nutritional security that are measurable at the output, outcome and impact levels.

A priority area for enhancing the national capacity to address malnutrition is to improve monitoring and evaluation systems Currently, assessments of the prevalence of child nutrition are conducted

periodically, between every three to five years. Nevertheless, in order to be able to measure short-term results in the prevention of stunting, a more systematic approach with shorter periodicity is recommended, of two years between each assessment. As the focus on the prevention of child undernutrition should target children before 2 years of age, these results will provide information to policy makers and practitioners on the results being achieved in the implementation of social protection and nutrition programmes. In practical terms, this may be achieved by strengthening a national nutrition surveillance system and complemented by ensuring that the effectiveness preventive interventions are adequately evaluated.

Another important element is to further the understanding of the determinants of child undernutrition in each context. As an initial step, it is recommended that the assessment of child nutrition also includes information that relates the nutritional status of the children to the livelihoods and economic activities of households, as well as access to basic services, such as water and sanitation. This information can be used to inform programme design and ensure that interventions effectively reach these vulnerable families with appropriate incentives and innovative approaches within social protection schemes.

A key element to addressing stunting is prevention. It is important to consider, in high prevalence areas, shifting from therapeutic policies to precautionary policies to reduce the prevalence of child undernutrition. From the health perspective, there are several actions that can be implemented or expanded to achieve this goal. Particular attention can be given to mothers and caretakers that might improve care practices. Potential programmes could include providing health awareness programmes for females before marriage and pregnancy; increasing the role of female health enumerators in rural areas; and provide them with necessary information to prepare healthy complete meals for their families. An important action can be investing in mass media campaigns by the Ministry of Health aiming at behavioural change, which also include messages developed to inform vulnerable families of nutritious low budget foods. Deworming interventions and infant and young feeding practices should also be considered as part of a complete health package.

To ensure the effectiveness of community interventions, it is vital to also address institutional capacity, particularly at the local level. Establishing training programmes for the capacity building of employees in the health sector can be an important opportunity in this sense, as it builds on the widespread presence of the Ministry of Health and the health units in various geographical locations in Egypt. The historical collaboration between the permanent Committee for Nutrition of the Ministry of Health and various concerned departments in the government will be crucial to propose and follow up on the implementation of policies and interventions and to obtain the adequate allocation of funds for its implementation. Additionally, new institutional arrangements can be proposed to coordinate the social response to the most vulnerable population through, for example, the Ministry of Planning that can guide, regulate and support short- and long-term policies.

In order to also address some of the consequences of childhood stunting, school feeding programmes, with proper targeting and monitoring, can also play an important role in a comprehensive nutritional response. Currently, there are an estimated 17 million students receive school feeding, a programme overseen by the Ministry of Education and supported by WFP. Although this intervention will not have an impact on the reduction of stunting, it can have a positive result in increasing enrolment and

attendance which is key for increasing the educational level of the population. Additionally, fortified date bars are distributed to targeted school complement meals, to address micronutrient deficiencies. There is also the opportunity to integrate nutrition-sensitive elements into these interventions, such as nutritional awareness material in the curriculum and book covers, and reviewing past experiences, such as awareness programmes for teachers on healthy nutrition. Targeting school girls with appropriate nutrition and health awareness, as well as suitable nutrition, is key, as those girls will be future mothers and shall bear the responsibility of feeding practices for their families.

From a market perspective, there are also policies that can be analysed and potentially contribute to an enabling environment that leads to the elimination of child undernutrition. The distribution and inclusion of healthier food commodities that supply a portion of the nutrition intakes for pregnant and lactating women, can have an impact in reducing lack of access to proper food. Examples of tools for distribution could include ration cards in areas of high vulnerability and in some cases special food subsidies. Innovative targeting approaches should be considered, such as categorizing subsidy system to offer food baskets by beneficiary/age group, noting, however, that this would add an additional financial and administrative burden to the food subsidy system; instead, index-linked cash and voucher options could also be considered as a complementary option. In a context of high volatility in the market and macroeconomic instability, mechanisms that limit the variation of food prices can be considered, particularly for healthy foods, such as fruits, vegetables, dairies and pulses. These market policies must consider actions to emphasize the importance of exclusive breastfeeding for children less than six months old, and continued to two years, and avoid its replacement with the milk formula. Also additional education should focus on optimal child weaning practices and including children 6-23 months of age among the target groups.

From an agricultural and production perspective, it is important to revise the agriculture policies and food commodities that are consumed by children, including ensuring basic standards are complied with in food fortification, particularly better control in salt iodization. Community-led interventions, such as educational and social kitchens should be monitored and evaluated in order to assess the efficiency and scalability, as well as analyse lessons learnt from programmes with food intervention components, particularly those targeted by geographic areas, such as slums, or special population groups, such as pregnant and lactating mothers.

The level of engagement of the private sector in eliminating stunting can also be a factor of success. Special incentives can be analysed to encourage corporate social responsibility in supporting non-governmental organizations that are implementing effective nutrition interventions. Additionally, encouraging the private sector and the media to develop nutrition awareness campaigns can have an important impact in improving overall care practices. These campaigns need to be properly guided to ensure proper messaging and targeting to the different beneficiary groups. The interaction with the private sector to agree on the regulation for the fortification of some specific commodities can also represent an important mechanism to reduce vitamin and mineral deficiencies.

Lastly, Egypt can also benefit from the exchange of experiences from within and outside the continent. In this sense, it is recommended that the interaction with the Scaling Up Nutrition Initiative is reactivated in order to integrate national nutritional goals within this global movement and help maintain political attention on child undernutrition as a national and continental priority.

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5. Country Results: Ethiopia

5.1 Brief Socio-Economic and Nutritional Background

In the year 2009, the GDP of the Federal Democratic Republic of Ethiopia (hereafter referred to as Ethiopia) was ETB335.4 billion.[1] The GNI per capita in 2011 was equivalent to approximately USD370, which is below the average for sub-Saharan Africa and the average for other low income countries.[2] Ethiopia is characterized by high food insecurity with a Global Hunger Index categorized at "alarming" due to high undernourishment. Ethiopia is also characterised by child undernutrition, child mortality and high unemployment rates, especially among the young population.[3]

The country has made important progress in the reduction of poverty. According to available data, the country has reduced the population living under the poverty line (earning less than USD1.25 a day), from 56 percent to 30 percent in the last decade (see Table 5.1).[4] Also, population growth rates have had a stable reduction from 2.5 percent to 2.1 percent in the last decade.[5] Ethiopia's main economic activity is agriculture, in which approximately 79 percent of the population works.[6] According to the World Bank, 35 percent of Ethiopia's land is considered agricultural land.[7]

TABLE 5.1
SOCIO-ECONOMIC INDICATORS, ETHIOPIA

Indicators	2000-2002	2005-2007	2009-2011
GDP, total in billions of ETB[a/]	66.56	172	335.4 (2009)
GNI per capita (Atlas method, current USD)	120	230	370
Poverty - $1.25 a day (PPP) (% of population)	56%	39%	30%
Poverty headcount ratio at national poverty line (% of population)	44%	39%	30%
GINI Index	30	29.8	…
Labour Force, total (in millions)	31.2	37.1	41.7
Rural population, percentage	85%	84%	83%
Population in Agriculture, percentage of labour force	…	…	79%
Unemployment, % of total labour force	…	17%	21%
Unemployment, youth total (% of total labour force ages 15-24)	…	25%	…
Unemployment, youth female (% of female labour force ages 15-24)	…	29%	…
Population growth (annual %)	2.5%	2.2%	2.1%
Life expectancy at birth, total (years)	52	56	59

Source if not otherwise noted: World Bank Database.
[a/]"World Economic Outlook Database October 2012.[8]

There is also a positive outlook to the economy. Ethiopia is one of the world's fastest growing economies, exceeding average global growth rates, as well as the averages for both Africa and Eastern Africa. As the African Economic Outlook illustrates, the positive trend is expected to continue through 2013, though with slightly slower growth than in the past few years (see Figure 5.1).[9]

FIGURE 5.1
TRENDS IN REAL GDP GROWTH, ETHIOPIA, 2003-2013
(In percentages)
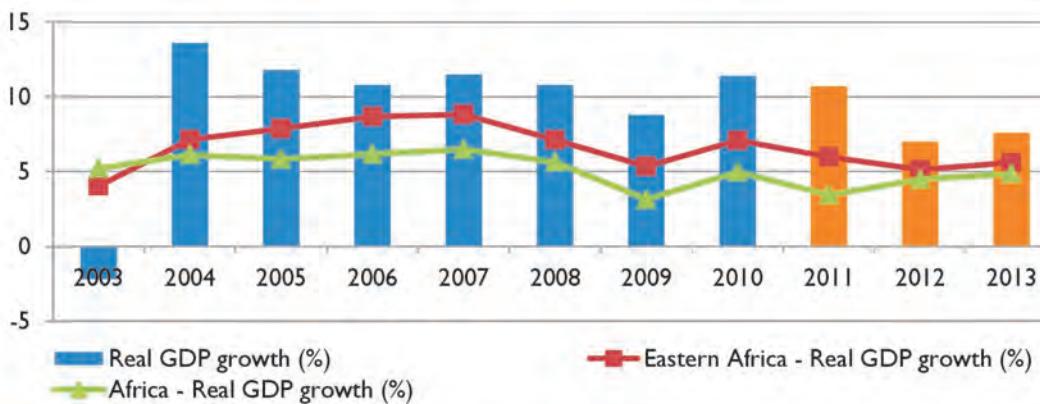
Source: African Economic Outlook,[10] Figures for 2010 are estimates; Orange bars for 2011 and later are projections.

Levels of public investment in the social sector have varied in the last 10 years (see Table 5.2). Public spending in education has increased as a proportion of the national budget, from 17 percent to 25 percent, above the regional average for Sub-Saharan Africa, with a higher per capita investment in students enrolled in primary education, compared to secondary.[11] However, percentage of public spending on education has descended as percentage of GDP. On the other hand, expenditure in health as a proportion of the GDP is below the regional averages, but with an incremental positive tendency in the last few years.[12]

TABLE 5.2
SOCIAL INVESTMENT INDICATORS, ETHIOPIA

Indicators	2005-06	2007-08	2009-10	Sub-Saharan Africa *
Public spending on education,(% govern. expenditure)	17.5%	22.8%	25.3%	18.8%
Public spending on education, total (% of GDP)	5.5%	5.4%	4.6%	4.6%
Expenditure per student, primary (% of GDP per capita)	…	…	18%	…
Expenditure per student, secondary (% of GDP per capita)	…	…	9.8%	…
Health expenditure per capita (current USD)	8.32	14.04	15.71	84.3
Health expenditure, total (% of GDP)	4.1%	4.3%	4.9%	6.5%
Health expenditure, public (% of total health expenditure)	55.3%	51.9%	53.4%	45%

Source: World Bank Database[13], most recent year available.   * Developing countries only - Latest data available.

Ethiopia has made important progress in the reduction of child undernutrition in the last decade.

According to the 2011 DHS survey (see Figure 5.2), approximately 44.2 percent of Ethiopian children under 5 suffered from low height for their age (stunting), which represented an important improvement from 50.7 percent in 2005. Additionally, the prevalence of underweight children has improved from 34.6 percent to 28.7 percent. For that same period, the levels of LBW also improved from 14 percent (2005) to 11 percent (2011).[14]

FIGURE 5.2
ESTIMATED UNDERNUTRITION TRENDS IN CHILDREN UNDER-FIVE, ETHIOPIA, 1990-2010
(In percentages)
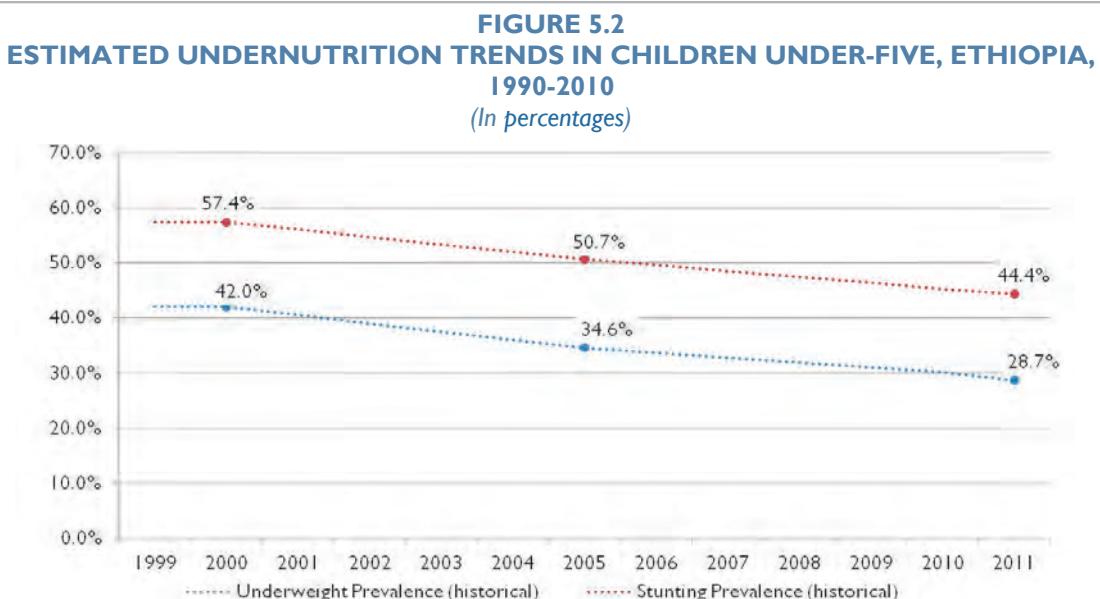
Source: Prepared based on information from DHS 2000/2005/2011.[15]
NOTE: Data prior to 2006, has been updated in line with new Child Growth Standards introduced by WHO in 2006[16] to replace the 1977 International Growth Reference, formulated by the National Center for Health Statistics (NCHS).[17]

Nevertheless, the current levels of child undernutrition are evidence of the continuing challenges in the reduction of child hunger. As shown in Table 5.3, it is estimated that 4.3 million of the 12.1 million children under the age of five in 2009 were affected by growth retardation and nearly 3 million children were underweight. This situation is especially critical for children between 12 and 24 months, where half of all children were affected by growth retardation.[18]

TABLE 5.3
POPULATION AND CHILD UNDERNUTRITION, ETHIOPIA, 2009[c]
(Population in thousands)

Age groups	Population size (2009)	Low Birth Weight		Underweight		Stunting	
		Population affected (2009)	Prevalence (2009)[b]	Population affected (2009)	Prevalence (2009)[c]	Population affected (2009)	Prevalence (2009)[c]
New-born (IUGR)[a]	2,484	148	6.0%				
0-11 months				455	18%	497	20%
12-23 months	2,454			793	32%	1,186	48%
24-59 months	7,161			1,743	24%	2,650	37%
Total	12,100	148		2,992	31%	4,333	44%

Source: Estimated based on DHS Surveys 2005 and 2011 and demographic projections.[19]
a/ In a given year, the new-born population is the same as the 0-11 month's age group.
b/ Estimated on the basis of the equation of De Onis et al, 2003.
c/ Data estimated from the most recent undernutrition prevalence figure available.

5.2 Effects and Costs of Child Undernutrition

Undernutrition is mainly characterized by wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age). In early childhood, undernutrition has negative life-long and intergenerational consequences; undernourished children are more likely to require medical care as a result of undernutrition-related diseases and deficiencies.[20] This increases the burden on public social services and health costs incurred by the government and the affected families. Without proper care, underweight and wasting in children results in a higher risk of mortality.[21] During schooling years, stunted children are more likely to repeat grades and drop out of school,[22] reducing thus, their income-earning capability later in life.[23] Furthermore, adults who were stunted as children are less likely to achieve their expected physical and cognitive development, thereby impacting on their productivity.[23] In addition to identifying the physical, psychological and social effects of undernutrition, there are significant economic costs.

5.2.A Social and Economic Cost of Child Undernutrition in the Health Sector

Undernutrition at an early age predisposes children to higher morbidity[24] and mortality[25] risks. The risk of becoming ill due to undernutrition has been estimated using probability differentials, as described in the methodology section. Specifically, the study has examined medical costs associated with treating low birth weight (LBW), underweight, anaemia, acute respiratory infections (ARI), acute diarrhoeal syndrome (ADS) and fever/malaria associated with undernutrition in children under the age of five.

(1) Effects on morbidity

Undernourished children are more susceptible to recurring illness.[26] Based on the differential probability analysis undertaken with DHS data, underweight children in Ethiopia are more affected by anaemia (an increase of 12 percentage points), diarrhoea (5 percentage points) and fever (4 percentage points) than healthy children. Acute respiratory infections are also more common in underweight children, particularly for children between 12 months and 24 months of life at an incremental rate of 6 percent.[27]

The COHA study estimated that in Ethiopia during the year 2009, there were almost 4.4 million more episodes associated with the higher vulnerability among underweight children (see Table 5.4). The

TABLE 5.4
MORBIDITIES FOR CHILDREN UNDER-FIVE ASSOCIATED WITH UNDERWEIGHT, BY PATHOLOGY, ETHIOPIA, 2009

Pathology	Number of episodes	Percentage of events
Anaemia	365,311	29%
ADS	527,153	41%
ARI	114,300	9%
Fever/Malaria	264,232	21%
Subtotal	1,270,996	
LBW	148,173	5%
Underweight	2,991,509	95%
Subtotal	3,139,682	
Total	**4,410,678**	

Source: Model estimations based on DHS 2005/2011 and demographic information.[28]

highest occurrence of episodes was found in diarrhoea with 527,153 more episodes in underweight children, followed by anaemia, with over 365,311 annual episodes.

(2) Stunting levels of the working age population

Undernutrition leads to moderate and severe stunting in children, which can impact their physical productivity later stages in life.[29] Although Ethiopia has made important progress in reducing the current levels of stunting in children, a large proportion of the adult population is currently living with the life-long consequences of childhood stunting. As illustrated in Figure 5.4, this study estimates that over 67 percent of the adult population in Ethiopia, aged 15-64, suffered from growth restriction before reaching the age of 5. Currently this represents more than 26.1 million people who are in a disadvantaged position compared to those who had healthy childhoods.

FIGURE 5.3
WORKING AGE POPULATION AFFECTED BY CHILDHOOD STUNTING, BY AGE GROUP, ETHIOPIA
(In thousands of people)
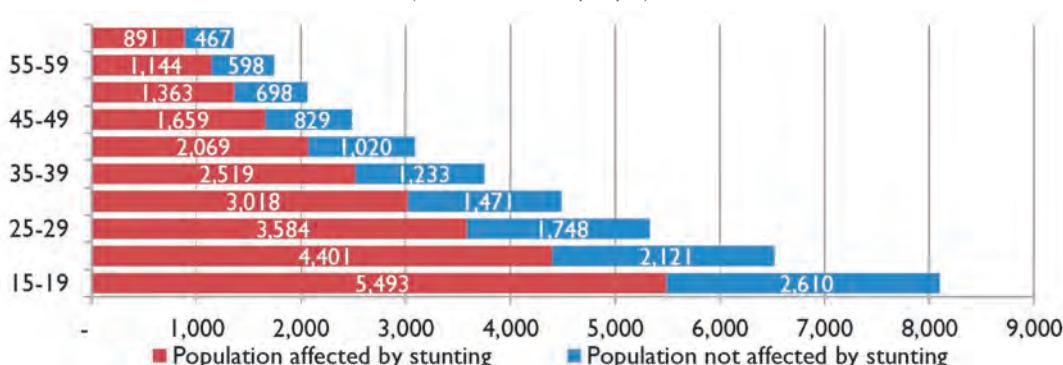
Source: Model compilation based on EHICES 2010/11.[30]

(3) Effects on mortality

Child undernutrition can lead to increased cases of mortality most often associated with incidences of anaemia, diarrhoea, pneumonia and malaria.[31] Nevertheless, when the cause of death is determined, it is rarely attributed to the nutritional deficit of the child but often to the illness that the child manifested. Given this limitation in attribution, the model utilizes relative risk factors[32] to estimate the risk of increased child mortality as a result of child undernutrition. Mortality risk associated with undernutrition was calculated using these relative risk factors, historical survival and mortality rates,[33] and historical nutrition information.

In the last 5 years alone, it is estimated that 378,591 child deaths in Ethiopia were directly associated with undernutrition (see Table 5.5). These deaths represent 28 percent of all child mortalities for this period. Thus, it is evident that undernutrition significantly exacerbates the rates of death among children and limits the country's capacity to achieve the MDGs, especially the goal to reduce child mortality.

These historical mortality rates will also have an impact on national productivity. The model estimates that an equivalent of 8.3 percent of the current workforce has been lost due to the impact of

undernutrition in increasing child mortality rates. This represents 3.2 million people who would have between 15-64 years old, and part of the working age population of the country.

TABLE 5.5
IMPACT OF UNDERNUTRITION ON CHILD MORTALITY,
ADJUSTED BY SURVIVAL RATE, ETHIOPIA, 1945-2009
(In number of mortalities)

Period	Number of child mortalities associated with undernutrition
1945-1994	3,230,218
1995-2004	913,008
2005-2009	378,591
Total	4,521,818

Source: ECA on the basis of life tables provided by UN Population Division[34] and population data provided by CSA.[35]

---

(4) Estimation of public and private health costs

The treatment of undernutrition and related illnesses is a critical recurrent cost for the health system. Treating a severely underweight child, for example, requires a comprehensive protocol[36] that is often more costly than the monetary value and effort needed to prevent undernutrition. The economic cost of each episode is often increased by inefficiencies when such cases are treated without proper guidance from a health-care professional or due to lack of access to proper health services. These costs generate a significant burden not just to the public sector, but to society as a whole.

It is estimated that 4.4 million clinical episodes in Ethiopia in 2009 were associated with the higher risk present in underweight children. As indicated in Table 5.6, these episodes generated an estimated cost of ETB1.8 billion.

TABLE 5.6
HEALTH COSTS OF UNDERNUTRITION-RELATED PATHOLOGIES,
ETHIOPIA, 2009
(In millions of ETB)

Pathology	Cost	% of episodes	% of cost
LBW/IUGR	563	3%	31%
Anaemia	130	8%	7%
ADS	144	12%	8%
ARI	61	3%	3%
Underweight	693	68%	38%
Fever/Malaria	231	6%	13%
Total Cost	**1,822**		

Source: Estimations based on data provided by the National Implementation Team, DHS 2006 and 2011,[37] and cost analysis carried out by the NIT (for details see Annex 5).

An important element to highlight is the particular costs generated by the treatment of low birth weight children. These cases represented 3 percent of all the episodes but generated 31 percent of the

total cost, making it the highest per capita element analysed. This is due to the special management protocol required by LBW children, which often includes hospitalization and time in intensive care.[38]

FIGURE 5.4
DISTRIBUTION OF INCREMENTAL EPISODES OF ILLNESS
ASSOCIATED WITH UNDERNUTRITION BY AGE GROUP, ETHIOPIA

	0 to 11 months 20%	12 to 23 months 25%	24 to 35 months 18%	36 to 47 months 18%	48 to 59 months 18%

% of Cases

% of Costs

44%	19%	12%	12%	12%

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%
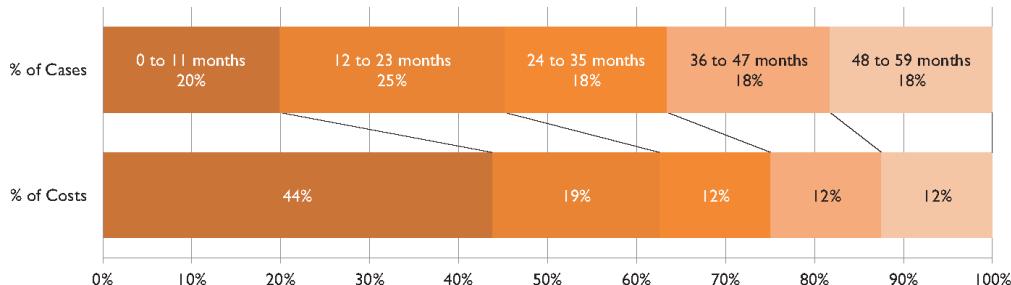
Source: Model estimations based on DHS 2005/2011, and demographic information.[39]

Another important element to analyse is in the distribution of cost between the public system and the families. The largest proportion of the cost of undernutrition are borne by the families themselves, as often these children are not provided with proper health care (see Figure 5.5). Based on information collected by the NIT, the model estimates that 3 out of every 10 episodes presented in these children are not able to obtain adequate health care. Although the model does not analyse the causes of this, it may be due to lack of access to health services, or the decision on the caretakers not to take the children to health posts.

FIGURE 5.5
DISTRIBUTION OF PRIVATE AND PUBLIC HEALTH COSTS, ETHIOPIA
(In percentages and millions of ETB)

1,646	185

■ Cost to families
■ Cost to system

0%   20%   40%   60%   80%   100%
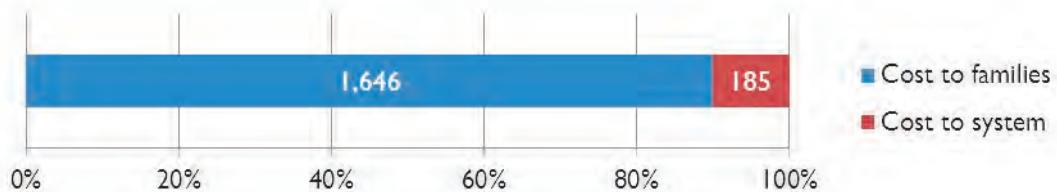
Source: Model estimations based on demographic information and DHS surveys.[42]

A contributing factor to this situation is the relatively low coverage of the national health system. According to information from the Ministry of Health, the service coverage is estimated at 45 percent, but the effective coverage of individuals is estimated to be much lower.[40] of particular concern is data on the percent of birth in proper health facilities, as about 85 percent of women deliver at home, about one in three use traditional birth attendants, and many others are assisted by relatives and family members.[41] Addressing this important element may be a critical to continue reducing the child mortality rates in the country.

The disproportion in the distribution of episodes that do not receive proper health care is also

reflected in the distribution of the health costs. As shown in Figure 5.5, in Ethiopia it is estimated that families carry 90 percent of the costs associated with undernutrition, ETB1.6 billion, while the public system carries 10 percent of the burden at ETB185 million.

Even when the families of the undernourished children are covering most of the health costs related to undernutrition, the burden of this phenomenon is still an important cost component in the public sector. In 2009-2010, the annual estimated cost to the public sector is equivalent to 2.3 percent of the total budget allocated to health.[43] As a whole, the economic impact of undernutrition in health-related aspects is equivalent to 0.55 percent of the GDP of that year.

5.2.B Social and Economic Cost of Child Undernutrition in the Education Sector

There is no single cause for repetition and dropout; however, there is substantive research that shows that students who were stunted before the age of 5 are more likely to underperform in school.[44] As a result, undernourished children are faced with the challenge of competing favourably in school due to their lower cognitive and physical capacities than children who were able to stay healthy in the early stages of life.[45]

The number of repetition and dropout cases considered in this section of the report result from applying a differential risk factor associated to stunted children, as well as to the official government information on grade repetition and dropouts in the educational system in 2009. The cost estimations are based on the average cost of a child to attend primary and secondary school in Ethiopia in 2009 provided by the Ministry of Education, as well as estimations of costs incurred by families to support child schooling.[46]

(1) Effects on repetition

Children who suffered from undernutrition before 5 years of age are more likely to repeat grades, compared to those were not afflicted by undernutrition (See Figure 5.6).[47] Currently, there are an estimated 17.5 million stunted children of school age, which represents 64 percent of the total population aged between 6 and 18 years in the country.

Based on official information provided by the Ministry of Education, 963,599 primary school students

FIGURE 5.6
REPETITION RATES IN PRIMARY EDUCATION BY NUTRITIONAL STATUS, ETHIOPIA, 2009
(In percentages)
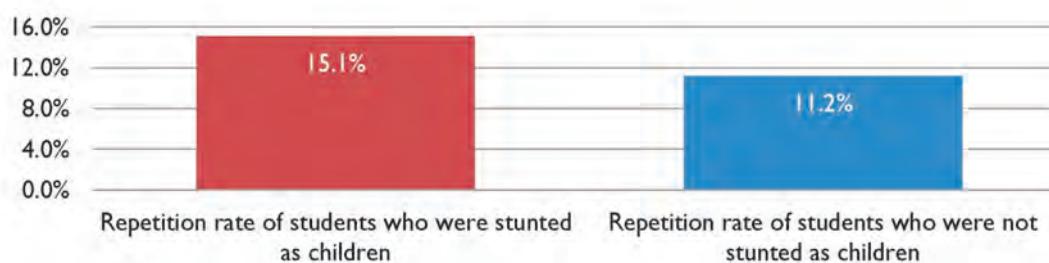
Source: Estimations based on data provided by NIT from Ministry of Education, Education Statistics Annual Abstract 2008-09.[49]

repeated grades in 2009 (13.9 percent).[48] Using data on the increased risk of repetition among stunted students, the model estimated that the repetition rate for stunted children was 15.1 percent, while the repetition rate for non-stunted children was estimated at 11.2 percent

Given these rates and the proportion of stunted students, the model estimated that 152,488 repetitions, or 15.8 percent of all repetitions in 2009 were associated with undernutrition (see Figure 5.7). These children generate an incremental cost to the education system, as they require twice as many resources, since they repeat the year. In addition, caretakers have to cater to their educational cost for an extra year.

FIGURE 5.7
GRADE REPETITION OF STUNTED CHILDREN IN PRIMARY SCHOOL, BY GRADE, ETHIOPIA, 2009
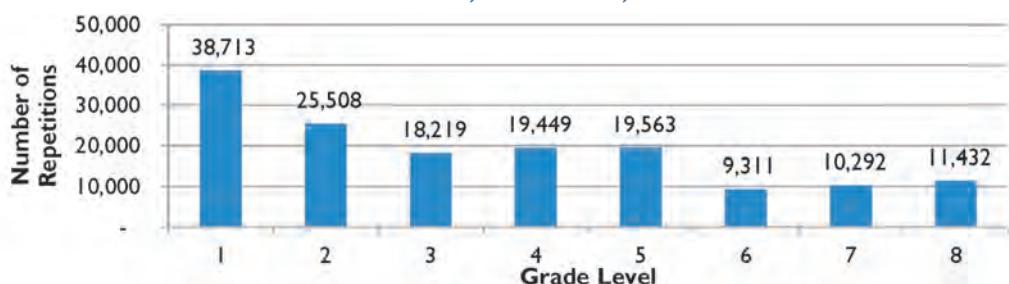
Source: Estimations based on data provided by NIT (Ministry of Education – Annual Abstract).[50]

(2) Effects on retention

Research shows that students who were stunted as children are more likely to drop out of school.[49] According to available data, and taking into account relative risks of stunting on education, it can be estimated that 23 percent of non-stunted population of working age completed primary school, compared to only 11 percent of stunted people. Figure 5.8 below shows the estimated grade achievement, based on their nutritional status.

The costs associated with school dropouts are reflected on the productivity losses experienced by individuals searching for opportunities in the labour market. As such, the impact is not reflected in the school-age population, but in the working-age population. Hence, in order to assess the social and

FIGURE 5.8
GRADE ACHIEVEMENT BY NUTRITIONAL STATUS, ETHIOPIA, 2009
(In percentages enrolled)
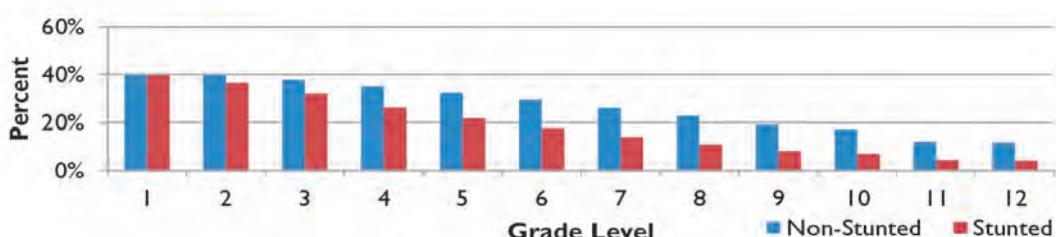
Source: Estimations based on the EHICES 2010/11.[51]

economic costs in 2009, the analysis focuses on the differential in schooling levels achieved by the population who suffered from stunting as children and the schooling levels of the population who were never stunted.

(3) Estimation of public and private education costs

Repetition in schooling years has direct cost implications to families and the school system. Consequently, in 2009, the 152,448 students who repeated grades (and whose repetition was associated with undernutrition) incurred a cost of ETB93 million (see Table 5.7). Given the limitations in data, this analysis only includes grade repetition in primary education; nevertheless, it is important to note that even though proportionally less stunted children would repeat in secondary, as a result of high dropout rates. Further, the per-pupil costs are higher in secondary than in primary education.[53]

TABLE 5.7
COSTS OF GRADE REPETITIONS ASSOCIATED WITH STUNTING, ETHIOPIA
(In millions of ETB)

	Primary	Secondary	Total
Number of repetitions associated with stunting	152,488	-	152,488
Public Costs per student (ETB)	223	428	
Private Costs per student (ETB)	390	650	
Total Public Costs (millions of ETB)	34	-	34
Total Private Costs (millions of ETB)	59	-	59
Total (millions of ETB)			**93**
% Social expenditure on education			1.48%

Source: Estimations based on official education statistics of Ministry of Education (2009).[52]

As in the case of health, the social cost of undernutrition in education is shared between the public sector and the families. Of the overall costs, a total of ETB 59.4 million (63 percent) is being covered by the caretakers, while ETB34 million (37 percent) is borne by the public education system (see Figure 5.9)**.**

FIGURE 5.9
DISTRIBUTION OF COSTS IN EDUCATION, ETHIOPIA
(In percentages)

■ Total costs to families　■ Total public costs
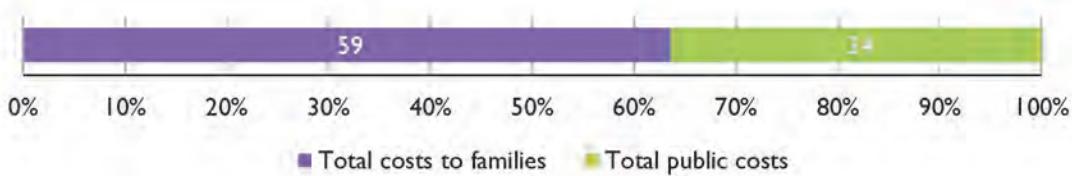
Source: Estimations based on information provided by the Ministry of Education (Education Statistics Annual Abstract).[54]

5.2.C Social and economic cost of child undernutrition in the productivity sector

As described in the health section of this report, the model estimated that 67 percent of the working-

age population in Ethiopia were stunted as children. Research shows that adults who suffered from stunting as children are less productive than non-stunted people and are less able to contribute to the economy.[55] This represents more than 26.1 million people in Ethiopia whose productive potential is affected by undernutrition.

Child undernutrition affects human capital and productivity in several dimensions. Stunted people, on average, have achieved fewer years of schooling than non-stunted people.[56] In non-manual activities, higher academic achievement is directly correlated with higher income.[57] Research shows that stunted workers engaged in manual activities tend to have less lean body mass[58] and are more likely to be less productive in manual activities than those who were never affected by growth retardation.[59] Moreover, undernutrition-related mortalities contribute to losses in potential national productivity.

The estimation of the population whose labour productivity is affected as a consequence of child undernutrition is based on historical nutritional information, in-country demographics projections, and consumption reported in the EHICES 2010/11.[60] The quantity of people who are absent from the workforce due to the higher mortality risk of undernourished children is estimated in the health section of this report.

FIGURE 5.10
MANUAL AND NON-MANUAL LABOUR DISTRIBUTION, BY AGE GROUP, ETHIOPIA, 2009
(In percentages)
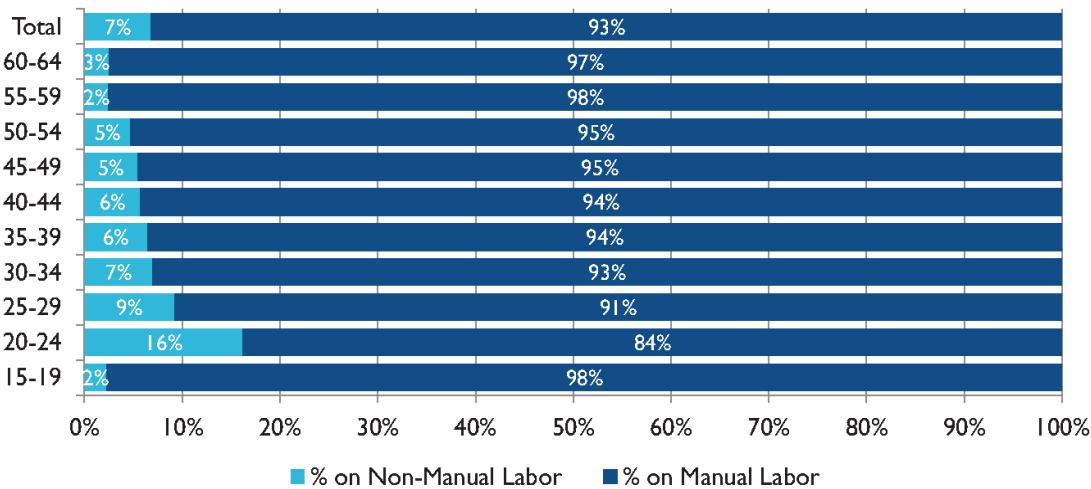
Source: Consumption and Expenditure Survey (EHICES) 2010/11.[61]

The cost estimates for labour productivity are a result of the differential income associated to lower schooling in non-manual activities and the lower productivity associated to stunted children in manual work, such as agriculture. The opportunity cost of productivity due to mortality is based on the expected income that a healthy person would have been earning, had he or she been part of the workforce in 2009.

The distribution of the working population in the labour market is an important contextual element in determining the impact of undernutrition on national productivity. Although the proportion of the

population engaged in non-manual activities is relatively small, the average income of this population is higher than that of the population working in manual activities. As shown in Figure 5.10, the trend of non-manual labour seems to be higher in the younger group (20 to 29 years of age) and manual activities seems to be even more predominant among 30 to 59 year olds. In 2009, 2.8 million of working-age people were involved in non-manual activities.

(1) Losses in non-manual activities

As described in the education section of this country report, students who were undernourished as children complete, on average, fewer years of schooling than students who were adequately nourished as children.[62] This loss in educational years has particular impact for people who are engaged in non-manual activities, in which a higher academic education represents a higher income.

Based on information from the EHICES, and as shown in Figure 5.11, it is estimated that the educational

FIGURE 5.11
AVERAGE SCHOOLING YEARS
FOR STUNTED AND NON-STUNTED POPULATION, ETHIOPIA
(In years of education)
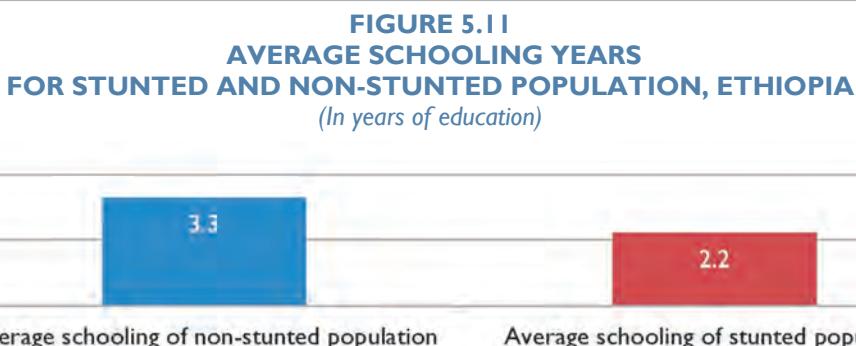
Source: Estimated from EHICES 2010/2011[63] CSA.[64]

gap between the stunted and non-stunted population is 1.1 years. It is important to note that over time there has been an improvement in the average years of schooling among the working population. Whereas the cohort from 60-64 years show and average level of school education of 0.7 years, the cohort aged 20-24 shows an average of 4.4 years of education.

TABLE 5.8
REDUCED INCOME IN NON-MANUAL ACTIVITIES
DUE TO STUNTING, ETHIOPIA, 2009

Age in 2009	Population working in non-manual sectors who were stunted as children *(In thousands of people)*	Income Losses in non-manual labour *(In millions of ETB)*
15-24	868	63
25-34	561	212
35-44	293	208
45-54	163	135
55-64	54	7
Total	**1,939**	**625**
% GDP		**0.20%**

Source: Model estimations based on income EHICES 2010/2011,[66] CSA,[67] and DHS 2006 and 2011.[68]

The lower educational achievement of the stunted population has an impact on the expected level of income a person would earn as an adult.[65] As presented in Table 5.8, the model estimates that 1.9 million people engaged in non-manual activities suffered from childhood stunting. This represents 5 percent of the country's labour force that is currently less productive due to lower schooling levels associated to stunting. The estimated annual losses in productivity for this group are ETB625 million, equivalent to 0.2 percent of the GDP in 2009.

(2) Losses in manual activities

Manual activities, mainly in agriculture, employ more than 70 percent of the Ethiopian working-age population. Research shows that stunted workers engaged in manual activities tend to have less lean body mass and are more likely to be less productive in manual activities than those who were never affected by growth retardation. The model estimated that 36.1 million Ethiopians are engaged in manual activities, of whom 24.3 million were stunted as children. This is equivalent to 62 percent of the working-age population and represents an annual loss that surpasses ETB12.8 billion, equivalent to 3.8 percent of the GDP, in potential income lost due to lower productivity (see Table 5.9).

TABLE 5.9
LOSSES IN POTENTIAL PRODUCTIVITY
IN MANUAL ACTIVITIES DUE TO STUNTING, ETHIOPIA, 2009

Age in 2009	Population working in manual labour who were stunted as children *(In thousands)*	Loss in productivity due to stunting *(In millions of ETB)*
15-24	9,053	4,251
25-34	6,062	3,455
35-44	4,307	2,508
45-54	2,867	1,613
55-64	1984	1030
Total	**24,273**	**12,857**
% GDP		**3.80%**

Source: Estimations based on data from EHICES 2010/2011[69] and WHO/NCHS Database information.[70]

(3) Opportunity costs due to mortalities

The model estimated that 3.2 million people of working age were absent from the workforce in 2009 due to child mortality associated with undernutrition. This represents a 8 percent reduction in the current workforce.

Considering the productive levels of the population, by their age and sector of labour, the model estimated that in 2009, the economic losses (measured by working hours lost due to undernutrition-related child mortality) were ETB 40 billion, which represented 11.9 percent of the country's GDP for 2009 (see Table 5.10).

TABLE 5.10
LOSSES IN POTENTIAL PRODUCTIVITY DUE TO MORTALITY ASSOCIATED
WITH UNDERNUTRITION, ETHIOPIA, 2009
(all values in millions)

Age groups	Working hours lost	Loss in productivity (ETB)	Loss in productivity (USD)
15-24	1,198.1	9,238.4	782.9
25-34	1,117.5	9,515.9	806.4
35-44	916.8	8,038.9	681.3
45-54	775.7	6,766.6	573.4
55-64	777.8	6,510.3	551.7
Total	**4,785.9**	**40,070.0**	**3,395.8**
% GDP		11.9%	

Source: Model estimations based on EHICES 2010/2011[71] and DHS 2005 and 2011.[72]

(4) Overall productivity losses

The total losses in productivity for 2009 are estimated at approximately ETB53.6 billion, which is equivalent to 16 percent of Ethiopia's GDP. Figure 5.12, below, illustrates the distribution of losses. The largest share of productivity loss, amounting to 75 percent, is due to working hours lost from individuals who died before reaching the age of five, due to high rates of undernutrition.

FIGURE 5.12
DISTRIBUTION OF LOSSES IN PRODUCTIVITY BY SECTOR, ETHIOPIA, 2009
(in percentage and millions of ETB)
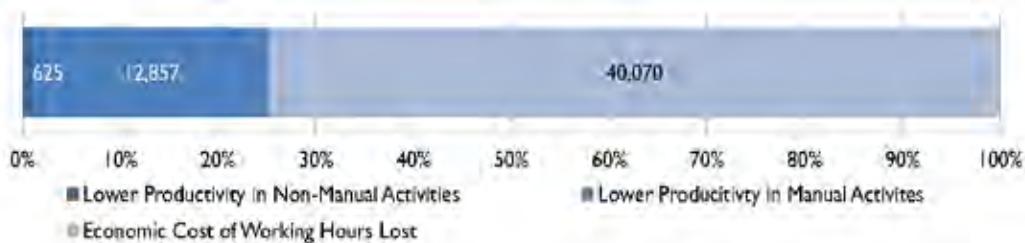
Source: Model compilation.

Lower productivity in manual activities represented 24 percent of the cost, as there is a large proportion of the population in Ethiopia engaged in agriculture. Given the small proportion of the population engaged in non-manual activities, the proportion of losses associated with this sector is estimated at only 1 percent of the total productivity losses.

5.2.D Summary of Effects and Costs

The developed methodology is used to analyse the impact of child undernutrition in different stages of the life cycle, without generating overlaps. As a result, the individual sectoral costs can be aggregated to establish a total social and economic cost of child undernutrition.

For Ethiopia, the total losses associated with undernutrition were estimated at ETB55.5 billion (USD4.7 billion) for the year 2009. These losses are equivalent to 16.5 percent of GDP of that year (see Table

5.11). The highest element in these costs relates to the lost working hours due to mortality associated with undernutrition.

	Episodes	Cost in millions of ETB	Cost in millions of USD	Percentage of GDP
TABLE 5.11 SUMMARY OF COSTS, ETHIOPIA, 2009				
Health Costs				
LBW and Underweight	3,139,682	1,256	106.4	
Increased Morbidity	1,270,996	566	48.0	
Total for Health	**4,410,678**	**1,822**	**154.4**	**0.54%**
Education Costs				
Increased Repetition - Primary	152,488	93	7.9	
Increased Repetition - Secondary	0	0	0.0	
Total for Education	**152,488**	**93**	**7.9**	**0.03%**
Productivity Costs				
Lower Productivity - Non-Manual Activities	1,938,632	625	53.0	
Lower Productivity - Manual Activities	24,273,274	12,857	1,089.6	
Lower Productivity - Mortality	3,230,218	40,070	3,395.8	
Total for Productivity	**29,442,124**	**53,552**	**4,538.4**	**15.97%**
TOTAL COSTS		**55,468**	**4,700.5**	**16.54%**

Source: Model estimation.

5.3 Analysis of Scenarios

The previous chapter showed the social and economic costs that affect Ethiopia in 2009 due to high historical trends of child undernutrition. Most of these costs are already cemented in society and policies must be put in place to improve the lives of those already affected by childhood undernutrition. Nevertheless, there is still room to prevent these costs in the future. Currently, two out of every five children in under-five in Ethiopia is stunted.[73]

This section analyses the impact that a reduction in child undernutrition could have on the socio-economic context of the country. The results presented in this section project the additional costs to the health and education sectors as well as losses in productivity that Ethiopian children would bear in the future. This is a call for action to take preventive measures and reduce the number of undernourished children to avoid large future costs to the society.

The scenarios developed for this report are as follows:

> **Baseline. The cost of inaction — Progress in reduction of stunting and underweight child stops.** For the baseline, progress in the reduction of the prevalence of undernutrition stops at the levels achieved in 2009. It also assumes that the population growth would maintain the pace reported in the year of the analysis, hence increasing the number of undernourished children and the estimated cost. As this scenario is highly unlikely, its main purpose is to establish a baseline, to which any improvements in the nutritional situation are compared in order to determine the potential savings in economic costs.

> **Scenario #1. Cutting by half the prevalence of child undernutrition by 2025.** In this scenario, the prevalence of underweight and stunted children would be reduced to half of the 2009 values corresponding to the reference year. In the case of Ethiopia, this would mean a constant reduction of 1.5 percentage points annually in the stunting rate, from 46.4 percent (estimate for 2009) to 23.2 percent in 2025. With the right combination of proven interventions, this scenario would be achievable, as the rate of reduction for stunting between 2001 and 2011 is estimated at 1.1 percentage points, which is close to the progress rate required in achieving this scenario.

> **Scenario #2. The goal scenario — Reduce stunting to 10 percent and underweight children to 5 percent, by 2025.** In this scenario, the prevalence of stunted children would be reduced to 10 percent and the prevalence of underweight children under the age of 5 to 5 percent. Currently, the global stunting rate is estimated at 26 percent, with Africa having the highest prevalence at 36 percent. This Goal Scenario would require a true call to action, and would represent an important continental challenge in which countries on the continent could collaborate jointly in its achievement. The progress rate required to achieve this scenario would be 2.3 percentage points annual reduction for a period of 16 years, from 2009 to 2025.

The model can generate a baseline for various scenarios, based on nutritional goals established in each country. Scenarios are constructed based on the estimated costs of the children born in each year, from 2009 to 2025 (net present value). While the previous section calculated the costs incurred in a

single year by historical trends of undernutrition, these costs represent the present values and savings generated by children born during 2009 to 2025.

As Figure 5.13 shows, the progressive reduction of child undernutrition generates a similar reduction in the cost associated with it. The distances between the trend lines indicate the savings that would be achieved in each scenario.

FIGURE 5.13
TRENDS OF ESTIMATED COSTS OF CHILD UNDERNUTRITION, ETHIOPIA, 2009-2025

Source: Model estimations.
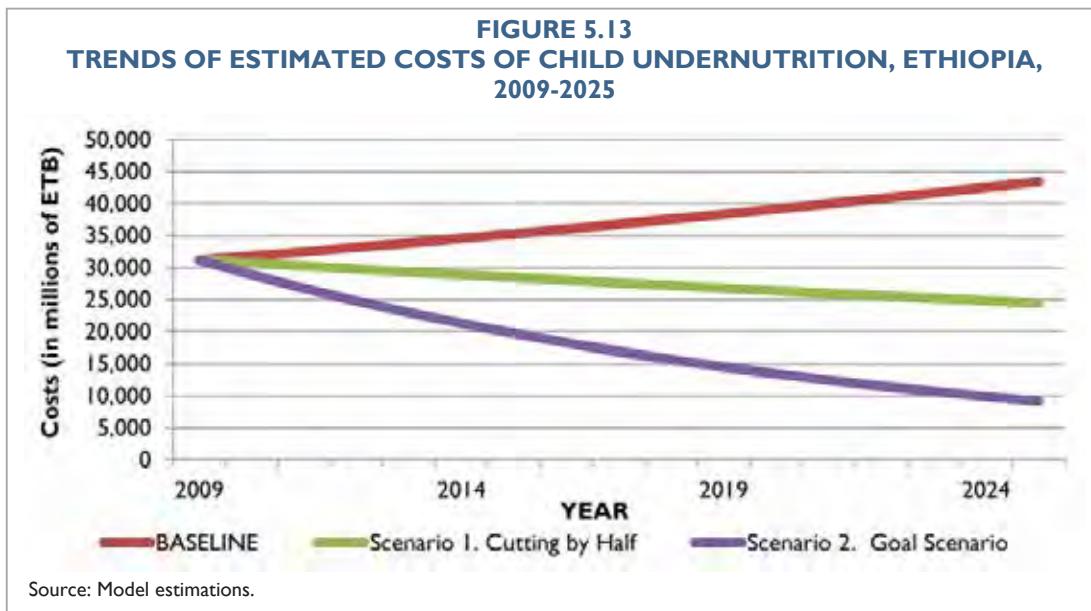
In the baseline, where progress in reducing child undernutrition would stop at the level of 2009, the cost in 2025 would reach ETB 43.4 billion million (USD3.7 billion) (see Table 5.12).

TABLE 5.12
ESTIMATED SAVINGS FOR EACH SCENARIO, ETHIOPIA, 2009
(All values in millions) [a]

	Baseline		S1. Cutting by Half		S2. Goal Scenario	
	ETB	USD	ETB	USD	ETB	USD
Projected cost in the year 2025	43,445.1	3,681.8	24,436.2	2,070.9	9,170.8	777.2
Total projected savings (2009-2025)	-	-	70,918.3	6,010.0	148,023.3	12,544.3
Annual projected savings (2009-2025)*	-	-	4,432.4	375.6	9,251.5	784.0
Annual percentage points reduction in stunting rates required to achieve scenario (2009-2025)	Progress stops		1.5%		2.3%	

Source: Model estimations.
a/ All values in net present values at an 8% social discount rate.

In Scenario #1 in which a reduction of half of the current prevalence is achieved, the cost in 2025 would reduce to ETB24.4 billion (USD2.1 billion). For the full period between 2009 to 2025, this would represent a total savings of ETB70.9 billion (USD6.0 billion). Although the tendency of savings would not be linear, as they would increase over time as progress was achieved, a simple average of the annual savings would represent ETB4.4 billion (USD375.6 million) per year.

In the case of the goal scenario, the cost in 2025 would be reduced to ETB9.2 billion (USD777.2 million). This translates into an increase in total savings to ETB148.0 billion (USD12.5 billion), which represents ETB 9.3 billion (USD784.0 million) per year, for the same 16-year period.

In addition to the scenarios presented, an additional analysis has been carried out for Ethiopia. The National Nutrition Plan[74] has established a target of achieving 30 percent stunting by the year 2015. If this target were to be achieved, the model estimated that the annual average savings of this scenario would be an average of USD106 million, and would require a progress of 2.7 percent annually from the values estimated for 2009.

5.4 Conclusions and Recommendations

5.4.A Implications for Ethiopia's Growth and Transformation Plan

The Cost of Hunger in Africa Study is an important step forward to better understand the role the child nutrition and human development can play as a catalyser, or as a constraint, in the implementation of Ethiopia's Growth and Transformation Plan (GTP).[75] This plan, that projects a sustained GDP growth of 11 percent to 15 percent from 2010 to 2015, represents the national strategy of Ethiopia towards poverty eradication. In its implementation, the GTP outlines opportunities in the agricultural and industrial sectors, and a series of indicators that needs to be monitored to assess the progress towards the ultimate goal. The results of the COHA study demonstrate that in order to enhance and sustain the results envisioned in this plan, child stunting must be addressed as a key priority.

The results of the COHA study in Ethiopia strongly suggest that in order for the country to achieve sustainable human and economic growth, special attention must be given to the early stages of life as the foundation of human capital. The results of the study are supported by a strong evidenced base, and a model of analysis specially adapted for Africa, which demonstrates the depth of the consequences of child undernutrition in health education and labour productivity. This study further quantifies the potential gains of addressing child undernutrition as a priority. Now, stakeholders have not only the ethical imperative to address child nutrition as a main concern, but a strong economic rationale to position stunting in the centre of the development agenda.

The GTP has a key element in its implementation that addresses the importance of improving access and quality of health services. This study estimates that child undernutrition generates health costs equivalent to 0.5 percent of the total public budget allocated to health. These costs are due to episodes directly associated with the incremental quantity and intensity of illnesses that affect underweight children and the protocols necessary for their treatment. Although this amount might seem relatively small, it is important to note that only 3 out of every 10 children are estimated to be receiving proper health attention. As the health coverage expands to rural areas, there will be an increase of people seeking medical attention; this can potentially affect the efficiency of the system to provide proper care

services. This study illustrates that a reduction of child undernutrition could facilitate the effectiveness of this expansion by reducing the incremental burden generated by the health requirements of underweight children.

The GTP also prioritizes the importance of reducing child mortality. The COHA study estimates that 28 percent of all cases of child mortality are associated with the higher risk of undernutrition. Hence, a preventive approach to undernutrition can help reduce this incremental burden to the public sector, and also reduce the costs that are currently being covered by caretakers and families.

One of the key elements of the GTP is the expanding preschool, primary and secondary access and increase enrolment. This represents a particular opportunity in Ethiopia where the population under 15 years is estimated to constitute 40 percent of the current population. These children and youth must be equipped with the skills necessary for competitive labour. Thus, the underlying causes for low school performance and early desertion must be addressed. As there is no single cause for this phenomenon, a comprehensive strategy must be put in place that considers improving in the quality of education and the conditions required for school attendance. This study demonstrates that stunting is one barrier to attendance and retention that must be removed to effectively elevate the educational levels and improve individuals' labour opportunities in the future.

The study estimated that children who were stunted experienced a 3.9 percent higher repetition rate in primary school. As a result, 16 percent of all grade repetitions in primary school are associated to the higher incidence of repetition that is experienced by stunted children. These numbers suggest that a reduction in the stunting prevalence could also support an improvement in schooling results, as it would reduce preventable burdens to the education system. There was not enough information to analyse this aspect for secondary education in Ethiopia.

A critical pillar in the successful implementation of the GTP lays in the capacity of the country to elevate the levels of productivity in the population, both in the rural and urban context. Achieving this in short-term, in a way that also has an impact in the reduction of poverty rates, it requires an important investment in specialized training to continuously build the capacities in the population. This will facilitate the shift of the workforce towards a more skilled labour, as the economy is able to produce new jobs to reduce youth unemployment.

The study estimates that 67 percent of the working-age population in Ethiopia is currently stunted. This population has achieved, on average, lower school levels than those who did not experience growth retardation of 1.1 years of lower schooling. As industries continue to develop increasing number of people participate in skilled employment, this loss in human capital will be reflected in a reduced productive capacity of the population. Thus, it may be a particularly crucial time to address child undernutrition and prepare future youth for better employment by prioritizing the reduction of stunting in the GTP.

The COHA model also provides an important prospective analysis that sheds light on the potential economic benefits to be generated by a reduction in the prevalence of child undernutrition. The model estimates that, in the analysed countries, a reduction of the prevalence to half of the current levels of child undernutrition by the year 2025 can generate annual average savings of ETB4.4 billion (USD376 million). An additional scenario shows that a reduction to 10 percent stunting and 5 percent underweight for that same period could yield annual average savings of ETB9.2 billion (USD784 million).

This economic benefit that would result from a decrease in morbidities, lower repetition rates and an increase in manual and non-manual productivity, presents an important economic argument for the incremental investments in child nutrition.

This study is also an important example of how South-South collaboration can work to implement cost effective activities in development and knowledge sharing. Ethiopia's participation as one of the pilot countries of the study, and its feedback in challenges faced in collecting the data at national level was an important element in adapting the COHA methodology to Africa. The contributions of the Ethiopia NIT will serve to facilitate the expansion of this tool in the continent.

Lastly, this study illustrates the valuable role that data and government-endorsed research can play in shedding light on pertinent issues on the continent. This study will help the country engage within global nutrition movements such as the Scaling Up Initiative as programmes and interventions are put in place to address stunting as a national priority.

5.4.B Recommendations of the Study

This study presents some key initial findings of the Cost of Hunger in Ethiopia, as well both challenges and opportunities regarding the reduction of child undernutrition to the country.

The Government of Ethiopia and its development partners have in place a series of activities, which in most cases, are demonstrating results in the reduction of child undernutrition. Nevertheless, an increase in the reduction rate will require scaling-up current interventions that have proved effective. Some of the actions recommended by the NIT include:

Promotion of awareness of the entire population. The government supports awareness activities through various sectors and mechanisms Nutrition awareness remains limited across the whole population including the educated. The demonstrated impact of nutritional deficiencies in most parts of the country requires enhancing the awareness on the importance of nutrition especially in the first 1000 days of a child's life and the school-going age group that has be found to facilitate nutritional catch-up starting from the early childhood care and development centres.

Promote the delivery of nutrition services integrated with other essential services: The government of Ethiopia has in place maternal child health such as ANC, PNC and Young child health services provided through the health delivery system. While these are directed to ensure healthy pregnancies and good birth outcomes while promoting positive health behaviour, the utilization is still limited. Because of this reason, nutrition services delivery at health facility level is low. Therefore utilization of essential health services should be increased and nutrition services should be delivered at all contact points.

Promote optimal complementary feeding practices: Though there is some improvement in breast feeding practice in the country, the level of appropriate complementary feeding practices is still very low. Therefore it is recommended that best practices observed in some area regarding improving the complementary feeding practice, through improved local food processing should be scaled up and interventions should be employed to enrich food with micronutrients.

Initiate mandatory food fortification programmes: In Ethiopia, consumption of balanced diets is often limited to the affluent population group mostly located in the urban areas. The bigger proportion

of Ethiopia's population is located in the rural areas. While access to food may not always be a problem, food diversity is limited and depends on the region. Hence the level of micronutrient deficiency in specific vulnerable group and the general population is high. Therefore it is recommended that mandatory fortification of staple foods with multiple micronutrients should be initiated and scaled up.

Promotion of Public-Private partnerships: Public-private partnerships could be promoted as a strategy of engaging the private sector (especially in the food production and processing industry) to better understand and incorporate the health and nutritional needs of the population in their products, promotions and distribution mechanisms This might also address the constraints (such as tax subsidies on processing technology equipment, fortificants, etc.) of the public sector related to coming up with the right products.

Increase efforts and explore further opportunities in Bio-fortification: Given that most rural communities practice subsistence farming and may not be able to access fortified food products due to either remoteness or affordability, bio fortification of common staple such as bean, maize, sweet potatoes may be promoted through the Ministry of Agriculture and other existing mechanisms in order to allow households practicing subsistence farming access better improved food commodities from own production.

Increase nutrition sensitization in existing sector activities: Sensitization may include developing of a nutrition hand guide that facilitates not only the literate but also educators on the locally available food commodities that could be used, blended, processed to develop a nutritionally enriched food that can be used by the various vulnerable groups. The last version of such a guide for Ethiopia was last updated in 1969.

Promote the nutrition service delivery of adolescents: In a country like Ethiopia where there is high rate of malnourished adolescent which is coupled by high teenage pregnancy, high levels of stunting can be predicted. To break the intergenerational cycle of malnutrition, programmes that address the nutritional needs of adolescents should be implemented.

In order for nutrition intervention to maximize their results, certain elements that are not directly within the scope of the activities themselves must be addressed, in order to achieve a sustained reduction in child undernutrition.

Improvements in the Policy Environment: An enabling policy environment to facilitate planning and implementation of the above recommendations; mandatory large scale industrial fortification of common staples widely consumed such as wheat, maize and vegetable oil; mandatory use of fortified maize flour and vegetable oil in school feeding programmes; tax subsidies on fortificants and other food processing and agricultural technology and equipment.

Coordination of multi-sectoral nutrition interventions for common objective of addressing undernutrition. In order to successfully implement the NNP, the Office of the Prime Minister (OPM) Nutrition Action Plan secretariat has been developed to coordinate implementation. This secretariat must be supported in the multi-sectoral coordination of the implementation of the national nutrition plan.

A clear recommendation of this study is that Ethiopia must review their national development

frameworks to ensure that the reduction of the stunting prevalence is an outcome indicator of their social and economic development policies. Chronic child undernutrition can no longer be considered a sectoral issue, as both its causes and solutions are linked to social policies across numerous sectors. As such, stunting reduction will require interventions from the health, education, social protection, and social infrastructure perspectives. Stunting can be an effective indicator of success in larger social programmes

This study encourages countries not to be content with "acceptable" levels of stunting; equal opportunity should be the aspiration of every country on the continent. In this sense, it is recommended that aggressive targets are set in Ethiopia for the reduction of stunting that go beyond proportional reduction, to establish an absolute value as the goal for the country at 20 percent by the year 2025. This interim value will demonstrate long term commitment and its achievement will set the basis for stronger efforts towards the elimination of child undernutrition in Ethiopia.

The achievement of this aggressive goal cannot be reached from just the health sector. In order to be able to have a decisive impact on improving child nutrition, a comprehensive multi-sectoral policy must be put in place, with strong political commitment and allocation of adequate resources for its implementation. This plan should look to accelerate the actions on the determinants of child undernutrition such as inadequate income, agricultural production, improving gender equality and girls' education, improving water supply and sanitation, but also by addressing deeper underlying determinants such as the quality of governance and institutions and issues relating to peace and security. To ensure sustainability of these actions, whenever possible, the role of international aid must be complementary to nationally led investments, and further efforts have to be done in ensuring the strengthening of national capacity to address child undernutrition.

An important element that must be addressed to enhance the national capacity to address malnutrition is to improve the monitoring and evaluation systems Currently, the assessments of the prevalence of child nutrition are carried-out with a periodicity of between 3 to 5 years. Nevertheless, in order to be able to measure short term results in the prevention of stunting, a more systematic approach with shorter periodicity is recommended, of 2 years between each assessment. As the focus on the prevention of child undernutrition should target children before 2 years of age, these results will provide information to policy makers and practitioners on the results being achieved in the implementation of social protection and nutrition programmes.

Lastly, it is crucial to further the understanding of the determinants of child undernutrition in each context. As an initial step, it is recommended that the assessment of child nutrition also includes information that relates the nutritional status of the children to the livelihoods and economic activities of the households. This information can be used to inform programme design to ensure that interventions effectively reach these vulnerable families with appropriate incentives and innovative approaches within social protection schemes.

5.5 Acknowledgements

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6. Country Results: Swaziland

6.1 Brief Socio-Economic and Nutritional Background

In the year 2009, the GDP of the Kingdom of Swaziland (hereafter referred to as Swaziland) was estimated at SZL25 billion and the per capita GNI at USD3,300, making it a low middle-income country (see Table 6.1).[1] The country and its population, estimated at 1.068 million, face important development challenges, particularly associated with income inequality, unemployment, food insecurity, and elevated levels of HIV prevalence amongst the population.

In recent years, there have been positive signs of poverty reduction. According to national surveys, the population living under the poverty line has dropped from 69 percent to 63 percent, with an estimated 40.6 percent of people living with under USD1.25 a day.[2] An important contextual factor is that there has been no improvement in the last decade regarding the high levels of income inequality.

Perhaps the most devastating factor impacting development are HIV and AIDS. Swaziland has the highest HIV prevalence rate in the world, at 26 percent among the adult population, and rising to a peak 49 percent among women aged 25 to 29 and an estimated 17 thousand children living with HIV.[3]

Most growth performance and human development indicators have been falling to the levels and pace of poorer economies.[4] Swaziland's main economic activities are agriculture, textiles and tourism, with over 78 percent of the population living in rural areas and a relatively small active labour force

TABLE 6.1
SOCIO-ECONOMIC INDICATORS, SWAZILAND

Indicators	2000-2002	2005-2007	2009-2011
GDP, (current prices) total in billions of SZL[a/]	12.5	20.8	25 (2009)
GNI per capita (Atlas method, current USD)	1,350	3,030	3,300
Poverty - $1.25 a day (PPP) (% of population)	62.9	40.6	…
Population below the national poverty line (% of the Population)	69	…	63
Gini Index	50.7	…	51.5
Labour Force, total (thousands)	321	342	367
Rural Population, percentage	77.7	78.3	78.7
Unemployment, % of total labour force	22.5	29.1	…
Population Growth (Annual %)	0.13	0.13	1.15
HIV Prevalence, total (% of population ages 15-49)	23.3	25.4	26
Life expectancy at birth, total (years)	46.5	46.8	48.7

Source if not otherwise noted: World Bank Database.[5]
[a/]"World Economic Outlook Database October 2012," World Economic Outlook Database, October 2012.[6]

FIGURE 6.1
TRENDS IN REAL GDP GROWTH, SWAZILAND, 2003-2013
(In percentages)
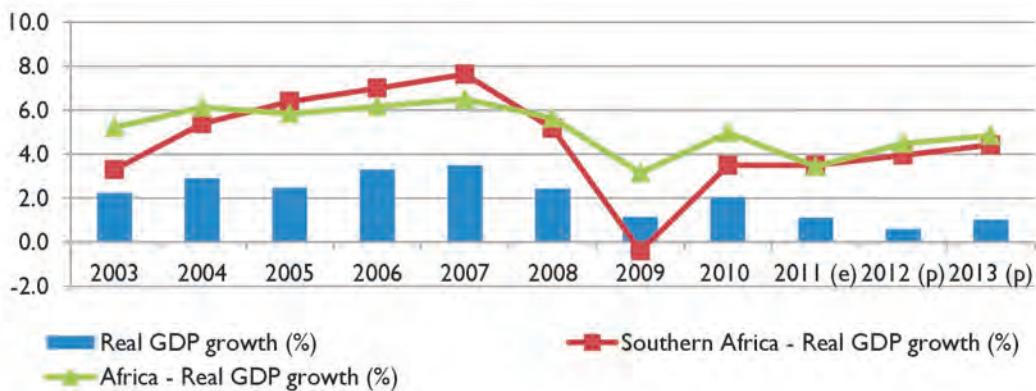
Source: African Economic Outlook 2012, Figures for 2010 are estimates; for 2011 and later are projections.[7]

comprising approximately one third of the population. Also, the country has experienced very low population growth rates, less than 0.2 percent; more recently, it has increased to over 1 percent annually.[8]

In the 1980s, Swaziland had one of the fastest growing economies in Africa. However, this dynamic has slowed down in recent years (see Figure 6.1). In 2011, the country faced an important fiscal crisis that affected the country's growth and development.[9] This crisis, paired with the possibility of rising food prices in the future, makes the economy vulnerable to inflation.

Public investment in the social sector has also varied in levels in the last 10 years. In the last few years, the proportion of the national budget allocated to education has been reduced from 24.4 percent to 15.9 percent, below the average level of Sub-Saharan Africa of 18.8 percent.[10] Nevertheless, there seems to be an incremental increase in the per capita investment per student, particularly in primary education, which denotes a continued commitment to the improvement on the educational system. Likewise, investments in the health sector have also showed a positive trend with a tendency to

TABLE 6.2
SOCIAL INVESTMENT INDICATORS, SWAZILAND

Indicators	2005-06	2007-08	2009-10	Sub-Saharan Africa *
Public spending on education, total (% of govern. expenditure)	…	24.4	15.9	18.8
Public spending on education, total (% of GDP)	5.5	8.1	7.4	4.6
Expenditure per student, primary (% of GDP per capita)	9.12	14.4	15.8	…
Expenditure per student, secondary (% of GDP per capita)	25.89	36.34	33.1	…
Health expenditure per capita (current USD)	62.25	155.75	203.12	84.32
Health expenditure, total (% of GDP)	5.8	5.9	6.6	6.5
Health expenditure, public (% of total health expenditure)	63.4	62.8	63.6	45.0

Source: World Bank Database, most recent year available.[11]
* Developing countries only - Latest data available.

increase the proportion on health investment in the national budget (see Table 6.2).

The nutritional situation of the children of Swaziland represents a challenge for the country. A recent nutritional survey led by the Ministry of Health showed an important increase in the prevalence of stunted children by more than 10 percentage points, from 29.5 to 40.4 percent, from the previous DHS survey for 2005-06.[12,13] The cause for this highly unusual increase in prevalence is not clear and it might require a deeper analysis and review of the methodological process carried-out in this last survey, to ensure comparability of the results.

On the other hand, the prevalence of underweight children has maintained a relatively stable trend, between 6 and 9 percent between the years 2000 and 2009 (see Figure 6.2). There is no nationally representative information for child nutrition before the year 2000.[14]

FIGURE 6.2
ESTIMATED UNDERNUTRITION TRENDS IN CHILDREN UNDER-FIVE,
SWAZILAND, 1990-2010
(In percentages)
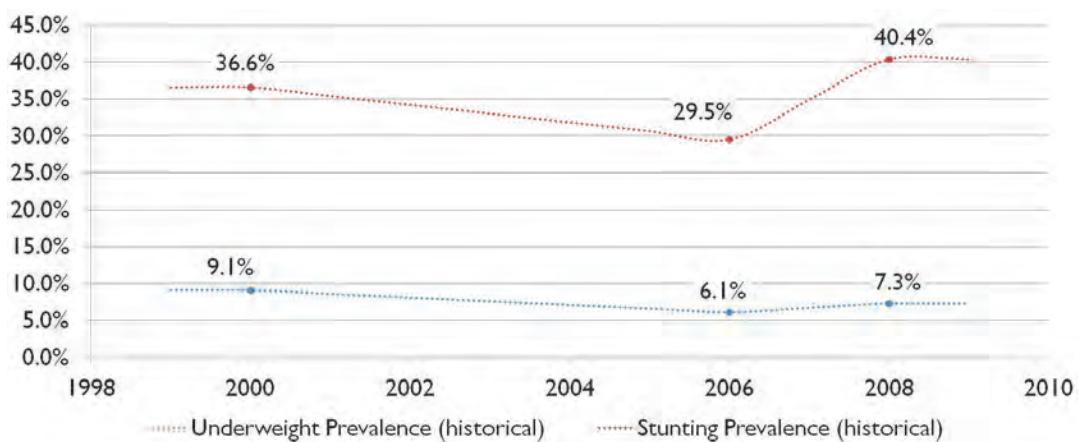
Source: Prepared in-house based on information from DHS 2006[15] and national surveys.[16] NOTE: Data prior to 2006, has been updated in line with new Child Growth Standards introduced by WHO in 2006 to replace the 1977 International Growth Reference, formulated by the National Center for Health Statistics (NCHS).[17]

The current levels of child undernutrition indicate the potential future challenges ahead for the reduction of child hunger. It is estimated that, in 2009, 45,926 of the 156,418 children under the age of 5 in Swaziland were affected by growth retardation in 2009 and 9,645 were underweight. This situation is especially critical for children from 12 to 23 months, where one out of every three children is affected by growth retardation.

Swaziland has taken important steps to address this situation. An important initiative has been provided by the Swaziland National Nutrition Council (SNNC), established by an Act of Parliament in 1945 and mandated to promote and coordinate food and nutrition activities and to technically advise the government accordingly. The SNNC is obligated to ensure that strategies and policies are developed and implemented to improve the nutritional status of the people of Swaziland. Currently the country has implemented interventions that include: infant and young child feeding (IYCF); integrated

community based growth monitoring and promotion (ICBGM&P); integrated management of acute malnutrition (IMAM); nutrition assessment, counselling and support for people living with HIV and TB; prevention and control of micronutrient deficiencies; and nutrition research and surveillance.[18]

		Low Birth Weight		Underweight		Stunting	
TABLE 6.3 **POPULATION AND CHILD UNDERNUTRITION, SWAZILAND, 2009^C** *(Population in thousands)*							
Age groups	Population size (2009)	Population affected (2009)	Prevalence (2009)[b]	Population affected (2009)	Prevalence (2009)[c]	Population affected (2009)	Prevalence (2009)[c]
New-born (IUGR)	32,665[a]	2,751	8.4%				
0-11 months				2,450	16%	267	18%
12-23 months	31,568			2,494	18%	546	39%
24-59 months	92,185			4,701	13%	1,469	40%
Total	**156,418**	**2,751**		**9,645**		**2,282**	

Source: Estimated based on DHS surveys 2006-07 and demographic projections.[19]
[a] In a given year, the new-born population is the same as the 0-11 month's age group.
[b] Estimated on the basis of the equation of De Onis et al, 2003.
[c] Data estimated from the most recent undernutrition prevalence figure available.

6.2 Effects and Costs of Child Undernutrition

Undernutrition is mainly characterized by wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age). In early childhood, undernutrition has negative life-long and intergenerational consequences; undernourished children are more likely to require medical care as a result of undernutrition-related diseases and deficiencies.[20] This increases the burden on public social services and health costs incurred by the government and the affected families. Without proper care, underweight and wasting in children leads to a higher risk of mortality.[21] During schooling years, stunted children are more likely to repeat grades and drop out of school,[22] thus reducing their income-earning capability later in life.[23] Furthermore, adults who were stunted as children are less likely to achieve their expected physical and cognitive development, thereby impacting on their productivity.[24]

6.2.A Social and Economic Cost of Child Undernutrition in the Health Sector

Undernutrition at an early age predisposes children to higher morbidity[25] and mortality[26] risks. The risk of becoming ill due to undernutrition has been estimated using probability differentials, as described in the methodology section. Specifically, the study has examined medical costs associated with treating low birth weight (LBW), underweight, anaemia, acute respiratory infections (ARI), acute diarrhoeal syndrome (ADS) and fever/malaria associated with undernutrition in children under the age of five.

(1) Effects on morbidity

Undernourished children are more susceptible to recurring illness.[27] Based on the differential probability analysis undertaken with DHS data in Swaziland, underweight children have a higher risk of anaemia (increased by 17 percentage points), and children under 12 months have a higher incidence of diarrhoea (increased by 15 percentage points) and more risk of acute respiratory infections (increased risk by 15 percentage points). Fever is also more prevalent in underweight children, especially those between 2 and 5 years, which show a higher risk of 3 more percentage points than a child of healthy

weight.[28]

The study estimated that in 2009 in Swaziland, there were 25,446 incremental episodes of illnesses that can be associated with the higher vulnerability of underweight children of becoming sick (see Table 6.14). In addition, pathologies related to calorie and protein deficiencies and low birth weight (associated to intrauterine growth restriction), totalled 19,591 episodes in 2009 as indicated in Table 6.4. Acute and chronic illness due to diseases such as ADS, anaemia, fever and ARI on the other hand represents 5,854 episodes annually. The biggest proportion of episodes is found in diarrhoea with 2,720 incremental episodes for underweight children, followed by acute respiratory infections, with 1,656 annual episodes.

TABLE 6.4
MORBIDITIES FOR CHILDREN UNDER-FIVE ASSOCIATED WITH UNDERWEIGHT, BY PATHOLOGY, SWAZILAND, 2009

Pathology	Number of episodes	Percentage of events
Anaemia	1,262	22%
ADS	2,720	46%
ARI	1,656	28%
Fever/Malaria	217	4%
Subtotal	5,854	
LBW	2,751	14%
Underweight	16,840	86%
Subtotal	19,591	
Total	**25,446**	

Source: Model estimations based on DHS 2006-2007.[29]

(2) Stunting levels of the working age population

Undernutrition leads to moderate and severe stunting in children, which can impact their physical productivity in later stages of life.[30] As illustrated in Figure 6.3, this analysis estimated that 270,188

FIGURE 6.3
WORKING AGE POPULATION AFFECTED BY CHILDHOOD STUNTING, BY AGE GROUP, SWAZILAND
(In thousands of people)
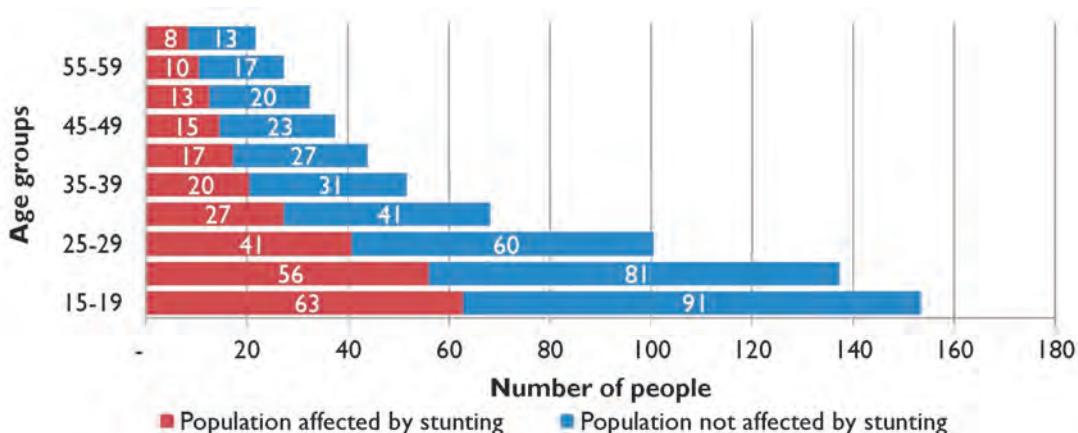
Source: Model compilation based on Swaziland Household Income and Expenditure Survey[31] and WHO/NCHS.[32]

working-age adults suffered from growth restriction before reaching the age of five. Currently this represents more than people 40 percent of the population aged 15-64 who are in a disadvantaged position as compared to those who had healthy childhoods.

(3) Effects on mortality

Child undernutrition can lead to increased cases of mortality, most often connected to episodes of diarrhoea, pneumonia and fever/malaria.[33] Nevertheless, when the cause of death is determined, it is rarely attributed to the nutritional deficit of the child but rather to the associated illness. Given this limitation in attribution, the model utilizes relative risk factors to estimate the higher risk of increased child mortality as a result of child undernutrition. Higher mortality risk associated with undernutrtion was calculated using these factors, combined with mortality rates information calculated from abridged life tables[34] and data provided by the Swaziland Central Statistical Office (CSO).[35]

In the last 5 years alone, it is estimated that 1,351 child deaths in Swaziland were directly associated with undernutrition. These deaths represent 8 percent of all child mortalities for this period. Thus, it is evident that undernutrition significantly exacerbates the rates of death among children and limits the country's capacity to achieve the MDGs, especially the goal to reduce child mortality.

TABLE 6.5
IMPACT OF UNDERNUTRITION ON CHILD MORTALITY,
ADJUSTED BY SURVIVAL RATE, SWAZILAND, 1945-2009
(In number of mortalities)

Period	Number of child mortalities associated with undernutrition
1945-1994	16,019
1995-2004	3,833
2005-2009	1,351
Total	21,203

Source: ECA on the basis of life tables provided by UN Population Division.[36]

These mortality rates, witnessed over the years, have an impact on national productivity. The model estimated that an equivalent of 2.4 percent of the current workforce was lost due to the impact of undernutrition on child mortality in between 1945 to 2009. This represents 16,019 people who would have been 15 to 64 years old and part of the working-age population of Swaziland in 2009.

(4) Estimation of public and private health costs

The treatment of undernutrition and related illnesses due to disease is a critical recurrent cost for the health system. Treating a severely underweight child for example, requires a comprehensive protocol that is often in excess of the cost and effort of preventing undernutrition, as multiple protocols would require to be administered.[37] The economic cost of each episode is often increased by inefficiencies when such cases are treated without proper guidance from a health-care professional, or due to lack of access to proper health services. These costs generate a significant important burden not just to the public sector, but to society as a whole.

It is estimated that 25,446 clinical episodes recorded in Swaziland in 2009 were associated to undernutrition. These generated an estimated cost of more than SZL60.7 million (see Table 6.6). Most

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TABLE 6.6
HEALTH COSTS OF UNDERNUTRITION-RELATED PATHOLOGIES, SWAZILAND, 2009
(In millions of SZL)

Pathology	Cost	% of episodes	% of cost
LBW/IUGR	5.6	11%	9%
Anaemia	1.1	5%	2%
ADS	1.7	11%	3%
ARI	0.8	7%	1%
Underweight	51.3	66%	85%
Fever/Malaria	0.2	1%	0%
Total Cost	**60.7**		

Source: Estimations based on data provided by DHS 2006,[39] and cost analysis carried-out by NIT (for details see Annex 4).

of the incurred costs were associated to the protocol required to bring an underweight child back to a proper nutritional status, which often involves therapeutic feeding.[38]

Most episodes of incremental illness associated to undernutrition happen before the first year of life; 33 percent of all episodes are experienced by children under 12 months, which represents 27 percent of all costs (see Figure 6.4). This is the period of the first thousand days of life, where children are most threatened due to the age-specific vulnerabilities.[40] This seems to indicate that preventing undernutrition and focusing on the mothers' health and nutritional education might generate important savings by reducing the incidence of episodes.

FIGURE 6.4
DISTRIBUTION OF INCREMENTAL EPISODES OF ILLNESS ASSOCIATED WITH UNDERNUTRITION BY AGE GROUP, SWAZILAND
(in percentages)
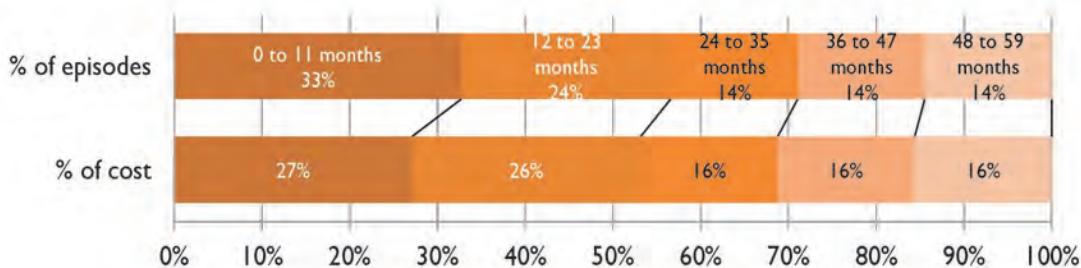
Source: Model estimations based on DHS 2006/2007 and demographic information.[41]

A large proportion of costs related to undernutrition are met by the families themselves as often these children are not provided with proper health care. Based on the information collected by the NIT, the model estimated that only 31 percent of the episodes presented in these children receive proper health care.

This disproportion is also reflected in the distribution of the health costs. Figure 6.5 summarizes the institutional (public system) costs and costs to caretakers of treating pathologies associated with undernutrition. In Swaziland, it is estimated that families carry more 88 percent of the costs

representing SZL54 million. On the other hand, the health system covered SZL7 million, corresponding to 12 percent of the total costs attributed to the health system.

FIGURE 6.5
DISTRIBUTION OF PRIVATE AND PUBLIC HEALTH COSTS, SWAZILAND
(in percentages and millions of SZL)

Source: Model estimations based on demographic information[43] and DHS.[44]

Even when the families of the undernourished children are covering most of the health costs of undernutrition, the burden of these costs is still an important expenditure component in the public sector. In 2009-2010 the annual estimated cost related to undernutrition was equivalent to 0.6 percent of the total budget allocated to health.[42] As a whole, the economic impact of undernutrition in health-related aspects was equivalent to 0.24 percent of the GDP of that year.

6.2.B Social and Economic Cost of Child Undernutrition in the Education Sector

There is no single cause for repetition and dropout in school. However, there is substantive research showing that students who were stunted before the age of 5 are more likely to underperform in school.[36]

The number of repetition and dropout cases considered in this section are estimated using a differential risk factor associated to stunted children, as well as to the official government information on grade repetition and dropouts in the educational system in 2009. The cost estimations are based on the average cost of a child to attend primary and secondary school in Swaziland in 2009 provided by the Ministry of Education as well as estimations of costs incurred by families to support child schooling.[45]

(1) Effects on repetition

Children who suffered from undernutrition before five years of age are more likely to repeat grades, compared to those were not afflicted by undernutrition.[46] In Swaziland in 2009, enrolment rates were relatively high, with an enrolment rate of 95 percent in primary education.[47] In 2009, there were an

FIGURE 6.6
REPETITION RATES IN PRIMARY EDUCATION BY NUTRITIONAL STATUS, SWAZILAND, 2009
(In percentages)

Source: Estimations based on data from Ministry of Education.[48]

estimated 168,228 stunted children of school age, which represents 40 percent of the total population aged between 6 and 18 years in the country.

Based on official information provided by the Ministry of Education and Training, 47,371 children repeated grades in 2009 (15.1 percent). Using data on the increased risk of repetition among stunted students, the model estimated that the repetition rate for stunted children was 18.9 percent, while the repetition rate for non-stunted children was 14.1 percent (see Figure 6.6). Given these rates and the proportion of stunted students, the model estimated that 5,550 repetitions, or 10.1 percent of all repetitions in 2009 were associated with undernutrition (see Figure 6.7).

FIGURE 6.7
GRADE REPETITION OF STUNTED CHILDREN IN SCHOOL, BY GRADE, SWAZILAND, 2009
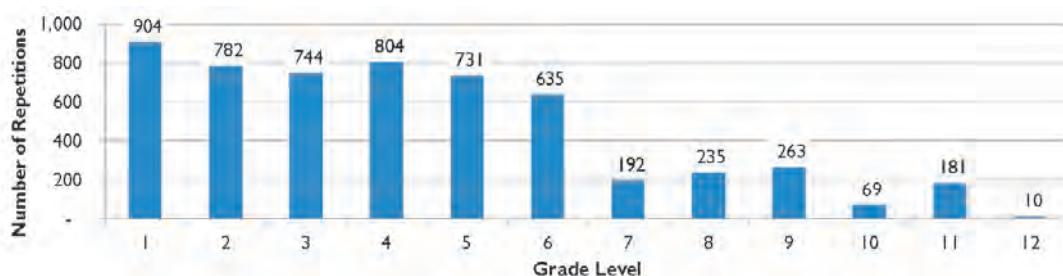
Source: Estimations based on data provided by NIT.[49]

These children generate an incremental cost to the education system, as they require twice as many resources, since they repeat the year. In addition, caretakers have to cater to their educational cost for an extra year.

(2) Effects on retention

Stunted people, on average, have achieved fewer years of schooling than non-stunted people.[50] According to available data and relative risks of the consequences of stunting in education, it can be

FIGURE 6.8
GRADE ACHIEVEMENT BY NUTRITIONAL STATUS, SWAZILAND, 2009
(In percentages of grade achieved)

■ Population not affected by stunting   ■ Population affected by stunting
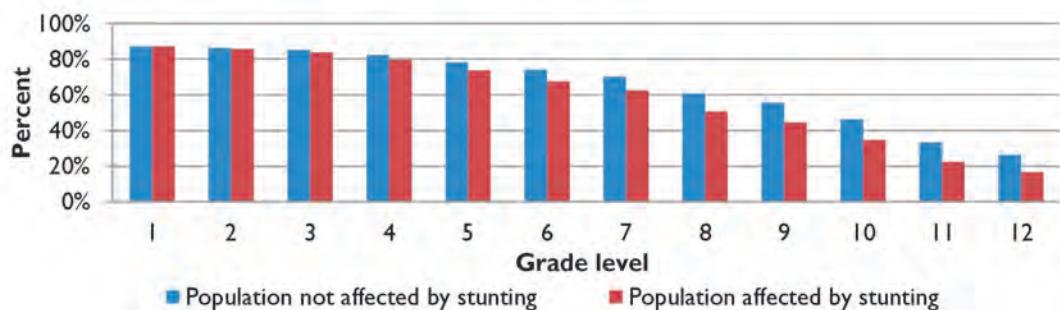
Source: Estimations based on data provided by NIT.[51]

estimated that 70.3 percent of the non-stunted population completed primary school, compared to only 63 percent of stunted children. Similar trends are observed in secondary school, where an estimated 26 percent of non-stunted people and less than 17 percent of the stunted people completed secondary school. The costs associated with school dropouts are reflected in the productivity losses experienced by individuals searching for opportunities in the labour market. As such, the impact is not reflected in the school-age population, but in the working-age population, particularly in non-manual activities.

(3) Estimation of public and private education costs

Repetition in school has direct cost implications to families and the school system. Consequently, in 2009, the 5,550 students who repeated grades (and whose repetition was associated with undernutrition) incurred a cost of SZL6 million (see Table 6.7). The largest proportion of repetitions occurred in primary school, where the cost burden mostly falls on the education system. However, unit costs are significantly higher for repetitions in secondary school.

TABLE 6.7
COST OF GRADE REPETITIONS ASSOCIATED WITH STUNTING, SWAZILAND, 2009

	Primary	Secondary	Total
Number of repetitions	4,792	758	5,550
Public costs per student (SZL)	560	2,000	
Private costs per student (SZL)	269	628	
Total public costs (millions of SZL)	2.7	1.5	**4.2**
Total private costs (millions of SZL)	1.3	0.5	**1.8**
Total (millions of SZL)	**4.0**	**2.0**	**6.0**
% Social expenditure on education			0.34%

Source: Estimations based on education statistics of Ministry of Education.[52]

As in the case of health, the social cost of undernutrition in education is shared between the public sector and the families. Of the total costs, a total SZL1.8 million (30 percent) was covered by the caretakers, while SZL4.2 million (70 percent), was borne by the public education system. Nevertheless, the distribution of this cost varies depending on whether the child repeated grades at primary or secondary level. In primary education, the caretakers cover 32 percent of the associated costs of repeating a year, whereas in secondary education the burden on the families was 24 percent, and the public systems covers a larger proportion of the costs (see Figure 6.9).

FIGURE 6.9
DISTRIBUTION OF COSTS IN EDUCATION, SWAZILAND, 2009
(In percentages and millions of SZL)
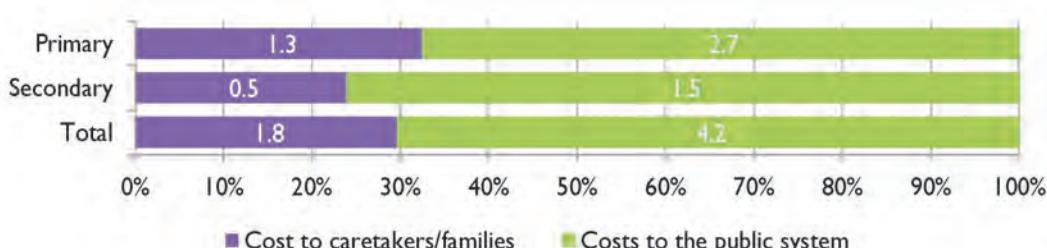
Source: Estimations based on education statistics of Ministry of Education (2009).[53]

6.2.C Social and Economic Cost of Child Undernutrition in the Productivity Sector

As described in the health section of this report, the model estimated that 40 percent of the working-age population in Swaziland were stunted during childhood. Research shows that adults who suffered from stunting as children are less productive than non-stunted workers and are less able to contribute to the economy.[54] This represents 270,188 people in 2009 whose productive potential was affected by undernutrition.

Child undernutrition affects human capital and productivity in several ways. Stunted people, on average, have achieved fewer years of schooling than non-stunted people.[55] In non-manual activities, higher academic achievement is directly correlated with higher income.[56] Research shows that stunted workers engaged in manual activities tend to have less lean body mass[57] and are more likely to be less productive in manual activities than those who were never affected by growth retardation.[58] Moreover, Undernutrition-related mortalities contribute to losses in potential national productivity.

The estimations for the population whose labour productivity was affected by child undernutrition was based on historical nutritional information, in-country demographics projections and incomes reported in the Swaziland National Household Survey (SHIES) 2009-2010.[59]

The cost estimates for labour productivity were calculated based on differential income associated to lower schooling in non-manual activities and the lower productivity associated to stunted children in manual work, such as agriculture. The opportunity cost of productivity due to mortality is based on the expected income that a healthy person would have been earning, had he or she been part of the workforce in 2009.

The distribution of the labour market is an important contextual element in determining the impact of undernutrition on national productivity (see Figure 6.10). Although the proportion of population working in non-manual activities is relatively small, the average income of this population is higher than that of the population working in manual activities, and constitutes a relevant sector of the economically active population (see Figure 6.10).

FIGURE 6.10
MANUAL AND NON-MANUAL LABOUR DISTRIBUTION, BY AGE GROUP, SWAZILAND, 2009
(In percentages)

Source: Swaziland Labour Force Survey (2007).[60]
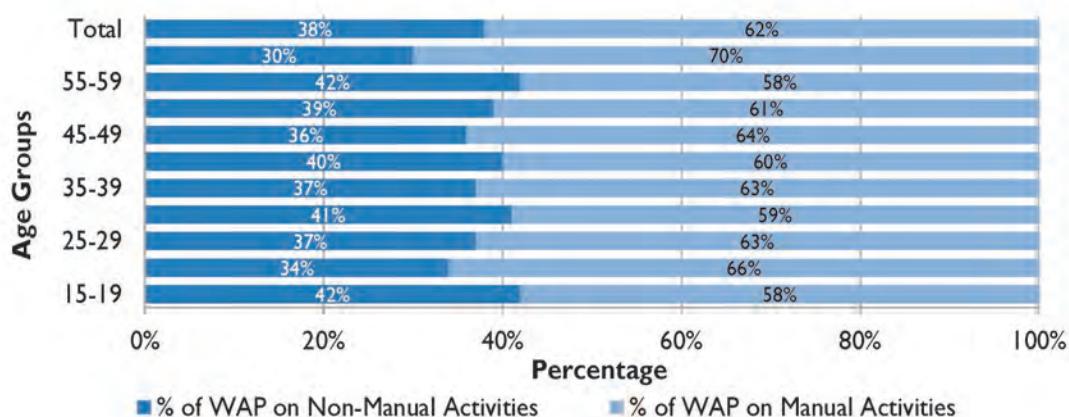
(1) Losses in non-manual activities

As described in the education section of this report, the stunted population completes on average fewer years of schooling than students who were adequately nourished as children. This situation affects mostly people who are engaged in non-manual activities, in which a higher academic education leads to improved income. In the case of Swaziland, 38 percent of the working-age population is engaged in non-manual activities.[61] The average schooling of the non-stunted population is estimated at 7.9 years, while people who suffered from childhood stunting achieved only 7.1 years (see Figure 6.11).

It is important to note that over time there has been an improvement in the average number of years people remained in the education system. Whereas the cohort of 60-64 years schooled on average 3.4 years, the cohort aged 20-24 recorded an average of 8.6 years of education, demonstrating an important improvement of the educational level of the population.

FIGURE 6.11
AVERAGE SCHOOLING YEARS
FOR STUNTED AND NON-STUNTED POPULATION, SWAZILAND, 2009
(In years of education)
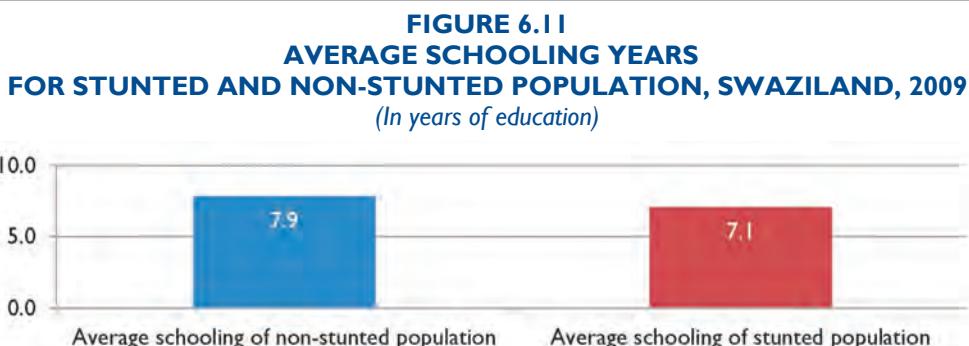
Source: Estimated from 2009-10 Swaziland Household Income and Expenditure Survey,[62] CSO.[63]

Data from the SHIES 2009-10 shows a progressive increase in income associated to higher schooling achievement, particularly in non-manual activities.[64] In this sense, the lower educational achievement of the stunted population has an impact on the expected level of income a person would earn as an adult.

The model estimates that 108,187 people engaged in non-manual activities in 2009 suffered from childhood stunting. This represents 16 percent of the country's labour force that is currently less productive due to lower schooling levels associated with stunting. As shown in Table 6.8, the estimated annual losses in productivity for this group amounted to SZL 251 million, which is equivalent to 1 percent of the GDP in 2009.

TABLE 6.8
REDUCED INCOME IN NON-MANUAL ACTIVITIES
DUE TO STUNTING, SWAZILAND, 2009

Age in 2009	Population working in non-manual sectors who were stunted as children *(In thousands of people)*	Income losses in non-manual labour *(In millions of SZL)*
15-24	46,773	43.4
25-34	27,423	89.2
35-44	15,427	56.6
45-54	11,002	43.6
55-64	7,562	18.1
Total	**108,187**	**250.9**
% GDP		**1.00%**

Source: Model estimations based on SIECS 2009[65] and DHS 2008.[66]

(2) Losses in manual activities

Manual activities are mainly observed in the agricultural, forestry and fishing subsectors, employing more than 62 percent of the population. In these types of activities, people who were stunted as children are have less lean body mass[67] and are therefore less physically capable than those who did not suffer from growth retardation. As such, they are expected to be less productive.[68] The model estimated that 416,702 people in Swaziland work in manual activities, of whom 175,432 were stunted as children, equivalent to 26 percent of the active labour force. This generated annual losses surpassing SZL126 million, equivalent to 0.5 percent of GDP, in potential income lost due to lower productivity (see Table 6.9).

TABLE 6.9
LOSSES IN POTENTIAL PRODUCTIVITY IN MANUAL ACTIVITIES DUE TO STUNTING, SWAZILAND, 2009

Age in 2009	Population working in manual labour who were stunted as children (In thousands)	Loss in productivity due to stunting (In millions of SZL)
15-24	75,603	26,947.6
25-34	43,591	32,709.1
35-44	24,769	25,677.2
45-54	18,420	24,673.6
55-64	13,048	16,168.8
Total	**175,431**	**126,176.4**
% GDP		**0.5%**

Source: Estimations based on data from DHS 2005-6[69] and WHO/NCHS database information.[70]

(3) Opportunity cost due to mortality

As indicated in the health section of this report, there is an increased risk of child mortality associated to undernutrition. The model estimates that the 16,019 people of working-age population who would have been part of the economy in 2009 (but died before the age of 5 from causes associated with undernutrition) could have increased national productivity by over 37 million working hours.

TABLE 6.10
LOSSES IN POTENTIAL PRODUCTIVITY DUE TO MORTALITY ASSOCIATED WITH UNDERNUTRITION, SWAZILAND, 2009

Age in 2009	Working hours lost (in thousands of working hours)	Loss in productivity (Thousands of SZL)	Loss in productivity (Thousands of USD)
15-24	8,364.8	28,488.9	3,351.6
25-34	8,251.2	65,534.7	7,710.0
35-44	7,852.4	82,236.0	9,674.8
45-54	6,746.8	87,775.6	10,326.5
55-64	6,269.0	75,565.0	8,890.0
Total	**37,484.3**	**33,600.2**	**39,953.0**
% GDP		**1.4%**	

Source: Estimations based on data from SHIES[71] and WHO/NCHS Database information.[72]

Considering the productive levels of the population, by their age and sector of labour, the model estimated that in 2009, the economic losses (measured by working hours lost due to undernutrition-related child mortality) are SZL 340 million, which represented 1.4 percent of the country's GDP.

(4) Overall productivity losses

The total losses in productivity for 2009 are estimated at approximately SZL717 million, which is equivalent to 2.9 percent of Swaziland's GDP. Figure 6.12, below, illustrates the distribution of losses. The largest share of productivity loss, at 47 percent, is due to working hours lost of individuals who died because of undernutrition. Due to the distribution of labour market of the population in Swaziland, lower productivity in non-manual activities represents an important element of the cost at 35 percent. For manual activities, the costs seem relatively low, at 18 percent, due to the lower income of this group.

FIGURE 6.12
DISTRIBUTION OF LOSSES IN PRODUCTIVITY, BY SECTOR, SWAZILAND, 2009
(In percentages and millions of SZL)
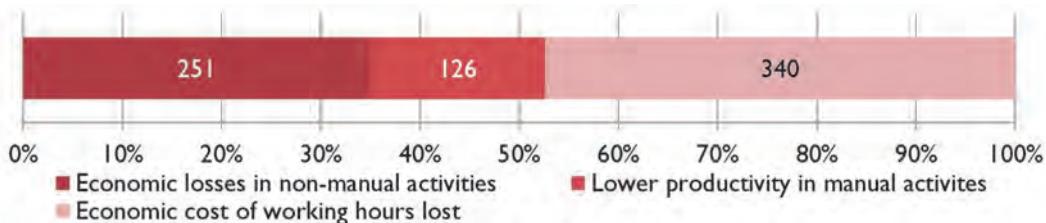
Source: Model Estimations.

6.2.D Summary of Effects and Costs

The methodology is used to analyse the impact of child undernutrition in different stages of the life cycle, without generating overlaps. As a result, the individual sectoral costs can be aggregated to establish a total social and economic cost of child undernutrition.

For Swaziland, the total losses associated with undernutrition are estimated at SZL783 million, or USD92 million for the year 2009, as presented in Table 6.11 (next page). These losses are equivalent to 3.1 percent of GDP of that year. The highest element in these costs relates to the lost working hours due to mortality associated to undernutrition. Due to the multi-causal phenomenon of grade repetition, the direct costs in education tend to be the lowest of the three sectors. Nevertheless, the potential gains in productivity for maintaining children in school are currently 32 percent of the total cost which still indicates an important productivity gain to be made from investments in school retention mechanisms.

TABLE 6.11
SUMMARY OF COSTS, SWAZILAND, 2009

	Episodes	Cost in millions of SZL	Cost in millions of USD	Percent-age of GDP
Health Costs				
LBW and Underweight	19,591	57	6.7	
Increased Morbidity	5,854	4	0.4	
Total for Health	**25,446**	**61**	**7**	**0.2%**
Education Costs				
Increased Repetition - Primary	4,792	4	0.5	
Increased Repetition - Secondary	758	2	0.2	
Total for Education	**5,550**	**6**	**0.7**	**0.02%**
Productivity Costs				
Lower Productivity - Non-Manual Activities	108,187	251	29.5	
Lower Productivity - Manual Activities	175,431	126	14.8	
Lower Productivity - Mortality	16,019	340	40.0	
Total for Productivity	**299,638**	**717**	**84**	**2.9%**
TOTAL COSTS		**784**	**92**	**3.1%**

Source: Model estimation

6.3 Analysis of Scenarios

The previous chapter showed the social and economic costs that affected Swaziland in 2009 due to high historical trends of child undernutrition. Most of these costs are already cemented in the society and policies must be put in place to improve the lives of those already affected by childhood undernutrition. Nevertheless, there is still room to prevent these costs in the future.

Currently, nearly one out of every three children under the age of five in Swaziland is stunted.[73] This section analyses the impact that a reduction in child undernutrition could have on the future socioeconomic context of the country. The results presented in this section project the additional costs to the health and education sectors as well as losses in productivity that children would bear in the future. They also indicate potential savings to be achieved. This is a call for action to take preventive measures and reduce the number of undernourished children to avoid large future costs to the society.

The scenarios developed for this report are as follows:

Baseline: The cost of inaction — Progress in reduction of stunting and underweight child stops

For the baseline, the progress of reducing the prevalence of undernutrition stops at the level achieved in 2009. It also assumes that the population growth would maintain the pace reported in the year of the analysis, hence increasing the number of undernourished children and the estimated cost. As this scenario is highly unlikely, its main purpose is to establish a baseline to which any improvements in the nutritional situation are compared in order to determine the potential savings in economic costs.

Scenario #1: Cutting by half the prevalence of child undernutrition by 2025

In this scenario, the prevalence of underweight and stunted children would be reduced to half of the 2009 values corresponding to the reference year. In the case of Swaziland this would mean a constant reduction of 0.9 percent points annually in the stunting rate, from 29.5 percent (estimate for 2009) to 14.8 percent in 2025. With the right combination of proven interventions, this scenario would be achievable, as the average rate of reduction for stunting between 2000 and 2006 was estimated at 0.9 percentage points, which is higher than the progress rate required in achieving this scenario. Nevertheless, in 2008, a national survey appeared to show an important increase in the prevalence rate, which might indicate the need for a new survey to validate the current levels of stunting in the country.

Scenario #2: The goal scenario — Reduce stunting to 10 percent and underweight children to 5 percent by 2025

In this scenario, the prevalence of stunted children under 5 would be reduced to 10 percent, and the prevalence of underweight children under the age of 5, to 5 percent. Currently, the global stunting rate is estimated at 26 percent, with Africa having the highest prevalence at 36 percent. This goal scenario, would require a true call for action, and would represent an important continental challenge towards which countries on the continent could collaborate to achieve. The progress rate required to achieve this scenario would be a 1.2 percentage points annual reduction over 16 years, from 2009 to 2025.

The model can generate various baseline scenarios, based on nutritional goals established in each country. Scenarios which were agreed upon with the national implementation team in Swaziland, can be used to advocate for increased investments in proven nutritional interventions.

These scenarios are constructed based on the estimated costs of the children born in each year, from 2009 to 2025 (net present value). While the previous section calculated the costs incurred in a single year by historical trends of undernutrition, these costs represent the present values and savings

FIGURE 6.13
TRENDS OF ESTIMATED COSTS OF CHILD UNDERNUTRITION, SWAZILAND, 2009-2025
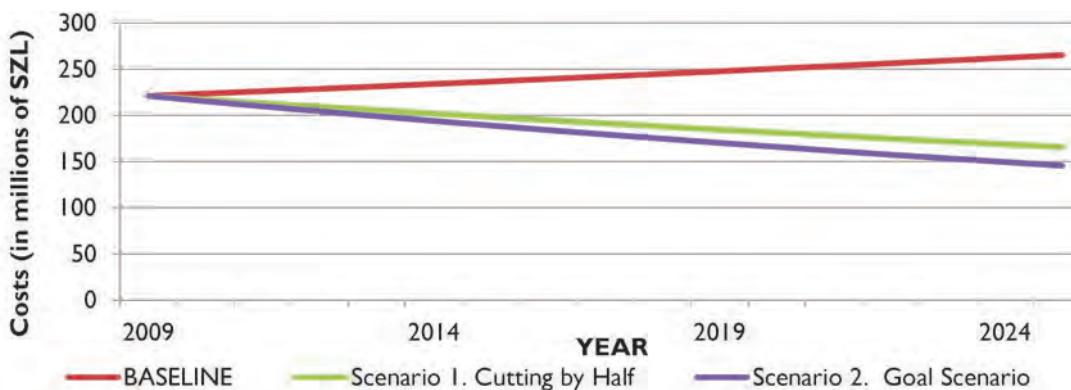
Source: Model estimations.

generated by children born during 2009 to 2025.

As Figure 6.13 shows, the progressive reduction of child undernutrition generates a similar reduction in the cost associated with it. The distances between the trend lines indicate the savings that would be achieved on each scenario.

In the baseline, where the progress of reduction of child undernutrition would stop at the level of 2009, the cost in 2025 would reach SZL265.3 million (USD31.2 million) (see Table 6.12).

	Baseline		S1. Cutting by Half		S2. Goal Scenario	
	SZL	USD	SZL	USD	SZL	USD
Projected cost in the year 2025	265.3	31.2	165.6	19.5	145.5	17.1
Total projected savings (2009-2025)			401.7	47.3	511.2	60.1
Annual projected savings (2009-2025)*			25.1	3.0	31.9	3.8
Annual percentage points reduction in stunting rates required achieve scenario (2009-2025)	Progress stops		0.9%		1.2%	

TABLE 6.12
COSTS AND SAVINGS BY SCENARIO, SWAZILAND
(All values in millions)[a]

Source: Model estimations.
a/ All values in net present values at an 8% social discount rate.

In Scenario #1 in which a reduction of half of the current prevalence is achieved, the cost in 2025 would reduce to SZL165.6 million (USD19.5 million). For the full period between 2009 to 2025, this would represent a total savings of SZL401.7 million (USD47.3 million). Although the tendency of savings would not be linear, as they would increase over time as progress was achieved, a simple average of the annual savings would represent SZL25.1 million (USD3.0 million) per year.

In the case of the goal scenario, the cost in 2025 would be reduced to SZl145 million (USD17.1 million). This translates into an increase in total savings to SZL511.2 million, (USD60.1 million), which represents SZL31.9 million (USD3.8 million) per year, for the same 16-year period.

6.4 Conclusions and Recommendations

6.4.A Implications for Implementation of the National Poverty Reduction Strategy

The COHA study is an important step forward to better understand the role that child nutrition and human development can play as a catalyser, or as a constraint, in the social and economic transformation. This report marks the first analysis on the social and economic impact of child undernutrition specific for Swaziland, opening the way for increased understanding of its consequences.

Its results strongly suggest that in order for the country to achieve inclusive human and economic growth, special attention must be given to the early stages of life as the foundation of human capital. The results of the study are supported by a strong-evidence base, and a model of analysis specially adapted for Africa, which demonstrates the depth of the consequences of child undernutrition in health

education and labour productivity. This study further quantifies the potential gains of addressing child undernutrition as a priority. Now, stakeholders have, not only the ethical imperative to address child nutrition as a main concern, but a strong economic rationale to position stunting in the centre of the development agenda.

The study estimates that child undernutrition generates health costs ranging to an equivalent of 0.6% of the total public budget allocated to health. These costs are due to episodes directly associated with the incremental quantity and intensity of illnesses that affect underweight children and the protocols necessary for their treatment. Although this amount might seem relatively small, it is important to note that only 3 out of every 10 children are estimated to be receiving proper health attention. As the health coverage expands to rural areas, there will be an increase of people seeking medical attention; this can potentially affect the efficiency of the system to provide proper care services. This study illustrates that a reduction of child undernutrition could facilitate the effectiveness of this expansion by reducing the incremental burden generated by the health requirements of underweight children.

Further, the study estimates that 1 out of every 10 cases of child mortality is associated with the higher risk of undernutrition. Hence, a preventive approach to undernutrition can help reduce this incremental burden to the public sector, and also reduce the costs that are currently being covered by caretakers and families. Increasing the educational level of the population, and maximizing the productive capacity of the population dividend, is a key element to increase competitiveness and innovation. This represents a particular opportunity in Swaziland where the population under 15 years is estimated to be 38 percent of the total population. These children and youth must be equipped with the skills necessary for competitive labour. Thus, the underlying causes for low school performance and early desertion must be addressed. As there is no single cause for this phenomenon, a comprehensive strategy must be put in place that considers improving in the quality of education and the conditions required for school attendance. This study demonstrates that stunting is one barrier to attendance and retention that must be removed to effectively elevate the educational levels and improve individuals' labour opportunities in the future.

The study estimated that children who were stunted experienced a 4.9 percent higher repetition rate in school. As a result, 12 percent of all grade repetitions in school are associated to the higher incidence of repetition that is experienced by stunted children. 86 percent of these cases of grade repartition occur in primary school. These numbers suggest that a reduction in the stunting prevalence could also support an improvement in schooling results, as it would reduce preventable burdens to the education system.

On the continent, more than half of the population is expected to live in cities by 2035.[74] An important component to prepare for this shift is to ensure that the workforce is ready to make a transition towards a more skilled labour, and economies are able to produce new jobs to reduce youth unemployment. By preventing child stunting thus avoiding the associated loss in physical and cognitive capacity that hinders individual productivity, people can be provided with a more equal opportunity for success.

The study estimates that 40 percent of the working age population in Swaziland is currently stunted. This population has achieved on average lower school levels than those who did not experience growth retardation of 0.8 years of lower schooling. As the country continues to urbanize, and an increasing

number of people participate in skilled employment, this loss in human capital will be reflected in a reduced productive capacity of the population. Thus, it may be a particularly crucial time to address child undernutrition and prepare future youth for better employment by prioritizing the reduction of stunting in Africa's transformation agenda.

The COHA model also provides and important prospective analysis that sheds light on the potential economic benefits to be generated by a reduction in the prevalence of child undernutrition. The model estimates that, in the analysed countries, a reduction of the prevalence to half of the current levels of child undernutrition by the year 2025 can generate annual average savings of SZL 25 million (USD3 million). An additional scenario shows that a reduction to 10 percent stunting and 5 percent underweight for that same period could yield annual average savings of SZL 32 million (USD4 million). This economic benefit that would result from a decrease in morbidities, lower repetition rates and an increase in manual and non-manual productivity, presents an important economic argument for the incremental investments in child nutrition.

This study is also an important example of how South-South collaboration can work to implement cost effective activities in development and knowledge sharing. Swaziland's participation as one of the pilot countries of the study, and its feedback in challenges faced in collecting the data at national level was an important element in adapting the COHA methodology to Africa. The contributions of the Swaziland NIT will serve to facilitate the expansion of this tool on the continent.

Lastly, this study illustrates the valuable role that data and government-endorsed research can play in shedding light on pertinent issues on the continent. This study will help the country engage within global nutrition movements such as the Scaling Up Nutrition Initiative as programmes and interventions are put in place to address stunting as a national priority.

6.4.B Recommendations of the Study

This study presents some key initial findings of the Cost of Hunger in Swaziland, as well both challenges and opportunities regarding the reduction of child undernutrition to the country.

A clear recommendation of this study is that Swaziland must review their national development frameworks to **ensure that the reduction of the stunting provenance is an outcome indicator of their social and economic development policies**. Chronic child undernutrition can no longer be considered a sectoral issue, as both its causes and solutions are linked to social policies across numerous sectors. As such, stunting reduction will require interventions from the health, education, social protection, and social infrastructure perspectives. Stunting can be an effective indicator of success in larger social programmes.

1. This study encourages countries not to be content with "acceptable" levels of stunting; equal opportunity should be the aspiration of every country the continent. In this sense**, it is recommended that aggressive targets are set in Swaziland for the reduction of stunting that go beyond proportional reduction, to establish an absolute value as the goal for the region at 10 percent**.

2. The achievement of this aggressive goal cannot be reached from just the health sector. In order to be able to have a decisive impact on improving child nutrition, **a comprehensive multi-**

sectoral policy must be put in place, with strong political commitment and allocation of adequate resources for its implementation. This plan should look to accelerate the actions on the determinants of child undernutrition such as inadequate income, agricultural production, improving gender equality and girls' education, improving water supply and sanitation, but also by addressing deeper underlying determinants such as the quality of governance and institutions and issues relating to peace and security. To ensure sustainability of these actions, whenever possible, **the role of international aid must be complementary to nationally led investments, and further efforts have to be done in ensuring the strengthening of national capacity to address child undernutrition**.

3. An important element that must be addressed to enhance the national capacity to address malnutrition is to improve the monitoring and evaluation systems. Currently, the assessments of the prevalence of child nutrition are carried-out with a periodicity of between 4 to 5 years. Nevertheless, **in order to be able to measure short term results in the prevention of stunting, a more systematic approach with shorter periodicity is recommended, of 2 to 3 years between each assessment.** As the focus on the prevention of child undernutrition should target children before 2 years of age, these results will provide information to policy makers and practitioners on the results being achieved in the implementation of social protection and nutrition programmes.

4. Another important element is to further the understanding of the determinants of child undernutrition in each context. As an initial step, it is **recommended that the assessment of child nutrition also includes information that relates the nutritional status of the children to the livelihoods and economic activities of the households.** This information can be used to inform programme design to ensure that interventions effectively reach these vulnerable families with appropriate incentives and innovative approaches within social protection schemes.

6.5 Acknowledgments

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7. Country Results: Uganda

7.1 Brief Socio-Economic and Nutritional Background

In the year 2009 the GDP of the Republic of Uganda (here after referred to as Uganda) was UGX 32,505.34 billion.[1] The per capita GNI was approximately USD510.0 and had doubled in the last decade.[2] There were also high levels of inequality (with a Gini index of 44.3)[3] and food insecurity (with a Global Hunger Index categorized at "serious") due to undernourishment, child undernutrition and child mortality, which presented important challenges for the country's development (see Table 7.1).[4]

Poverty remains a significant challenge for Ugandans. In 2009-2010, approximately 7.5 million Ugandans living in 1.2 million households were considered poor, representing 24.5 percent of the country's population. The incidence of poverty is higher in rural areas where approximately 27.2 percent of the population lives below the poverty line, as compared to 9.1 percent in urban areas.[5] This illustrates a higher burden of poverty on rural communities; rural populations represent 85 percent of the population, but a disproportionate 94 percent of the national poverty burden.[6]

TABLE 7.1
SOCIO-ECONOMIC INDICATORS, UGANDA

Indicators	2000-2002	2005-2007	2009-2011
GDP, total in billions of Uganda shillings[a/]	11,672	22,854	32,505 (2009)
GNI per capita, Atlas method (current US$)[a/]	250	380	510
Poverty - $1.25 a day (PPP) (% of population)	57.4	51.5	38
Population below the National Poverty Line (% of the population)	…	31.1	24.5
Gini Index	45.8	42.6	44.3
Labour force, total (in millions)	10.7	12.1	13.4
Rural population, percentage	87.5	86	84.4
Percentage of population in agriculture	66	72	66
Unemployment, % of total labour force	3.5	2	4.2
Unemployment, youth total (% of total labour force ages 15-24)	…	4.4	5.4
Population growth (Annual %)	3.19	3.25	3.19
Life expectancy at birth, total (years)	47.5	51.7	54.1

Source if not otherwise noted: World Bank Database[8]
[a/]"World Economic Outlook Database October 2012.[9]

Uganda's labour market is highly dependent on self-employment, with only 21 percent of the population working as paid employees. Although the contribution of agriculture to total GDP has been declining over the years, the sector has continued to dominate the Ugandan economy.[7] According to official estimates, agriculture contributed approximately 21 percent of the total GDP in 2009 and 90

percent of the total export earnings, with coffee remaining the predominantly exported cash crop. Furthermore, more than one third of the working population is engaged in manual activities, such as agriculture, forestry and fishing.[11] Although the country has been able to maintain relatively low levels of unemployment, the rate for youth labour is higher than that of the general population, which presents a challenge to providing quality employment for young people.[12]

Uganda's economy has experienced a positive trend in the last decade, with growth rates that exceeded 10 percent in 2008 (see Figure 7.1). Nevertheless, recently the economy has experienced a slowdown with high inflation rates and currency depreciation. Even with these constraints, there is a positive outlook for 2012 and 2013, driven in part by the oil sector.[13]

FIGURE 7.1
TRENDS IN REAL GDP GROWTH, UGANDA, 2003-2013
(In percentages)
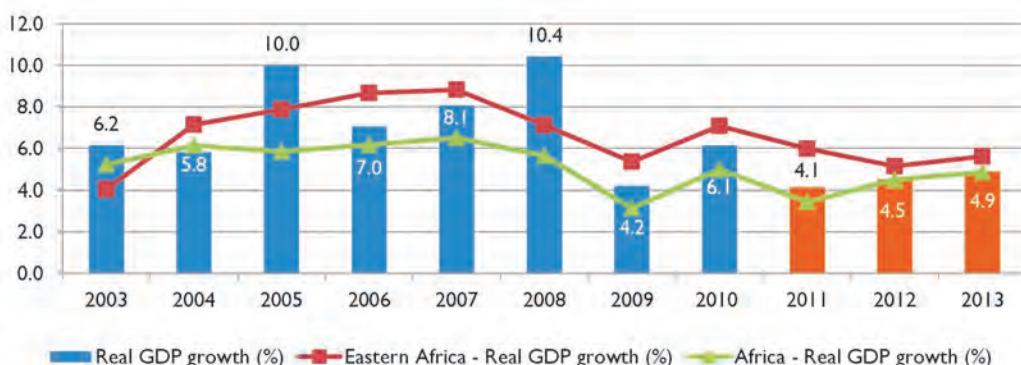
Source: African Economic Outlook 2012, Figures for 2010 are estimates; Orange bars for 2011 and later are projections.[10]

Social investment levels have also been consistent in the last few years, contributing to a positive social outlook. Investments in health have been well above the regional average, with levels as high as 9% of the GDP in recent years (see Table 7.2).[14] On the other hand, investments in education have decreased proportionally from 3.8 percent to 3.2 percent of the GDP, below the regional average, which is 4.6 percent for Sub Saharan Africa.[15]

TABLE 7.2
SOCIAL INVESTMENT INDICATORS, UGANDA

Indicators	2005-06	2007-08	2009-10	Sub-Saharan Africa *
Public spending on education, total (% of Gov. expenditure)	…	18.9	15	18.8%
Public spending on education, total (% of GDP)	…	3.8	3.2	4.6%
Expenditure per student, primary (% of GDP per capita)	…	8.39	7.21	…
Expenditure per student, secondary (% of GDP per capita)	…	26.00	20.47	…
Health expenditure per capita (current USD)	33.35	45.32	46.72	84.3
Health expenditure, total (% of GDP)	8.9	8.6	9	6.5%
Health expenditure, public (% of total health expenditure)	21	17.2	21.7	45%

Source: World Bank Database[16], most recent year available.
* Developing countries only - Latest data available.

The recent improvement in poverty rates has been accompanied by a reduction in child undernutrition, particularly in stunting. According to the 2011 Demographic and Household Survey (DHS), approximately 33.4 percent of Ugandan children under the age of 5 were suffering from low height for their age (stunting), which represents an important improvement from the 38.1 percent reported by DHS in 2006. Additionally, the prevalence of underweight children has also improved from 16.4 percent to 13.8 percent (see Figure 7.2). For that same period, the level of low birth weight prevalence in children has also remained steady, at around 10 percent.[17]

FIGURE 7.2
ESTIMATED UNDERNUTRITION TRENDS IN CHILDREN UNDER-FIVE, UGANDA,1990-2010
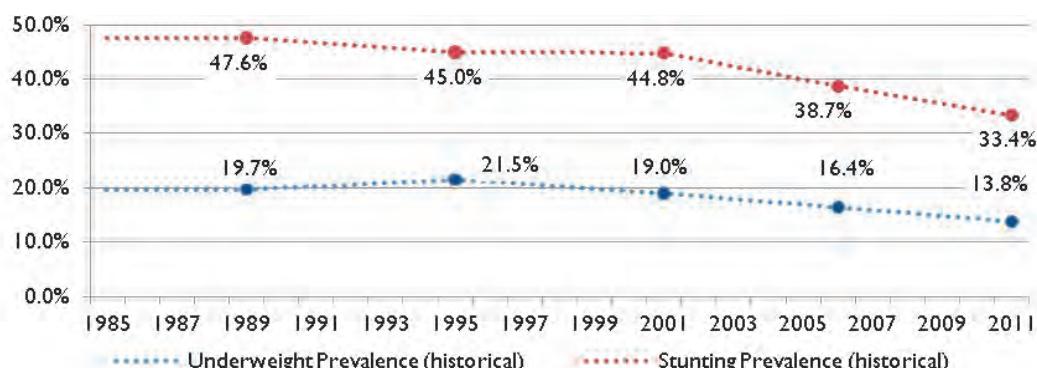
Source: Prepared based on information from DHS 2000/2005/2011.[18]
NOTE: Data prior to 2006, has been updated in line with new Child Growth Standards introduced by WHO in 2006[19] to replace the 1977 International Growth Reference, formulated by the National Center for Health Statistics (NCHS).[20]

The current levels of child undernutrition illustrate the continuing challenges for reduction of child hunger. It is estimated that 2.3 million of the 6.6 million children under the age of five in Uganda were affected by stunting in 2009 and almost one million of children were underweight (see Table 7.3). This

TABLE 7.3
POPULATION AND CHILD UNDERNUTRITION, UGANDA, 2009[c]
(Population in thousands)

Age groups	Population size (2009)[b]	Low Birth Weight		Underweight		Stunting	
		Population affected (2009)	Prevalence (2009)[/c]	Population affected (2009)	Prevalence (2009)[/c]	Population affected (2009)	Prevalence (2009)[/c]
New-born (IUGR)/[a]	1,515	83	5.5%				
0-11 months				246	16%	267	18%
12-23 months	1,405			251	18%	546	39%
24-59 months	3,667			478	13%	1,469	40%
Total	**6,587**	**83**		**975**		**2,282**	

Source: Estimated based on DHS surveys 2006/2011 and demographic projections.[22]
[a] In a given year, the new-born population is the same as the 0-11 month's age group.
[b] Estimated on the basis of the equation of De Onis et al, 2003.
[c] Data estimated from the most recent undernutrition prevalence figure available.

situation is especially critical for children between 24 and 59 months, where two out of every five children are affected by stunting.[21]

7.2 Effects and Costs of Child Undernutrition

Undernutrition is mainly characterized by wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age). In early childhood, undernutrition has negative life-long and intergenerational consequences; undernourished children are more likely to require medical care as a result of undernutrition-related diseases and deficiencies.[23] This increases the burden on public social services and health costs incurred by the government and the affected families. Without proper care, underweight and wasting in children results in a higher risk of mortality.[24] During schooling years, stunted children are more likely to repeat grades and drop out of school,[25] reducing thus, their income-earning capability later in life.[26] Furthermore, adults who were stunted as children are less likely to achieve their expected physical and cognitive development, thereby impacting on their productivity.[27]

7.2.A Social and Economic Cost of Child Undernutrition in the Health Sector

Undernutrition at an early age predisposes children to higher morbidity[28] and mortality risks.[29] The COHA model estimated risk of becoming ill due to undernutrition using probability differentials, as described in the methodology section. Specifically, the study has examined medical costs associated with treating low birth weight (LBW), underweight, anaemia, acute respiratory infections (ARI), acute diarrhoeal syndrome (ADS) and fever/malaria associated with undernutrition in children under the age of five (see Table 7.4).

(1) Effects on morbidity

Undernourished children are more susceptible to recurring illness.[30] Based on the differential probability analysis undertaken with DHS data in Uganda,[31] underweight children are more affected by diarrhoea (an increased risk of 18 percentage points) and fever (10 more percentage points) than healthy children. Acute respiratory infections are also more common in underweight children, particularly during the first 12 months of life at an incremental rate of 7 more percentage points. Despite a higher incidence of anaemia in underweight children aged 24 to 59 months, the risk of children under five years of age having anaemia is high regardless of their nutritional status.

TABLE 7.4
MORBIDITIES FOR CHILDREN UNDER-FIVE ASSOCIATED WITH UNDERWEIGHT, BY PATHOLOGY, UGANDA, 2009

Pathology	Number of episodes	Percentage of events
Anaemia	55,923	11%
ADS	289,994	59%
ARI	27,462	6%
Fever/Malaria	121,943	25%
Subtotal	495,322	
LBW	82,635	8%
Underweight	975,450	92%
Subtotal	1,058,085	
Total	1,553,407	

Source: Model estimations based on DHS 2006 and 2011,[32] and demographic information from UBOS.[33]

The study estimated that in 2009 in Uganda there were almost 1.6 million more episodes of illness related to diseases associated with being underweight. The highest occurrence of episodes was with diarrhoea, with almost 289,994 more episodes in underweight children, followed by fever, with over 121,943 annual episodes.

(2) Stunting levels of the working-age population

Undernutrition leads to stunting in children, which can impact on their productivity at later stages in life.[34] Although Uganda has made significant progress in reducing the levels of stunted children, a large proportion of the adult population is currently living with the life-long consequences of childhood stunting rates that had reached almost half of the population in the late 1980s.

As illustrated in Figure 7.3 below, this analysis estimated that over 8 million adults in the working-age population suffered from growth restriction before reaching the age of five. Currently this represents more than 54% of the population aged 15-64, who are in a disadvantaged position as compared to those who had healthy childhoods.

FIGURE 7.3
WORKING AGE POPULATION AFFECTED BY CHILDHOOD STUNTING, BY AGE GROUP, UGANDA
(In thousands of people)
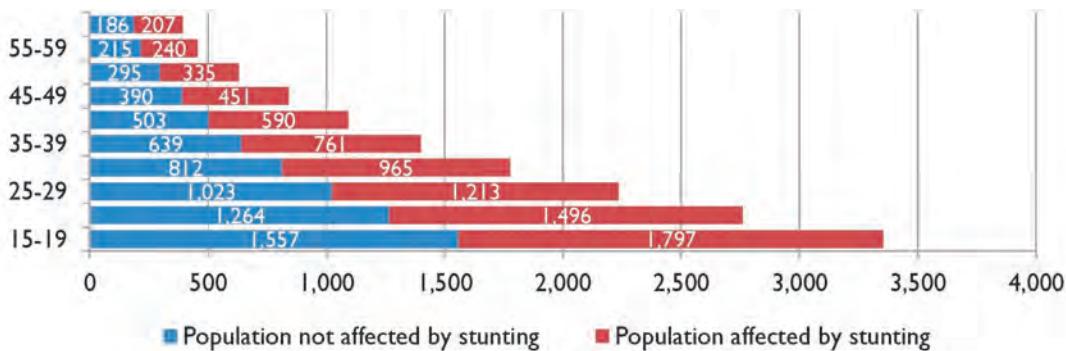
Source: Model estimations based on demographic information[35] and WHO/NCHS nutritional surveys.[36]

(3) Effects on mortality

Child undernutrition can lead to increased cases of mortality most often associated with incidences of diarrhoea, pneumonia and malaria.[37] Nevertheless, when the cause of death is determined, it is rarely attributed to the nutritional deficit of the child but rather to the related illness. Given this limitation in attribution, the model utilizes relative risk factors to estimate the risk of increased child mortality as a result of child undernutrition. Using these factors, abridged life tables[38] are used to estimate the incidence of higher mortality risk due to undernutrition.

The model estimates that in Uganda nearly one out of every seven reported child deaths (under five) is associated with undernutrition. As indicated in Table 7.5 below, in the last 5 years alone, it is estimated there would be 110,220 child mortalities in this age group associated with undernutrition. These deaths represented 15 percent of all child mortalities for this period. Thus, it is evident that undernutrition significantly exacerbates the rates of death among children and limits the country's capacity to achieve

the MDGs, especially the goal to reduce child mortality.

TABLE 7.5
IMPACT OF UNDERNUTRITION ON CHILD MORTALITY,
ADJUSTED BY SURVIVAL RATE, UGANDA, 1945-2009
(In number of mortalities)

Period	Number of child mortalities associated with undernutrition
1945-1994	567,048
1995-2004	207,935
2005-2009	110,220
Total	**885,203**

Source: ECA on the basis of life tables provided by UN Population Division.[39]

These historical mortality rates will also have an impact on national productivity. The model estimated that between 1945 and 2009, an equivalent of 3.8 percent of the current workforce has been lost due to the impact of undernutrition in increasing child mortality rates. This represents 567,048 people who would have between 15-64 years old, and part of the working age population of the country.

(4) Estimation of public and private health costs

The treatment of undernutrition and related illnesses is a critical recurrent cost for the health system. Treating a severely underweight child, for example, requires a comprehensive protocol that is often more costly than the monetary value and effort needed to prevent undernutrition.[40] These costs generate a significant burden not just to the public sector, but to society as a whole.

It is estimated that 1.6 million clinical episodes recorded in Uganda in 2009 were associated with undernutrition. These generated an estimated cost of more than UGX525 billion, as indicated in Table 7.6 below. Most of the incurred costs were associated to the protocol requiring bringing an underweight child back to a proper nutritional status, which often involves therapeutic feeding. An important element to highlight is the particular costs generated by the treatment of low birth weight children. These cases represented 5 percent of all the episodes but generated 26 percent of the total cost, making it the highest per capita element analysed. This is due to the special management protocol

TABLE 7.6
HEALTH COSTS OF UNDERNUTRITION-RELATED PATHOLOGIES,
UGANDA, 2009
(In millions of UGX)

Pathology	Cost	% of episodes	% of cost
LBW/IUGR	134,342	5%	26%
Anaemia	1,313	4%	0%
ADS	4,778	19%	1%
ARI	1,971	2%	0%
Underweight	369,477	63%	70%
Fever/Malaria	13,955	8%	3%
Total Cost	**525,835**	100%	100%

Source: Estimations based on data from DHS 2006 and 2011,[41] and cost analysis carried-out by NIT (for more details see Annex 5).

applied to LBW children, which often includes hospitalization and time in intensive care.

A large proportion of costs related to undernutrition are met by the families themselves, as often these children are not provided with proper health care. Based on the information collected by the NIT, the model estimated that only about 15 percent of underweight children under the age of five are attended at the health facilities. However, this number increases to 25 percent when the child presents an additional pathology such as diarrhoea, anaemia, fever/malaria or acute respiratory infection. This may indicate that caretakers may not react quickly enough to loss in weight, hence increasing the risk for health complications.

Most episodes of incremental illness associated to undernutrition happen before the first year of life. This is the period of the first thousand days of life, where children are most threatened due to age-specific vulnerabilities. In Uganda in 2009, 34 percent of all incremental episodes occurred in children under 12 months, representing 44 percent of costs (see Figure 7.4).

FIGURE 7.4
**DISTRIBUTION OF INCREMENTAL EPISODES OF ILLNESS
ASSOCIATED WITH UNDERNUTRITION BY AGE GROUP, UGANDA**
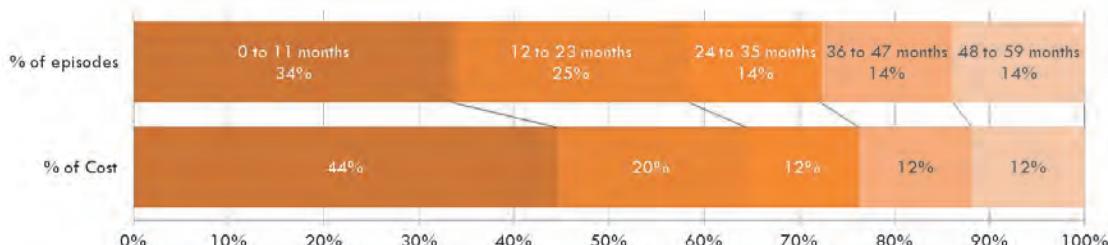
Source: Models estimations based on DHS 2006 and 2011,[42] and demographic information from UBOS.[43]

The discrepancy in the distribution of episodes that do not receive proper health care is also reflected in the distribution of the health costs. In Uganda, it is estimated that families bear around 87% of the health costs associated to undernutrition, representing UGX456 billion, while 13% of the total costs were attributed to the health system (see Figure 7.5).

FIGURE 7.5
DISTRIBUTION OF PRIVATE AND PUBLIC HEALTH COSTS, UGANDA
(In percentages and billions of UGX)

■ Cost to the Caretakers   ■ Cost to the Public System
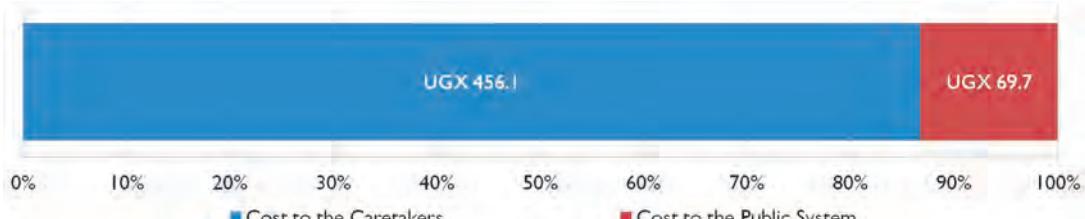
Source: Estimations based on data provided by DHS 2006 and 2011,[44] and data collected by NIT.

Although the families of undernourished children incur most of the health costs related to undernutrition, the burden of this phenomenon is still an important component in public sector expenditure. In 2009-2010 the annual estimated cost related to undernutrition was equivalent to 11% of the total budget allocated to health. In total, the economic impact of undernutrition in health-related aspects was equivalent to 1.6% of the GDP of that year.

7.2.B Social and Economic Cost of Child Undernutrition in the Education Sector

There is no single cause for repetition and dropout; however, there is substantive research that shows that students who were stunted before the age of 5 are more likely to underperform in school.[45] As a result, undernourished children are faced with the challenge of competing favourably in school due to their lower cognitive and physical capacities than children who were able to stay healthy in the early stages of life.

The number of repetition and dropout cases considered in this section of the report result from applying a differential risk factor associated to stunted children, as well as to the official government information on grade repetition and dropouts in the educational system in 2009. The cost estimations were based on the average cost of a child to attend primary and secondary school in Uganda in 2009 provided by the Ministry of Education, as well as estimations of costs incurred by families to support child schooling.

(1) Effects on repetition

Children who suffered from undernutrition before 5 years of age are more likely to repeat grades, compared to those were not afflicted by undernutrition.[46] According to official information provided by the Ministry of Education, over 1.8 million children repeated grades in 2009 (10.7 percent). Given the increased risk of repetition among stunted students, the model estimated that the repetition rate for was 12.2 percent while the repetition rate for non-stunted children was estimated at 9.1 percent (see Figure 7.6). Based on these rates and the proportion of stunted students, the model estimated that 128,970 repetitions, or 7.3 percent of all repetitions in 2009 were associated with undernutrition.

FIGURE 7.6
REPETITION RATES IN PRIMARY EDUCATION BY NUTRITIONAL STATUS, UGANDA, 2009
(In percentages)
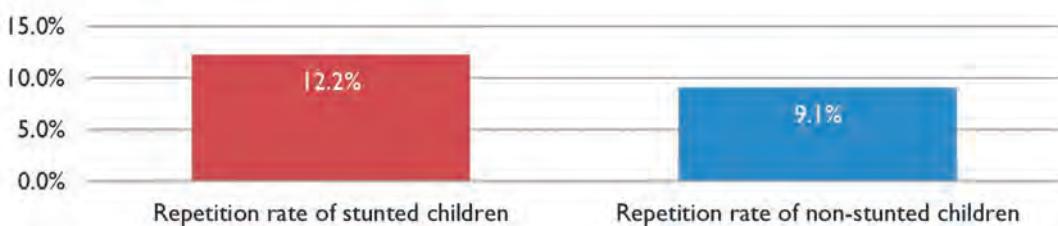
Source: Estimations based on data from EMIS (Ministry of Education – Education Management Information System for 2009 provided by NIT.[47]

As shown in Figure 7.7, most of these grade repetitions happen during primary school. There are far fewer children who repeat grades during secondary school; this largely due to the fact that many underperforming students would have dropped out of school before reaching secondary education.

FIGURE 7.7
GRADE REPETITION OF STUNTED CHILDREN IN SCHOOL,
BY GRADE, UGANDA, 2009
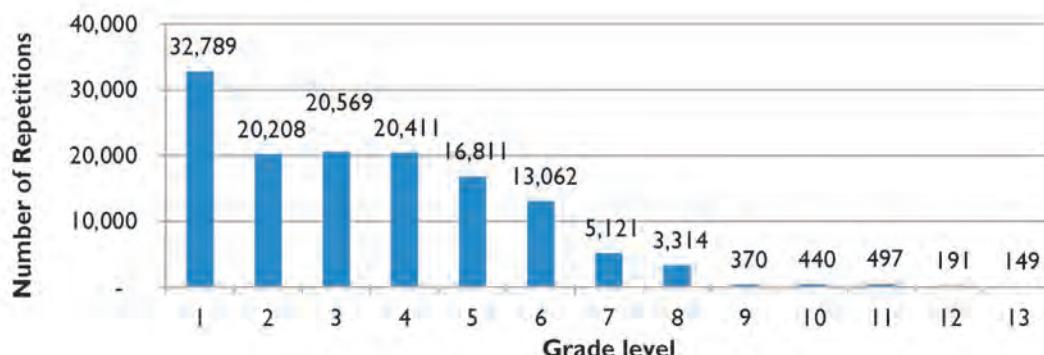
Source: Estimations based on data from EMIS Ministry of Education – Education Management for 2009 provided by NIT.[49]

Additionally, it is important to note that while Uganda does have a policy of automatic promotion,[48] official statistics provided by the ministry of education indicate that for various reasons, repetitions still occur.

(2) Effects on retention

According to the available data and relative risks of stunting on education, it can be estimated that 50 percent of the non-stunted population completed primary school, compared to only 34.2 percent of stunted children. Similar trends are observed in secondary school, where an estimated 11.9 percent of non-stunted children and less than 4.8 percent of stunted children completed secondary school (see Figure 7.8).

FIGURE 7.8
GRADE ACHIEVEMENT BY NUTRITIONAL STATUS, UGANDA, 2009
(In percentages)
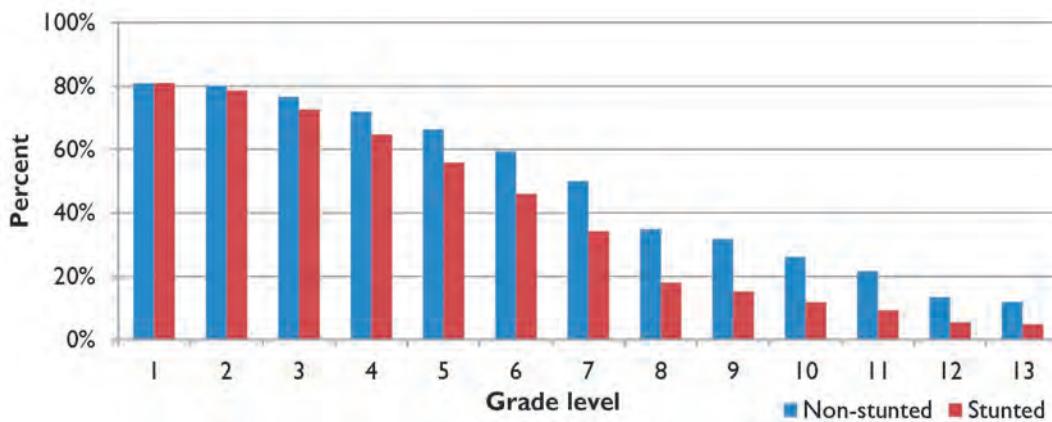
Source: Model estimations based from Uganda Bureau of Statistics (UBOS).[50]

The costs associated with school dropouts are reflected in the productivity losses experienced by individuals who are searching opportunities in the labour market. As such, the impact is not reflected in the school-age population, but in the working-age population, particularly in non-manual activities.

(3) Estimation of public and private education costs

Repetition in school has direct cost implications to families and the school system. Consequently in 2009, the 133,931 students, who repeated grades (and whose repetition was associated with undernutrition), incurred a cost of UGX19.7 billion (see Table 7.7). The largest proportion of repetitions occurred in primary school, where the cost burden mostly falls on the public education system. However, unit costs are significantly higher for repetitions in secondary school. The following chart summarizes the public and private education costs associated with stunting.

TABLE 7.7
COST OF REPETITIONS, UGANDA

	Primary	Secondary	Total
Public Costs per student (UGX)	62,415	208,952	
Private Costs per student (UGX)	62,731	499,616	
Number of repetitions	128,970	4,961	133,931
Total Public Costs (millions of UGX)	8,050	1,037	9,086
Total Private Costs (millions of UGX)	8,090	2,479	10,569
Total (millions of UGX)	**16,140**	**3,516**	**19,655**
% Social expenditure on education			**1.8%**

Source: Estimations based on official education statistics from EMIS Ministry of Education – Education Management Information System for 2009.[51]

As in the case of health, the social cost of undernutrition in education is shared between the public sector and the families. Of the overall costs, a total of UGX10.5 billion (46 percent) was covered by the caretakers, while UGX9.1 billion (54 percent) was borne by the public education system (see Figure 7.9). Nevertheless, the distribution of this cost varies depending on whether the child repeated grades at primary or secondary level. In primary education, the families cover 50 percent of the associated costs of repeating a year, whereas in secondary education the burden on the families is as high as 71 percent. This could also be a contributing factor to the higher dropout rates found in secondary education.

FIGURE 7.9
DISTRIBUTION OF COSTS IN EDUCATION, UGANDA
(In millions of UGX)

Source: Estimations based on official education statistics from EMIS Ministry of Education – Education Management Information System for 2009.[52]

7.2.C Social and economic cost of child undernutrition in productivity

As described in the health section of this report, the model estimated that 54 percent of the working-age population in Uganda were stunted as children. Research shows that adults who suffered from stunting as children are less productive than non-stunted workers and are less able to contribute to the economy.[53] This represents more than 8 million people in Uganda whose productive potential is affected by undernutrition.

Child undernutrition affects human capital and productivity in several dimensions. Stunted workers, on average, have achieved fewer years of schooling than non-stunted workers. In non-manual activities, higher academic achievement is directly correlated with higher income. Research shows that stunted workers engaged in manual activities tend to have less lean body mass[54] and are more likely to be less productive in manual activities than those who were never affected by growth retardation.[55] Moreover, undernutrition-related mortalities contribute to losses in potential national productivity.

The estimation of the population whose labour productivity is affected as a consequence of child undernutrition is based on historical nutritional information, in-country demographic projections and income reported in the Uganda National Household Survey 2009-2010. The workforce lost due to higher mortality risk of undernourished children is based on adjusted mortality rates estimated in the health section of this report.

The cost estimates for labour productivity are based the differential income associated to lower schooling in non-manual activities and the lower productivity associated to stunted children in manual work, such as agriculture. The opportunity cost of productivity due to mortality is based on the expected income that a healthy person would have been earning, had he or she been part of the workforce in 2009.

The distribution of the working population in the labour market is an important contextual element in determining the impact of undernutrition on national productivity. Although the proportion of the population engaged in non-manual activities is relatively small, the average income of this population is

FIGURE 7.10
MANUAL AND NON-MANUAL LABOUR DISTRIBUTION, BY AGE GROUP, UGANDA, 2009
(In percentages)

Source: Uganda National Household Survey (2009-2010) UBOS.[56]
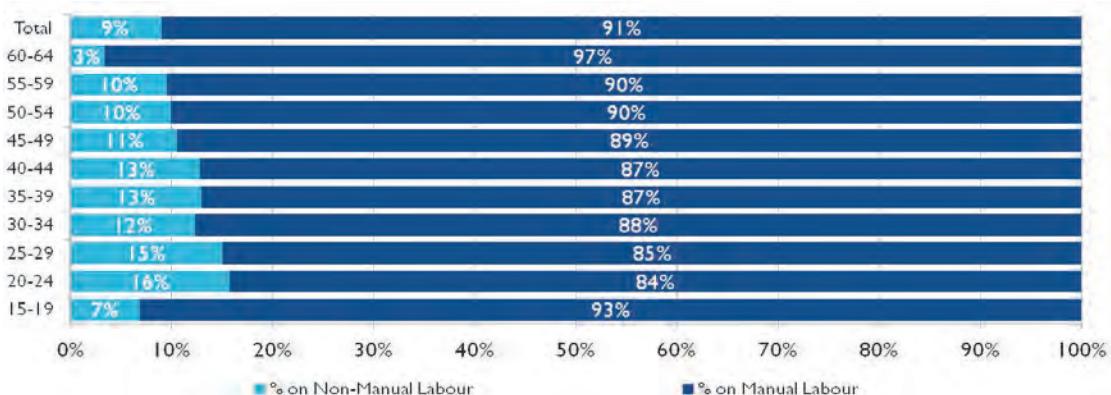
higher than that of the population working in manual activities. As shown in Figure 7.9, the trend of non-manual labour seems to be higher in the younger group (20 to 29 years of age) and manual activities seems to be more predominant among 30 to 59 year olds. In 2009, 1.7 million of working-age people were involved in non-manual activities.

(1) Losses in non-manual activities

As described in the education section of this report, stunted people complete, on average, fewer years of schooling than students who were adequately nourished as children. This situation affects mostly people who are engaged in non-manual activities, in which a higher academic education leads to improved income. In the case of Uganda, 9 percent of the working-age population is engaged in non-manual activities.[57] The average schooling of the non-stunted population is estimated at 6.1 years, while people who suffered from childhood stunting achieved only 4.9 years (see Figure 7.11).

FIGURE 7.11
AVERAGE SCHOOLING YEARS
FOR STUNTED AND NON-STUNTED POPULATION, UGANDA
(In years of education)
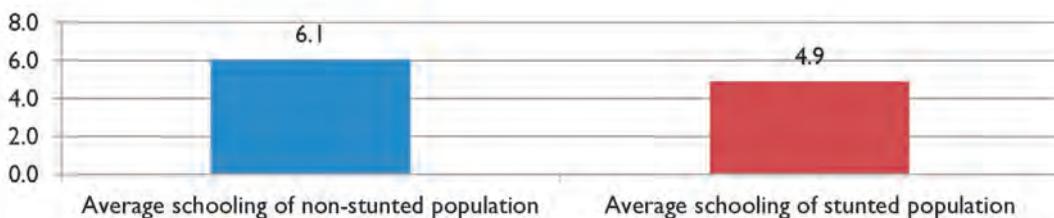
Source: Model estimations, based on UNHS 2009-2010 UBOS[58] and DHS 2006 and 2011.[59]

It is important to note that over time there has been an improvement in the average number of years people remained in the education system, whereas the cohort of 60-64 years schooled on average 3.5 years, the cohort aged 20-24 recorded an average of 6.5 years of education, demonstrating an important improvement of the educational level of the population (see Table 7.8).[60]

TABLE 7.8
LOWER PRODUCTIVITY IN NON-MANUAL ACTIVITIES
DUE TO STUNTING, UGANDA, 2009

Age in 2009	Population working in non-manual sectors who were stunted as children *(In numbers of people)*	Income Losses in non-manual labour *(In millions of UGX)*
15-24	359,786	51,549
25-34	300,931	60,246
35-44	174,098	59,834
45-54	80,777	56,046
55-64	29,962	13,389
Total	**945,554**	**241,064**
% GDP		**0.7%**

Source: Model estimations based on income UNHS 2009/2010 UBOS[62] and DHS 2006/2011.[63]

Data from the UNHS 2009/10 shows a progressive increase in income associated to higher schooling achievement, particularly in non-manual activities.[61] In this sense, the lower educational achievement of the stunted population has an impact on the expected level of income a person would earn as an adult.

The model estimated that 945,554 people engaged in non-manual activities suffered from childhood stunting. This represents 6.3 percent of the country's labour force that is currently less productive due to lower schooling levels associated with stunting. As shown in Table 7.8 the estimated annual losses in productivity for this group amount to UGX 241 billion, which are equivalent to 0.7 percent of the GDP in 2009.

(2) Losses from manual activities

Manual activities are mainly observed in the agricultural, forestry and fishing subsectors, employing more than 93 percent of the population.[64] In these type of activities, people who were stunted as children have less lean body mass[65] and are therefore less physically capable than those who did not suffer from growth retardation. As such, they are expected to be less productive.[66] The model estimated that 13.1 million people in Uganda work in manual activities, of which 7.1 million were stunted as children. This represented annual losses surpassing UGX 417 billion, equivalent to 1.28 percent of GDP, in potential income lost due to lower productivity (see Table 7.9).

TABLE 7.9
LOSSES IN POTENTIAL PRODUCTIVITY IN MANUAL ACTIVITIES DUE TO STUNTING, UGANDA, 2009

Age in 2009	Population working in manual labour who were stunted as children (In thousands)	Loss in productivity due to stunting (In millions of UGX)
15-24	2,934	140,094
25-34	1,877	133,737
35-44	1,177	72,160
45-54	705	55,700
55-64	417	15,241
Total	**7,110**	**416,932**
% GDP		**1.28%**

Source: Estimations based on data from UNHS 2009-2010 UBOS[67] and WHO/NCHS Database information.[68]

(3) Opportunity costs due to mortality

As indicated in the health section of this report, there is an increased risk of child mortality associated to undernutrition. The model estimates that the 567,048 people of working-age population who would have been part of the economy in 2009 could have increased national productivity by over 943 million working hours.

Considering the productive levels of the population by their age and sector of labour, the model estimated that in 2009 the economic losses (measured by working hours lost due to undernutrition-related child mortality) amounted to UGX 656.6 billion, which represented 2 percent of the country's GDP (see Table 7.10).

TABLE 7.10
LOSSES IN POTENTIAL PRODUCTIVITY DUE TO MORTALITIES, UGANDA, 2009

Age in 2009	Working hours lost due to higher mortality of underweight children (in millions of Working Hours)	Loss in productivity (in millions of UGX)
15-24	298	163,984
25-34	236	180,188
35-44	175	127,031
45-54	125	126,985
55-64	108	58,416
Total	**943**	**656,604**
		2.0%

Source: Model estimations based on UNHS 2009/2010 UBOS[69] and DHS 2006/2011.[70]

(4) Overall productivity losses

The total losses in productivity for 2009 are estimated at approximately UGX1.2 trillion, which is equivalent to 3.91 percent of Uganda's GDP. As presented in Figure 7.12, the largest share of productivity loss is due to the working hours lost from individuals who died because of undernutrition. Reduced productivity in manual activities represents 29 percent of the total loss, as there is a large proportion of the population in Uganda engaged in manual activities. For non-manual activities, the loss seems relatively low, although the per capita losses in this sector are higher than the losses in manual activities.

FIGURE 7.12
DISTRIBUTION OF LOSSES IN PRODUCTIVITY, BY SECTOR, UGANDA, 2009
(In percentages and millions of UGX)
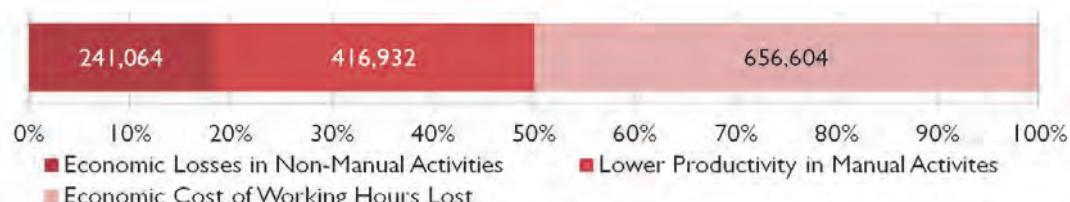
Source: Model Estimations.

7.2.D Summary of Effects and Costs

The developed methodology allowed the study to analyse the impact of child undernutrition in different stages of the life cycle, without generating overlaps. As a result, the individual sectoral costs can be aggregated to establish a total social and economic cost of child undernutrition.

For Uganda, the total losses associated with undernutrition are estimated at UGX1.86 trillion, or USD899 million for the year 2009. These losses are equivalent to 5.6 percent of GDP of that year (see Table 7.11). The highest element in these costs relates to the lost working hours due to mortality associated to undernutrition. Nevertheless, the costs incurred in the health sector also constitute an important element of analysis, representing nearly 30 percent of the total cost.

TABLE 7.11
SUMMARY OF COSTS, UGANDA, 2009

	Episodes	Cost in billions of UGX	Cost in millions of USD	Percent-age of GDP
Health Costs				
LBW and Underweight	1,058,084	503.8	243.5	
Increased Morbidity	495,322	22.0	10.6	
Total for Health	**1,553,407**	**525.8**	**254.1**	**1.6%**
Education Costs				
Increased Repetition - Primary	128,970	16.1	7.8	
Increased Repetition - Secondary	4,961	3.5	1.7	
Total for Education	**133,931**	**19.7**	**9.5**	**0.05%**
Productivity Costs				
Lower Productivity - Non-Manual Activities	945,554	241.1	116.5	
Lower Productivity - Manual Activities	7,110,178	416.9	201.5	
Lower Productivity - Mortality	567,048	656.6	317.3	
Total for Productivity	**8,622,781**	**1,314.6**	**635.4**	**3.95%**
TOTAL COSTS		**1,860.1**	**899**	**5.6%**

Source: Model estimations.

Due to the multi-causal phenomenon of grade repetition, the direct costs in education tend to be the lowest of the three sectors. Nevertheless, the potential gains in productivity for maintaining children in school are currently 13 percent of the total cost, which still indicates an important productivity gain to be made from investments in school retention mechanisms.

7.3 Analysis of Scenarios

The previous chapter showed the social and economic costs that affected Uganda in 2009 due to high historical trends of child undernutrition. Most of these costs are already cemented in the society and policies must be put in place to improve the lives of those already affected by childhood undernutrition. Nevertheless, there is still room to prevent these costs in the future. Currently, one out of every three children under the age of five in Uganda is stunted.

This section analyses the impact that a reduction in child undernutrition could have on the socio-economic context of the country. The results presented in this section project the additional costs to the health and education sectors as well as losses in productivity that Ugandan children would bear in the future. They also indicate potential savings to be achieved. This is a call for action to take preventive measures and reduce the number of undernourished children to avoid large future costs to the society.

The model can generate a baseline for various scenarios, based on nutritional goals established in each country. Scenarios, which were agreed upon with the national implementation team in Uganda, can then be used to advocate for increased investments in proven nutritional interventions.

Scenarios are constructed based on the estimated net present value of the costs of the children born in each year, from 2009 to 2025. While the previous section calculated the costs incurred in a single year

by historical trends of undernutrition, these costs represent the present values and savings generated by children born during 2009 to 2025.

The scenarios developed for this report are as follows:

Baseline: The cost of inaction — Progress in reduction of stunting and underweight child stops

For the baseline, the progress of reducing the prevalence of undernutrition stops at the levels achieved in 2009. It also assumes that the population growth would maintain the pace reported in the year of the analysis, hence increasing the number of undernourished children and the estimated cost. As this scenario is highly unlikely, its main purpose is to establish a baseline, to which any improvements in the nutritional situation are compared in order to determine the potential savings in economic costs.

Scenario #1: Cutting by half the prevalence of child undernutrition by 2025

In this scenario, the prevalence of underweight and stunted children would be half of the 2009 values corresponding to the reference year. In the case of Uganda this would mean a constant reduction of 1.11% percentage points annually in the stunting rate from 35.5 (estimate for 2009) to 17.8 percent in 2025. With the right combination of proven interventions, this scenario would be achievable, as the average rate of reduction for stunting between 2001 and 2011 was estimated at 1.14 percentage points, which is higher than the progress rate required in achieving this scenario. Nevertheless, for the period 2006-2011, a minor slowdown in the reduction rate (1.06 percentage points) was registered, which appears to indicate that stronger investments are required to continue the downward trend.

Scenario #2: The goal scenario — Reduce stunting to 10 percent and underweight children to 5 percent by 2025

In this scenario, the prevalence of stunted children would be reduced to 10 percent and the prevalence of underweight children under the age of 5, to 5 percent. Currently, the global stunting rate is estimated at 26 percent, with Africa having the highest prevalence at 36 percent. This goal scenario, would require a true call for action and would represent an important continental challenge, in which countries on the continent could collaborate jointly in its achievement. The progress rate required to achieve this scenario would be 1.6 percentage points annual reduction for a period of 16 years, from 2009 to 2025.

As Figure 7.13 shows, the progressive reduction of child undernutrition generates a similar reduction in the cost associated with it. The distances between the trend lines would indicate the savings that would be achieved on each scenario.

In the baseline, where the progress of reduction of child undernutrition would stop at the level of 2009, the cost in 2025 would reach UGX 1.4 billion (USD670.0 million).

In Scenario #1 in which a reduction of half of the current prevalence is achieved, the cost in 2025 would reduce to UGX627.7 million (USD309.1 million). For the full period between 2009 to 2025, this

would represent a total savings of UGX2.9 billion (USD1.4 billion). Although the tendency of savings would not be linear, as they would increase over time as progress was achieved, a simple average of the annual savings would represent UGX179.3 million (USD88.3 million) per year.

FIGURE 7.13
TRENDS OF ESTIMATED COSTS OF CHILD UNDERNUTRITION,
UGANDA, 2009-2025
(In millions of UGX)
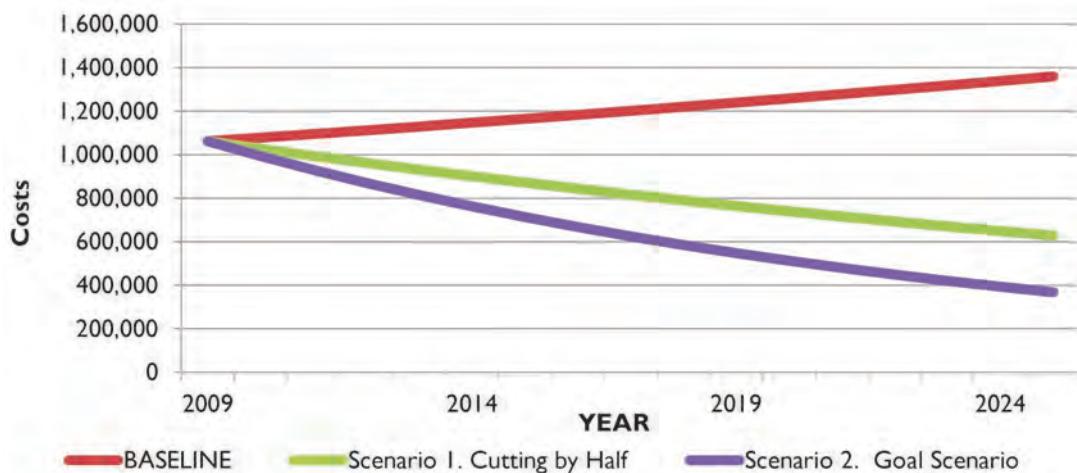
Source: Model estimations.

In the case of the goal scenario, the cost in 2025 would be reduced to UGX368.0 million (USD181.2 million). This translates into an increase in total savings to UGX4.3 billion (USD2.1 billion), which represents UGX266.9 million (USD131.5 million) per year, for the same 16-year period (see Figure 7.13 and Table 7.12).

TABLE 7.12
COSTS AND SAVINGS BY SCENARIO, UGANDA

	Baseline		S1. Cutting by Half		S2. Goal Scenario	
	UGX	USD	UGX	USD	UGX	USD
Projected cost in the year 2025	1,359.8	669.7	627.7	309.1	368.0	181.2
Total projected savings (2009-2025)			2,869.2	1,413.1	4,270.6	2,103.2
Annual projected savings (2009-2025)*			179.3	88.3	266.9	131.5
Annual percentage points reduction in stunting rates required achieve scenario (2009-2025)	Progress stops		1.14%		1.6%	

Source: Model estimations.

7.4 Conclusions and Recommendations

7.4.A Conclusions

The COHA study presents an opportunity to better understand the role that child nutrition can play as a catalyst for social and economic transformation, and human development. This report marks an important step forward for Uganda, serving as a gateway for policy-makers to understand the socio-economic consequences of child undernutrition on Uganda's economy and population.

The results of the study strongly suggest that, in order for Uganda to achieve sustainable human and economic growth, special attention must be given to addressing nutrition in the early stages of an individual's life. The results of the study are supported by a nationally representative evidence-base, and a model of analysis specially adapted for the African context. The model uses nationally collected data to estimate the additional costs in health, education and productivity that are incurred as a result of child undernutrition. This study further quantifies the potential gains of addressing child undernutrition as a priority. As a result of this study, stakeholders now not only have the ethical imperative to address child nutrition, but a strong economic rationale to position nutrition the centre of Uganda's development agenda.

The study estimates that child undernutrition generates health costs equivalent to 11 percent of the total public budget allocated to health. These costs are due to episodes directly associated with the incremental quantity and intensity of illnesses that affect underweight children and the protocols necessary for their treatment. It is also important to note that only 1 out of every 5 children is estimated to be receiving proper health attention. As the health coverage expands to rural areas, there will be an increase of people seeking medical attention; this can potentially affect the efficiency of the system to provide proper care services. This study illustrates that a reduction of child undernutrition could facilitate the effectiveness of this expansion by reducing the incremental burden generated by the health requirements of underweight children.

Further, the study estimates that 15 percent of all cases of child mortality are associated with the higher risk of undernutrition. Hence, a preventive approach to undernutrition can help reduce this incremental burden to the public sector, and also reduce the costs that are currently being covered by caretakers and families.

Increasing the educational level of the population, and maximizing the productive capacity of the population dividend, is a key element to increase competitiveness and innovation. This represents a particular opportunity in Uganda where the population under 15 years is estimated to be 48 percent of the total population. These children and youth must be equipped with the skills necessary for competitive labour. Thus, the underlying causes for low school performance and early desertion must be addressed. As there is no single cause for this phenomenon, a comprehensive strategy that considers improving in the quality of education and the conditions required for school attendance must be put in place. This study demonstrates that stunting is one barrier to attendance and retention, and to effectively elevate the educational levels and improve individuals' labour opportunities in the future, this barrier must be removed.

The study estimated that children who were stunted experienced a 3.1 percent higher repetition rate in school. As a result, 7 percent of all grade repetitions in school were associated to the higher

incidence of repetition that is experienced by stunted children. 96 percent of these grade repartitions occur in primary school, suggesting that a reduction in the stunting prevalence could also support an improvement in schooling results, as it would reduce preventable burdens to the education system.

On the continent, more than half of the population is expected to live in cities by 2035.[71] An important component to prepare for this shift is to ensure that the workforce is ready to make a transition towards a more skilled labour, and economies are able to produce new jobs to reduce youth unemployment. By preventing child stunting thus avoiding the associated loss in physical and cognitive capacity that hinders individual productivity, people can be provided with a more equal opportunity for success.

The study estimates that 54 percent of the working age population in Uganda is currently stunted. This population has achieved on average, lower schooling levels than those who did not experience growth retardation of 1.2 years of lower schooling. As the country continues to urbanize, and an increasing number of people participate in skilled employment, this loss in human capital will be reflected in a reduced productive capacity of the population. Thus, it may be a particularly crucial time to address child undernutrition and prepare future youth for better employment by prioritizing the reduction of stunting in Africa's transformation agenda.

The COHA model also provides and important prospective analysis that sheds light on the potential economic benefits to be generated by a reduction in the prevalence of child undernutrition. The model estimates that in Uganda, a reduction of the prevalence to half of the current levels of child undernutrition by the year 2025 can generate annual average savings of UGX174 billion (USD86 million). An additional scenario shows that a reduction to 10 percent stunting and 5 percent underweight for that same period could yield annual average savings of UGX260 billion (USD128 million). This economic benefit that would result from a decrease in morbidities, lower repetition rates and an increase in manual and non-manual productivity, presents an important economic argument for the incremental investments in child nutrition.

This study is also an important example of how South-South collaboration can work to implement cost effective activities in development and knowledge sharing. Uganda's participation as one of the pilot countries of the study, and its feedback in challenges faced in collecting the data at national level was an important element in adapting the COHA methodology to Africa. The contributions of the Uganda NIT will serve to facilitate the expansion of this tool in the continent.

Lastly, this study illustrates the valuable role that data and government-endorsed research can play in shedding light on pertinent issues on the continent. This study will help the country engage within global nutrition movements such as the Scaling Up Initiative as programmes and interventions are put in place to address stunting as a national priority.

7.4.B Recommendations

This study presents some key findings of the Cost of Hunger in Uganda, as well as, both challenges and opportunities regarding the reduction of child undernutrition to the country.

(1) Recommendations for on-going interventions

The Government of Uganda and its development partners a series of activities in place, which in most cases, are demonstrating results in the reduction of child undernutrition. Nevertheless, an improvement in the reduction rate will require a scaling-up in current interventions that have proved effective. Some of the actions recommended by the NIT in for this include the following.

- **Promotion of access to and utilization of essential services.** The Government of Uganda has put in place maternal child health services such as Pre Natal Care (PNC), Ante Natal Care (ANC), and young child health services provided through the health delivery system. These are directed at ensuring healthy pregnancies and good birth outcomes are achieved while promoting positive health, seeking the coverage and utilization still remains limited. To increase the rate of reduction of child stunting in Uganda, **it is recommended that the health system outreach services coupled with logistics and supplies management be strengthened and supported to facilitate access and promotion of the utilization at community and household level**.

- **Scaling up of food fortification for school going children and children above 6 months**. In Uganda, consumption of balanced diets is often limited to the affluent population group mostly located in the urban areas. The bigger proportion of Uganda's location is located in the rural areas. While access to food may not always be a problem, food diversity is limited and food consumed depends on the region. Worse still, the complementary foods used for children above six months of age are often starch-based and of low nutrient value. Children in primary school face similar challenges of limited diversity. Given the strong link between micronutrient deficiencies and stunting, **it is recommended that flour fortification is scaled up to facilitate mandatory use of fortified food in school meals and ensure increased nutrient intake for school going children**.

- **Promotion of the consumption of fortified complementary food especially in populations most affected by micronutrient deficiencies and stunting**. This could include exploring home fortification using Micronutrient powders as a strategy for improving the quality of complementary food for children above 6 months of age.

- **Promotion of Public-Private partnerships**. Encouraging public-private partnerships can serve as a way to engage the private sector (especially in the food production and processing industry), and better incorporate the health and nutritional needs of the population in their products, promotions and distribution mechanisms This might also assist in addressing the constraints (such as tax subsidies on processing technology equipment, fortificants, etc) of the public sector related to coming up with the right products.

- **Increase efforts and explore further opportunities in bio-fortification**. Given that most rural communities practice subsistence farming and may not be able to access fortified food products due to either remoteness or affordability, bio fortification of common staple

such as bean, maize, sweet potatoes may be promoted through the Ministry of Agriculture and other existing mechanisms in order to allow households practicing subsistence farming access better improved food commodities form own production.

- **Promotion of awareness of the entire population**. The government supports awareness activities through various sectors and mechanisms. Nutrition awareness remains limited across the whole population including the educated. The demonstrated impact of nutritional deficiencies in most parts of the country requires enhancing the awareness on the importance of nutrition especially in the first 1000 days of a child's life and the school-going age group that has be found to facilitate nutritional catch-up starting from the early childhood care and development centres.

- **An important mechanism to help raise this awareness is to increase nutrition sensitization actions on existing sector activities**. These may include developing of a nutrition hand guide that facilitates not only the literate but also educators on the locally available food commodities that could be used, blended, processed to develop a nutritionally enriched food that can be used by the various vulnerable groups. The last version of such a guide for Uganda was last updated in 1969. An updated on the takes into account foods that have since been introduced into country (as imports or locally grown) may be considered.

(2) Recommendations for addressing bottlenecks

In order for nutrition intervention to maximize their results, certain elements that are not directly within the scope of the activities themselves must be addressed, in order to achieve a sustained reduction in child nutrition.

From the policy environment perspective.
- An enabling policy environment to facilitate planning and implementation of the above recommendations.
- Mandatory large-scale industrial fortification of common staples widely consumed such as wheat, maize and vegetable oil.
- Mandatory use of fortified maize flour and vegetable oil in school feeding programmes.
- Tax subsidies on fortificants and other food processing and agricultural technology and equipment.

Coordination of multi-sectoral nutrition interventions for common objective of addressing undernutrition
- Support the OPM Uganda Nutrition Action Plan (UNAP) secretariat in their coordination role of ensuring the different sectors play their role in contributing to the implementation of the national nutrition plan.
- A clear recommendation of this study is that Uganda must review their national development frameworks to ensure that the reduction of the stunting provenance is an outcome indicator of their social and economic development policies. Chronic child undernutrition can no longer be considered a sectoral issue, as both its causes and solutions are linked to social policies across numerous sectors. As such, stunting reduction will require interventions from

the health, education, social protection, and social infrastructure perspectives. Stunting can be an effective indicator of success in larger social programmes

- This study encourages countries not to be content with "acceptable" levels of stunting; equal opportunity should be the aspiration of every country the continent. In this sense, it is recommended that aggressive targets are set in Uganda for the reduction of stunting that go beyond proportional reduction, to establish an absolute value as the goal for the region at 10%.

- The achievement of this aggressive goal cannot be reached from just the health sector. In order to be able to have a decisive impact on improving child nutrition, a comprehensive multi-sectoral policy must be put in place, with strong political commitment and allocation of adequate resources for its implementation. This plan should look to accelerate the actions on the determinants of child undernutrition such as inadequate income, agricultural production, improving gender equality and girls' education, improving water supply and sanitation, but also by addressing deeper underlying determinants such as the quality of governance and institutions and issues relating to peace and security. To ensure sustainability of these actions, whenever possible, the role of international aid must be complementary to nationally led investments, and further efforts have to be done in ensuring the strengthening of national capacity to address child undernutrition.

- An important element that must be addressed to enhance the national capacity to address malnutrition is to improve the monitoring and evaluation systems Currently, the assessments of the prevalence of child nutrition are carried-out with a periodicity of between 3 to 5 years. Nevertheless, in order to be able to measure short term results in the prevention of stunting, a more systematic approach with shorter periodicity is recommended, of 2 years between each assessment. As the focus on the prevention of child undernutrition should target children before 2 years of age, these results will provide information to policy makers and practitioners on the results being achieved in the implementation of social protection and nutrition programmes.

- Another important element is to further the understanding of the determinants of child undernutrition in each context. As an initial step, it is recommended that the assessment of child nutrition also includes information that relates the nutritional status of the children to the livelihoods and economic activities of the households. This information can be used to inform programme design to ensure that interventions effectively reach these vulnerable families with appropriate incentives and innovative approaches within social protection schemes.

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PART III:

Conclusions and Recommendations

8. Conclusions

The Cost of Hunger in Africa Study is an important step forward to better understand the role the child nutrition and human development can play as a catalyser, or as a constraint, in the social and economic transformation of Africa. Its results strongly suggest that in order to achieve this agenda, special attention must be given to the early stages of life as the foundation of human capital. The results of the study are supported by a strong evidenced base, and a model of analysis was specially adapted for Africa. The results demonstrate the deep impacts of child undernutrition in health, education and labour productivity. This study further quantifies the potential gains of addressing child undernutrition as a priority. Therefore, stakeholders have not only the ethical imperative to address child nutrition as a main concern, but also a strong economic rationale to position stunting at the centre of the development agenda.

The conclusions of this study highlight specific linkages between child undernutrition and the efforts to reduce inequalities in health, maximize the benefits of the population dividend and prepare for the rapid urbanization and industrialization process of the continent. All of these issues are key elements of Africa's transformation agenda.

Eliminating the inequality in access to health care is a key element of the social transformation agenda in Africa, which requires, as a precondition, a reduction of rural/urban gap in coverage. As the health coverage expands to rural areas, there will be an increase of people seeking medical attention; this can potentially affect the efficiency of the system to provide proper care services. This study illustrates that a reduction of child undernutrition could facilitate the effectiveness of this expansion by reducing the incremental burden generated by the health requirements of underweight children.

The study estimated that child undernutrition generates health costs ranging from an equivalent of 1 percent to 11 percent of the total public budget allocated to health. These costs are due to episodes directly associated with the incremental quantity and intensity of illnesses that affect underweight children and the protocols necessary for their treatment. Additionally, the study estimates that the larger proportion of these episodes, 69 percent to 81 percent, do not seek medical attention and are treated at home, thus increasing even further the risk for complications and evidence of an unmet demand for health care. Further, the study estimated that between 8 percent and 28 percent of all child mortalities are associated with the higher risk of undernutrition. Hence, a preventive approach to undernutrition can help reduce this incremental burden to the public sector and also reduce the costs that are currently being covered by caretakers and families.

Increasing the educational level of the population and maximizing the productive capacity of Africa's population dividend are key elements to increase competitiveness and innovation on the continent. This represents a particular opportunity in sub-Saharan Africa, where the population under 15 years of age is estimated to be 40 percent of the total population.[1] These children and youth must be equipped

with the skills necessary for competitive labour. Thus, the underlying causes for low school performance and early desertion must be addressed. As there is no single cause for this phenomenon, a comprehensive strategy that considers improving the quality of education and the conditions required for school attendance must be put in place. This study demonstrates that stunting is one barrier to attendance and retention that must be removed to effectively elevate the educational levels and improve individuals' future labour opportunities.

In each analysed country, children who were stunted experienced higher repetition rates in school ranging from 2 percent to 4.9 percent. As a result, 7 percent to 16 percent of all grade repetitions in school are associated with the higher incidence of repetition that is experienced by stunted children. 90 percent of the cases of grade repetition occur in primary school. These numbers suggest that a reduction in the stunting prevalence could also support an improvement in schooling results, as it would reduce preventable burdens to the education system.

By 2035, more than half of the population in Africa is expected to live in cities.[2] An important component to prepare for this shift is to ensure that the workforce is ready to make a transition towards a more skilled labour and the economies are able to produce new jobs to reduce youth unemployment. By preventing child stunting and by thus avoiding the associated loss in physical and cognitive capacities that hinder individual productivity, people can be provided with a more equal opportunity for success.

The study estimates that 52 percent of the working age population in the analysed countries is currently stunted. This population has achieved on average lower school levels than those who did not experience growth retardation, ranging from 0.2 to 1.2 years of lower schooling. As African countries continue to urbanize and an increasing number of people participate in skilled employment, this loss in human capital will be reflected in a reduced productive capacity of the population. Thus, it may be a particularly crucial time to address child undernutrition and prepare future youth for better employment by prioritizing the reduction of stunting in Africa's transformation agenda.

The COHA model also provides an important prospective analysis that sheds light on the potential economic benefits to be generated by a reduction in the prevalence of child undernutrition. The model estimates that a reduction in the prevalence of the current levels of child undernutrition by half by the year 2025 can generate annual average savings from USD3 million to USD376 million in the analysed countries. An additional scenario shows that a reduction to 10 percent stunting and 5 percent underweight for that same period could yield annual average savings from USD4 million to USD784 million. Such economic benefits that would result from a decrease in morbidity and lower repetition rates and an increase in manual and non-manual productivity, present an important economic argument for the incremental investments in child nutrition.

This study is also an important example of how South-South collaboration can work to implement cost effective activities in development and knowledge sharing. It demonstrates the feasibility of developing and implementing tools that are sensitive to the particular conditions of the continent. The applied methodology, constructed with regional expertise, in strong collaboration between ECA and ECLAC, could not have been effectively implemented without the support of the regional specialized bodies such as WFP and NEPAD and the field expertise of national experts from the governments. This partnership was built based on the comparative advantage of each contributing partner and

demonstrates the potential for global collaboration on this issue.

Lastly, this study illustrates the valuable role that data and government-endorsed research can play in shedding light on pertinent issues on the continent. Although the availability of uniform and readily-available data in Africa is limited, the COHA results have shown that the undertaken analysis has potential to bring the issue of child nutrition to forefront of the development arena. In this sense, in order to support African governments to develop appropriate transformation policies, it is crucial to emphasize the importance of collecting and analysing data to better understand the determinants of current situations and track progress.

Citations

[1] *World Urbanization Prospects: The 2011 Revision*, report, accessed October 2, 2013, http://esa.un.org/unpd/wup/pdf/
WUP2011_Highlights.pdf.

[2] Ibid

9. Recommendations

9.1 Policy Recommendations

Stunting is a useful indicator to evaluate effective social policies. The causes of and solutions for chronic undernutrition are linked to social policies across numerous sectors. As such, stunting reduction will require interventions from the health, education, social protection and social infrastructure perspectives. Stunting can be an effective indicator of success in larger social programmes.

Strong political will can be reflected in aggressive goals. This study encourages countries not to be content with "acceptable" levels of stunting; equal opportunity should be the aspiration of the continent. In this sense, it is recommended that aggressive targets are set in Africa for the reduction of stunting that go beyond proportional reduction, to establish an absolute value as the goal for the region at 10%. Countries with high and very high levels of stunting, of over 35%, might pursue an interim goal of reduction to 20%, but for countries that have been able to achieve progress enough to reduce stunting to below 35%, the establishment this target would be acceptable and desirable.

A multi-causal problem requires a multi-sectoral response. The achievement of this aggressive goal cannot be reached from just the health sector. To have a decisive impact on improving child nutrition, a comprehensive multi-sectoral policy must be put in place, with strong political commitment and allocation of adequate resources for its implementation.

Efficient rural economies and effective social protection schemes are key drivers for the sustained reduction of child undernutrition. Fostering rural economies, by enhancing the productivity of agricultural activities and expanding the non-agricultural support activities, is a key element in accelerating the reduction rate of malnutrition. Efforts carried out by CAADP and the development of value chains of strategic agricultural commodities can be key elements to focus efforts on in the coming years. Additionally, it is important to consider the role of social protection programmes in reducing hunger and malnutrition, in order to achieve the appropriate combination of transfers and services that is adequate for each context.

Sustainability requires strong national capacity. To ensure sustainability of these actions, whenever possible, the role of international aid must be complementary to nationally led investments, and further efforts have to be made in ensuring the strengthening of national capacity to address child undernutrition.

Monitoring is needed for progress. To measure short-term results in the prevention of stunting, a more systematic approach with shorter periodicity is recommended, such as two years between each assessment. As prevention of child undernutrition should target children before two years of age, these results would provide information to policy makers and practitioners on effectiveness of social

protection and nutrition programmes.

Long-term commitment is necessary to achieve results. The COHA initiative represents a valuable opportunity to place nutrition within a strategy to ensure Africa's sustainable development. As the deadline for Millennium Development Goals nears, new priorities and targets will be set that will serve as a guide for development policies in years to come. It is recommended that the prioritization of the elimination of stunting be not only presented in the traditional forums, but also included in the wider discussions of development, as a concern for the economic transformation of Africa.

Interventions must address both the current effects of stunting that are affecting society today, as well as address the future rates of stunting. As the study demonstrates, a large proportion of African population is currently stunted. Thus, a comprehensive response must also include targeted actions to address its consequences. One of the elements that can have an impact in the educational context is school feeding. These interventions, within a wider framework of social protection, have proven to contribute to raising enrolment rates (particularly for girls), attendance, educational achievement and cognition of students. Its implementation has to be analysed within specific contexts of each situation and within the scope of nutrition sensitive interventions.

The prevention of stunting is the most effective way of reducing its prevalence, as addressing children who are already stunted is very challenging. This is due to the already impaired physical and cognitive development, which typically happens before the age of two. In this sense, national actions should be directed towards proven interventions that address the nutritional status of pregnant and lactating mothers and newborn children

As the National Implementation Teams carried out the study, particular challenges were faced in obtaining specific information on child nutrition, especially in the health sector. These challenges might result from a gap in the information systems and/or the need to increase the relevance of nutrition in the current health systems. As aggressive goals are set to reduce stunting, improvements in data system can be proposed as a direct result of the specific efforts of this study. The data will allow the formulation of specific policies focusing on children, especially under the age of two.

9.2 Pending questions and research opportunities

The COHA represents an important step forward in shedding light on the importance of nutritional investments, as a fundamental basis for human development. Nevertheless, the process also served as an important exercise to identify gaps in knowledge that can help increase the dimensions of the analysis, that include:

Sub-national differences in the social and economic impacts of child undernutrition. There is an opportunity to raise the advocacy on sub-regional and local actions by developing a model to distribute the cost of hunger by region and further engage local governments and communities in the implementation of local actions to improve nutrition.

The impact of early child malnutrition on women's contributions to the household. As most women in Africa are responsible for household chores and caring activities, their contributions are not accurately measured by proxy of labour productivity, rather, by their capacity to provide wellbeing in the household. Nevertheless, the intensity in which this capacity is affected as a consequence of child malnutrition in not comprehensibly address in current literature.

There are still gaps of region-specific risk analysis in Africa, particularly in educational outcomes and labour productivity. A comprehensive analysis of a longitudinal study in Africa, can also serve as an important source of information to update further the relative risks faced by undernourished children, in different aspects of their lives.

Complementary analysis could be carried out to further understand the sectoral consequences of undernutrition. Additional multi-variable analysis could also help to explain variations across countries.

PART IV:

Annexes

Annex 1: Resolution 898 - 5th Joint Meeting of the AU Conference of Ministers of Economy and Finance and the ECA Conference of African Ministers of Finance, Planning and Economic Development

The Cost of Hunger in Africa: Social and Economic Impacts of Child Undernutrition

The Conference of Ministers,

Recognizing that cutting hunger and thereby achieving food and nutrition security in Africa is not only one of the most urgent means of reducing the vulnerability and enhancing the resilience of national economies, but also one of those which produces the highest returns for broader social and economic development,

Noting that if more progress had been made against hunger in Africa in recent years, the continent's recent solid growth performance would have been even more impressive, with potentially strong impacts on poverty reduction,

Noting further the negative impacts on Africa's growth prospects of recurrent but avoidable episodes of acute hunger, including large and destabilizing displacements of human populations,

Stressing the urgent need for policies and investment by member States to prevent such episodes of acute hunger, and also to address the causes and consequences of chronic hunger,

Appreciating the fact that the African Union's African Regional Nutrition Strategy and Comprehensive Africa Agriculture Development Programme provide robust frameworks for policy and action to address both acute and chronic hunger in Africa,

Noting that the Strategy and the Programme identify child undernutrition as one of the most damaging dimensions of chronic hunger in Africa,

Affirming that eradicating child undernutrition constitutes an effective investment in high-quality human capital, which is widely recognized to be a critical requirement for sustainable growth and development

Commending the efforts of member States to collect and disseminate comprehensive data about undernutrition at the individual and community levels, with special emphasis on child undernutrition,

Recognizing the continued lack of clear data on the aggregate social and economic costs of child undernutrition, and the aggregate social and economic benefits of eradicating it,

Recognizing further the critical need for such data to raise awareness among the general public, policymakers and development partners about those aggregate costs and benefits, and to guide relevant policies and investments,

1. *Urges* member States to intensify their efforts and investments to address acute and chronic hunger, applying the principles and priorities put forward in the African Regional Nutrition Strategy and Comprehensive Africa Agriculture Development Programme;

2. *Requests* the African Union Commission and the Economic Commission for Africa to intensify their support for these efforts and investments by member States;

3. *Welcomes* the multi-country study on the cost of hunger in Africa being led by the African Union Commission and the Economic Commission for Africa, in collaboration with the World Food Programme, to quantify the aggregate social and economic impacts of chronic hunger in Africa;

4. *Anticipates* that the study will lead to increased understanding among key national and regional policymakers of the depth and breadth of child undernutrition on the continent, and its aggregate social and economic consequences, and thereby establish a firmer foundation for policies and investments to cut hunger in Africa;

5. *Commends* the consultative process through which the study is being implemented, in particular the technical oversight role of the African Task Force on Food and Nutrition Development;

6. *Notes* that the African Task Force on Food and Nutrition Development has endorsed the methodology being applied in the study;

7. *Acknowledges* the technical support for the study being provided by the United Nations Economic Commission for Latin America and the Caribbean, as an excellent illustration of South-South cooperation;

8. *Takes note* of the preliminary results of the study indicating potentially large aggregate social and economic impacts of child undernutrition in African contexts;

9. *Requests* the African Union Commission and the Economic Commission for Africa, in collaboration with the World Food Programme, to expedite the successful completion of the study, including wide dissemination of the results at country and regional levels; and

10. *Urges* member States and partners participating in the study to provide the necessary resources for the successful completion of the study.

Annex 2: Supplementary Methodological Information

The following section is the result of the consultation process for the adaptation of the Model for Analyzing the Social and Economic Impact of Child Undernutrition[1], developed by ECLAC, to the context of Africa. This model draws and builds on the analytical work presented by ECLAC to establish the methodological framework, and was formulated in a joint collaboration between ECA and ECLAC.

1. Utilization of Risk Factors in the Model

Estimates of the impacts of undernutrition on health, education, and productivity are based on the concept of the *relative risk* run by individuals who suffer from undernutrition during the early stages of life.

To estimate relative risk, probability estimators of the occurrence of consequences for health (mortality, morbidities) and education (repeated grades and dropping out) are needed for the population groups with and without undernutrition.

Relative risk is not the same thing as the impact achieved by social programmes aimed at mitigating the problem. The former corresponds to the differential probability of having a problem (in health, education, productivity) between different populations (those that do or do not suffer from undernutrition). The latter, in contrast, reflects the effectiveness of an intervention in the affected population (that is, those who have those problems), compared to the population for which no intervention has been made. When reliable data for relative risk estimation are not available, the impact estimator can be used as a proxy, provided that considerations are made for the bias that may be introduced[2].

The relative risk indicators used in this study are:

(a) Probability differences (ΔP): this corresponds to the difference between the probability of occurrence of a consequence *(i)* among those suffering from undernutrition(P^U) and those not suffering from undernutrition(P^{NU}). That is,

$$\Delta P_i = P_i^U - P_i^{NU}$$

(b) Probability ratio (PR): this corresponds to the ratio between the probabilities of occurrence of a consequence *(i)* among those suffering from undernutrition (P^U) and those not (P^{NU}). That is,

$$PR_i = \frac{P_i^U}{P_i^{NU}}$$

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[1] Martinez R, Fernandez A. Model for Analyzing the Socialand Economic Impact of ChildUndernutrition in Latin America Manual Series 52. ECLAC, September 2007.

[2] For example, if a group of students suffering from undernutrition reduces the dropout rate from 10 to 8 percentage points as part of a nutritional supplement programme, the effectiveness is 2, or 20%. On the other hand, if the dropout rate among students not suffering from undernutrition is 7%, the difference for students with undernutrition would be 3 (10-7), and the differential relative risk of dropping out of school for those with undernutrition would be equivalent to 3/7, or 42.86%.

(c) Probability odds (PO): when the data in a cross-sectional study are displayed in a tetrachoric table just as in a prospective study or a cases and controls study, in the health field the expression "*prevalence – odds*" has been proposed, corresponding to the ratio between the probability of having a consequence *(i)* among those not suffering from malnutrition (P^U) and their counterparts. That is,

$$PO_i = \frac{P_i^U}{(1 - P_i^U)}$$

(d) Odds ratio (OR): this corresponds to the relationship between two PO values. That is,

$$OR = \frac{\frac{P_i^U}{1 - P_i^U}}{\frac{P_i^{NU}}{1 - P_i^{NU}}}$$

The ΔP indicator is particularly important, since that is the one that makes it possible to estimate the number of cases to consider in the cost calculation. In the literature, however, estimates for total probabilities (P_i) and associations with PR and OR can be found, so to use them as ΔP requires derivations that allow for the estimation of (P^U) and (P^{NU}), both for the different risk assessed.

Depending on the variable used, the probability P acquires a specific name. Thus:

- for mortality, it is ΔPMM or ΔMM
- for morbidity, it is ΔPM or ΔM
- for repeated grades, it is ΔPr or Δr
- for school dropouts, it is ΔPd or Δd
- for proportions of the population that reach each level of education, it is ΔPe or Δe
- for average level of education or schooling, it is ΔPE or ΔE

The concept of relative risk is applied, and plays an equally important role, in both dimensions of analysis. These two differ, however, in terms of both the period of time considered and the cohorts analyzed.

2. Effects and costs: Incidental retrospective dimension

2.1. Effects on health

These are measured as the ΔP corresponding to the incidence of mortality and the prevalence of morbidity that exist among people without undernutrition and those who have suffered undernutrition at some point before the age of five. The values of these differences specific to each pathology and each age group depends on the intensity of the undernutrition, and is generally different also in each locality, region, or country.

However, few estimates have been made in the world, so the relationships most recently described in the literature can be used for developing countries, along with the epidemiological follow-up data, official statistics from the countries, and interviews with specialists.

To estimate the number of deaths associated with undernutrition in a year *(x)*, the formula is:

$$MM_x^U = \sum_{i=1}^{i} MM_{ix}^U$$

In which,

MM_x^U = Number of annual deaths associated with undernutrition (in a year x)

MM_{ix}^U = Number of deaths from each pathology *(i)* associated with undernutrition (in a year x)

Alternatively, this indicator can be defined as:

$$MM_x^U = (U * N * \Delta MM^U)_x$$

In which,

U = Prevalence of undernutrition among boys and girls aged 0 to 59 months

N = Population size of the cohort aged 0 to 4 years (or 59 months)

ΔMM^U = Difference in probability of death between those who do and those who do notsuffer undernutrition before 60 months of age

The cumulative number of deaths, or burden of mortality, caused by undernutrition in a period of *n* years, is:

$$MM_n^U = \sum_{x-n}^{x} (U * N * DMM^U)_x$$

In which,

MM_n^U = Number of annual deaths associated with undernutrition occurring ina period of n years (from x-n to x)

Undernutrition affects mortality through a number of different pathologies, the most prominent of them being: diarrhoea, pneumonia, malaria, and measles. In order to limit the number of errors resulting from the quality of official records on cause of death, for the estimates in this study the differential relative risks for all causes of death are used. For the results of the 1st phase countries of the study, the latest information came from the Lancet 2008 Series. For the 2nd phase countries, the information will be updated with Lancet 2013 data, applied to the demographic information available for each country.

To estimate the number of disease episodes occurring for each pathology in a specific year caused by undernutrition in children under five, the formula is:

$$M_n^U = \sum_{j=1}^{j} \sum_{x-n}^{x} (\Delta M_{ij}^U * \mu_{ij}) * U_j * N_j)_x$$

In which,

M_n^U = Number of annual disease episodes occurring for each pathology *(i)* caused by undernutrition in a year x.

ΔM_{ij}^U = Difference in the probability of occurrence of a pathology *(i)* caused by undernutrition, in each sub-cohort or stage of the cycle *(j)* where there is undernutrition in children under the age of five (0-28 days, 1 to 11 months, 12 to23 months, 24 to 59 months)

μ_{ij} = Annual average number of times a pathology *(i)* occurs in those who present with it, during each stage of the cycle *(j)*.

U_j= Prevalence of undernutrition (differentiated according to the age group or sub-cohort among children 0-4 years old *(j)*)

N_j = Number of persons making up each sub-cohort of the cycle of 0-4 years *(j)*.

2.2. Effects on education

The effects of stunting on an individual's school performance can be summed up as the results shown in five indicators:

  a. Performance: grade point average below that of students that do not suffered from undernutrition (stunting).
  b. Repeated grades: loss of one or more years as a result of poor performance.
  c. Dropping out: leaving the educational system permanently or partially (on hold) before completing the process.
  d. Delay: entering a grade at an older age than is normal for the grade. This can be the result of late entry into school (due to coverage or access problems, immaturity, lack of resources), repeated grades, or putting school on hold for a certain period.
  e. Level of education: lower number of grades and levels passed.

The aggregate effect is estimated based on the achievement differentials corresponding to each indicator, annually at the population level, between those with and without stunting. However, for the purpose of measuring the associated costs, the analysis focuses on two indicators:

  • *Academic years lost:* this corresponds to the larger number of academic years per student that the system must operate due to repeated grades associated with stunting in the early stages of the life cycle (up to five years).

$$Y_{rep_x}^U = \sum_{z-1}^{z} (\Delta r_z * U_z * N_z)_x$$

$Y_{rep_x}^U$=Extra number of years of operation per child generated in a year *(x)* because of repeated grades associated with stunting.

Δr_z = Difference in the probability of repeating grade (z) associated with stunting suffered before the age of five.

U_z =Modal prevalence of stunting for the age group currently in each grade (z) at the time when those students were zero to four years old.

N_z = Size of the student population that should be assigned to each school grade (z) according to age (estimated from the corresponding time of enrolment).

- *Schooling differential:* this is equivalent to the differential of average years of schooling caused by stunting during the initial stages of the life cycle.

$$\Delta S_x = (S^{NU} - S^U)_x$$

In which,

ΔS_x = Differential of average number of years of schooling associated with stunting in a year *(x)*.

S^{NU} =Average level (years) of schooling attained by children and adolescents in thepopulation that did not suffered from stunting.

S^U = Average level (years) of schooling attained by children and adolescents who suffered stunting before the age of five.

To estimate the effects of stunting on school results and hence the costs, the official indicators available in the different countries are used, applying differential risks of passing, failing, and dropping out during basic (primary) education and intermediate (secondary) education, for boys and girls who suffered stunting before the age of five. Thus, the range of individual and average schooling (*S*) varies between 0 years and 12 or 13 years of schooling, depending on the current standard in each country.

The country data are generated by the respective national ministries and are organized to respond to the specific needs of their administrative procedures.

The principal assumptions, instruments, and sources of information related to educational indicators that were considered in the methodology are the following:

a. *Student population:* To estimate the number of boys and girls attending each grade (z) in the formal education system, the number officially enrolled in each country is considered. Alternatively, the net enrolment rate or coverage of primary and secondary education for each country according to UNESCO can be used, along with the population in the age group corresponding to each grade level, based on population estimates carried out by the country of the African Centre Statistics. This second alternative facilitates country-by-country comparisons.

b. *Student population by nutritional history:* To determine the effects of stunting associated with the education sector, the highest value of the prevalence (mode) of stunting observed in the categories is applied for the cohort of children aged 0 to59 months[3], to the enrolment per

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[3]If disaggregated data are not available for the cohort aged 0-59 months, alternatively the average prevalence of undernutrition for the entire group may be used, instead of the modal value.

grade in a given period, or, in its absence, to the aggregate enrolment figure for each level of education[4]. An adjustment rate has been applied to the prevalence of stunting in children of school age, to consider the higher risk of mortality of the undernourished children.

The prevalence of stunting for a cohort changes with age. Based on empirical evidence presented in the specialized literature, however, in this model it is assumed that stunting in the first years of life causes effects in educational achievement throughout the school years. This is based on the following considerations:

- Equal prevalence of stunting between the population enrolling in the school system at the appropriate time and those who do not enrol or do so at a late age. An association between stunting and late school entry has been hypothesized, but there are no data that can corroborate it reliably. Even though the net school enrolment rate is less than 100% and those outside the system are part of the same vulnerable population that suffers from stunting, existing data are not sufficient to verify the causal relationship. Therefore, this potential effect has not been included in the analysis. Early stunting has an effect on school results, which will have an impact on the system's aggregate pass and fail rates.

- Assuming a positive correlation between failing a grade and dropping out of school, if the previous point is proven correct, boys and girls who have had stunting early in life have a greater probability of dropping out[5].

c. *Years of schooling and mandatory education:* The years of schooling correspond to the number of grades in the educational system passed by an individual, whereas mandatory education refers to the minimum number of years of schooling a country establishes for its citizens in the corresponding regulations. In Africa, this figure varies depending on the specific policies in place. Schooling is considered incomplete when the number of grades successfully completed by an individual is lower than the total number of grades in the primary and secondary levels of education in each country.

d. *Passage rate per grade:* This corresponds to the number of students who have passed –that is, who have performed satisfactorily in evaluations, according to current legislation– compared to the total number enrolled in a grade or level during an academic year.

e. *Repetition rate per grade:* A student who has failed a grade is one who has not met the academic requirements necessary to be promoted to the next grade. In this manner, the failure rate is calculated as the ratio between the number of students who have failed a given grade or level, and the total number enrolled in that level or grade, during the same academic period.

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[4]In the first case, statistics compiled on the basis of a longitudinal study are needed; the second case requires at least a cross-sectional study of the universe of students or of a statistically significant sample of them.

[5]The issue of the higher dropout rate in the population that suffered from undernutrition before the age of five compared to the population with normal nutrition is addressed in more detail in the estimate of costs associated with undernutrition associated with the loss of productivity during the economically active life of the population.

Repeated grades refer to a student re-enrolling in a grade after having failed it. Reenrolment refers to registering again in the system after dropping out before.

Those with automatic promotion in one or more grades show a bias in this indicator and in the passage rate. In Africa, several countries have a non-repetition policy in place; nevertheless, the policies include a certain set of conditions in which the students can be held back. The model will consider these as cases the total cases of grade repetitions, officially reported by national systems. T

To estimate the composition of the population repeating grades according to their nutritional status in a given year *(x)*, different alternatives can be used depending on the information available in each country. In those where cohort studies have been done on students to determine their nutritional profile, those results can be used directly. In other countries, it is possible to estimate this figure by considering: the incidence of failed and repeated grades for the population for each grade (or level), the populations with and without stunting per grade or level, and the differential relative risk of repeating. (Δr_{zx}). Thus, for a given year *(x)*, the formula is:

$$\Delta r_{zx} = (r_z^U - r_z^{NU})_x$$

In which,

Δr_{zx} = Differential probability of repetition for each level (z) in a year *(x)* for those who had stunting before the age of five.

r_z^U = Probability of repetition for the population that suffered from stunting before the age of five at that educational level (z).

r_z^{NU}z = Probability of repetition for the population that suffered from stunting before the age of five at that educational level (z).

Since the rate of repetition (r) in the total population in a certain grade (z) is a weighted average of the repetition rate of the population according to its state of stunting, with an estimate of the repetition probability ratio (RPr) it is feasible to estimate the incidence for the population suffering from stunting and the population not suffering from it, as well as the differential.

When direct information on repeated grades is not available, but there is information on failed grades, the latter can be used as a proxy for the former.

f.   *Dropout rate:* This is equal to the proportion of students who leave the education system during the school year or between years, either during basic (primary) or intermediate (secondary) education.

To estimate the dropout rate among students suffering from undernutrition (stunting) (d^U), the sameprocedure is followed as in the case of grade repetition, using a dropout probability ratio (PR^d)estimator that is applied to students who suffered stunting before the age of five. The dropout rate is estimated for each year in the education level, based on the average number of

years of schooling reported in household surveys. All those who did not complete the secondary level are identified as dropouts. The distribution of the total number of dropouts according to their stunting status is estimated using an optimization function that generates differential average dropout risks for each grade (PR^d), thus adjusting it for the total estimated dropout figure for the entire education level.

When a specific (PR^d) is not available for a given country, an external one can be used as a proxy. However, in view of the differences in coverage and education level among these countries, the percentage distribution of years of schooling attained may be biased. These can be estimated by comparing the estimates with the information provided by the household surveys for the age range of 20 to 24 years. To correct this problem, the risk factor that is applied must be made more sensitive to eliminate the differences in this comparison.

When direct information on dropouts is not available, but there is information on withdrawal (meaning that the student has left the education system but has not indicated whether it is a permanent departure), the latter can be used as a proxy for the former. When a differential risk estimate is available for repeated grades but not for dropouts, the same factor can be used for both.

g. *Level of education*: This indicator reflects the last grade of school completed. Thus, students who drop out at a given grade (*z*) achieve a level of education equivalent to the previous grade (*z-1*).The indicator for the effect of stunting on education corresponds to the differential percentage distribution of years of schooling attained. Thus, there is one distribution for the universe of students that suffered stunting before the age of five and another for those who didn't suffered. The differences in each grade (0, 1, 2, … 12, 13 years of school) and in the general average reflect the effect.

Estimating the education differential requires an indicator of proportion differences or of probabilities, (Δe^U) specific to each grade (*1 to z*) for each year *(x)*. Due to the effects of undernutrition itself, these differences tend to be negative at the lower levels and positive at the higher ones.

$$\Delta e^U_{zx} = (e^{NU}_z - e^U_z)_x$$

In which,

Δe^U_{zx} = Probability differential of having a level of education (z) associated with undernutrition (stunting), existing in a year *(x)*.

e^{NU}_z = *Proportion* of students that do not suffered from stunting who reach each level of education (z).

e^U_z = Proportion of students that suffered from stunting who reach each level of education.

For this variable, all levels of education can be counted. However, in this study only the basic and intermediate levels are considered. The differential for higher education is not estimated because there is no reliable data on the impact that child stunting has on it.

To estimate the additional years caused by repeated grades associated with stunting, the following steps are taken:

- Take available data on the numbers passing and failing each grade.
- Obtain a relative risk estimator for failed grades.
- Compile population sizes by age group and estimate the potential number of enrolments in a scenario of total coverage.
- Total the number of students failing each grade.
- Apply to the above number the relative risk of failure caused by stunting.

To estimate the education differential generated by stunting, the following steps are taken:

- Obtain a relative risk estimator for dropping out.
- Estimate the proportional distribution of education levels for the total population in the study. For this process, there are three alternatives:

    1. *Official information – longitudinal follow-up*: estimate based on follow-up studies of cohorts for school results. Although this is a recommended alternative, it is not customary to find this type of study in the region, making it unlikely that the data necessary for its application will be available.

    2. *Cohort Reconstruction Method*: If longitudinal follow-ups are not available, this method is a good alternative. The problem, in particular, lies in the reliability of estimating the dropout rate based on aggregate data.

    3. *Household survey – closest cohort (20-24):* estimate based on the level of education declared in the latest household survey available in each country. The advantage of this alternative is that it is estimated on the basis of persons who are already past school age and their level of education is not very likely to change. However, it has the disadvantage that this cohort was affected by a different stunting rate than the one corresponding to the year of analysis *(x)*.

- Create a table of relative frequencies with the proportion corresponding to each level of education for each group (e_z^{NU} y e_z^{U}), based on the number of students dropping out of eachgrade and those completing each level (basic and intermediate). Ideally, as many distributions should be constructed as there are cohorts in the analysis, but if reliable data are not available, the current distribution for all cohorts should be used.
- Estimate Δe_{zx}^{U} (probability differential of students that suffered from stunting for each grade, compared to non-undernourished students).
- Calculate the weighted average level of education for each group (undernourished and non-undernourished) based on the data on population, coverage, stunting rate and relative frequency distribution of the levels of education.

2.3 Economic effects

As indicated in the theoretical framework section, total costs derived from undernutrition (underweight) (TC^U) aresummed up in a function that is a result of: higher public and private spending on healthcare (HC^U), inefficiencies in educational processes (EC^U), and lower productivity (PC^U). Thus:

$$TC^U = (HC^U + EC^U + PC^U)$$

The costs derived from stunting are estimated in national currency at the current exchange rate, on the basis of an annual period.

- Health costs:

$$HC_x^U = (HSC^U + IHC^U)$$

In which,

HC_x^U = Health costs associated with stunting, estimated for a specific year of analysis *(x)*.

HSC^U = Incremental costs in the healthcare system resulting from the epidemiological profile of undernourished individuals in the year of analysis *(x)*.

IHC^U = Private costs incurred by individuals and their families as a result of thetime and quality of life lost associated with these illnesses and mortality, in the year of analysis *(x)*.

The cost to the healthcare system, at an aggregate level, for the year of analysis *(x)* equals:

$$HSC_x^U = \sum_{j=1}^{j} \sum_{i=1}^{i} (M_{ijx}^U * SM_{ijx}^U * AHC_{ijx})$$

In which,

M_{ijx}^U = Number of annual disease episodes caused by undernutrition occurring for each pathology *(i)*, in a sub-cohort *(j)*, in the year of analysis *(x)*.

SM_{ij}^U = Percentage of cases that seek professional medical attention for each pathology *(i)*, in a sub-cohort *(j)*, in the year of the analysis *(x)*.

AHC_{ijx} = Average unit cost of treatment in the healthcare system for each pathology event *(i)*, in a sub-cohort *(j)*, in the year of analysis *(x)*.

The costs associated with treatment protocols are calculated based on the values reported by the respective ministries and public agencies that make up the healthcare sector in each country, equivalent to the treatment of one person for one event, and for the number of events associated with the pathology. These costs include both fixed costs (infrastructure and equipment) and variable costs (human resources and inputs) during the diagnostic, treatment, and follow-up phases, at the primary and hospital care levels required for each pathology. The latter includes the costs of intensive treatment, applied to the proportion of cases requiring it, in accordance with the corresponding treatment protocol.

Thus,

$$AHC_{ij} = PPC_{ij} + h_{ij} * HC_{ij} + ic_{ij} * ICC_{ij}$$

In which,

PPC_{ij} = Average unit cost of primary care for the pathology *(i)*, for each a sub-cohort *(j)*.

h_{ij} = Proportion of pathology events *(i)* requiring hospitalization in each sub-cohort *(j)*.

HC_{ij} = Average unit cost of hospital care for the pathology *(i)*, for each a sub-cohort *(j)*.

ic_{ij} = Proportion of pathology events *(i)* requiring intensive care in each sub-cohort *(j)*.

ICC_{ij} = Average unit cost of intensive care for the pathology *(i)*, for each a sub-cohort *(j)*.

To estimate private health costs, incurred by undernourished children and their families as a result of illnesses derived from undernutrition in a year *(x)*, the formula is

$$IHC_x^U = \sum_{j=1}^{j} \sum_{i=1}^{i} (M_{ijx}^U * AIC_{ijx} + (M_{ijx}^U * NSM_{ijx}^U * AHC_{ijx}))$$

In which,

M_{ijx}^U = Number of annual disease events caused by undernutrition occurring for each pathology *(i)*, in a sub-cohort *(j)*, in the year of analysis *(x)*.

AIC_{ijx} = Average cost incurred by the individual or his family for each pathology event *(i)*, in a sub-cohort *(j)*, in the year of analysis *(x)*.

NSM_{ij}^U = Percentage of cases that do not seek professional medical attention for each pathology *(i)*, in a sub-cohort *(j)*, in the year of the analysis *(x)*.

The average unit cost for each pathology, incurred by the individual (or his family) in a given year *(x)*, for treated episodes:

$$AIC_{ijx} = \left((tPC_{ij} * Ct + t_{ij} + ICPC_{ij}) + h_{ij}(tH_{ij} * Ct + t_{ij}) + ic_{ij}(tic_{ij} * Ct + t_{ij}) \right)_x$$

In which,

tPC_{ij} = Average time an adult (accompanying a child patient) spends on primary caretreatment for the pathology *(i)* in the sub-cohort *(j)*. The estimation should include travel and treatment time.

Ct = Alternative time cost

t_{ij}= Cost of transportation (or access) required to continue treatments for eachpathology *(i)* in the sub-cohort *(j)*.

$ICPC_{ij}$ = Input costs to the family (not covered by the healthcare system) for primary caretreatment of the pathology *(i)* in the sub-cohort *(j)*.

h_{ij}= Proportion of pathology events *(i)* requiring hospitalization for each pathology *(i)* in each sub-cohort*(j)*.

tH_{ij} = Average time an adult (accompanying a child patient) spends on hospitaltreatment for the pathology *(i)* in the sub-cohort *(j)*.

ic_{ij} = Proportion of pathology events *(i)* requiring intensive care for each pathology *(i)* in each sub-cohort *(j)*.

tic_{ij} = Average time an adult (accompanying a child patient) spends on intensive care treatment for the pathology *(i)* in the sub-cohort *(j)*.

The time cost *(Ct)* is measured in $/hour and corresponds to the equivalent of the minimum hourly wage *(Wh)* for each country, according to each country's laws.

If the information is not available a proxy can be estimated by dividing the monthly minimum wage (*Wm*) for160 hours for Africa. Thus, in the latter case, it would be

$$C_t = W_m/160$$

The cost of transportation has been estimated as the average equivalent value of two trips on urban public transportation in each country.

When the costs of treating certain pathologies are not detailed in this manner in the model, but rather are presented as aggregate values (per group of pathologies, type of care and/or cohort),the average costs of treatment per patient can be estimated. It should be noted, however, that this can increase the estimation errors.

- Education costs:

$$EC_x^U = ESC_x^U + PEC_x^U$$

In which,

EC_x^U = Education costs associated with undernutrition, estimated for a year *(x)* of analysis.

ESC_x^U= Public costs to the education sector in a year *(x)*due to the need to cover the incremental demand produced by the higher probability of repeated grades among students who suffered undernutrition before the age of five.

PEC_x^U = Private costs in a year *(x)*due to the increase in inputs requirements produced by the higher probability of repeated grades among students who suffered undernutrition before the age of five.

The aggregate cost to the educational system (during a period x) is equal to:

$$ESC_x^U = \sum_{l=1}^{l}(Y_{replx}^U * OC_{Elx})$$

In which,

Y_{replx}^U= Extra number of years of operation per child generated in the year of analysis *(x)*at the education level *(l)* because of repeated grades associated with undernutrition.

OC_{Elx} = Operating cost per academic year per student (infrastructure, equipment, human resources, educational inputs, and meals) at the education level *(l)* in the year of analysis *(x)*.[6]

The private education costs incurred by individuals that suffered from undernourishment and their families due to the need for more educational inputs and others, in the year of analysis *(x)*, are the result of:

$$PEC_x^U = \sum_{l=1}^{l}(Y_{replx}^U + FC_{Elx})$$

In which,

Y_{replx}^U= Extra number of years of operation per child generated in the year of analysis*(x)* at the education level *(l)* because of repeated grades associated with undernutrition.

FC_{Elx} = Average family cost of keeping the student in school for one year (educational material and inputs) at the education level *(l)* in the year of analysis *(x)*.

Substituting equations 17 and 18 in equation 16, the education cost is:

$$EC_x^U = \sum_{l=1}^{l}(Y_{replx}^U * (OC_E + FC_E)_{lx})$$

For purposes of analysis, when some inputs or meals are not covered by the educational system, these costs are passed on to the family. Due to a lack of access to data, the other incremental costs derived from the need for more heterogeneity of offerings because delays in schooling expand the age range of the student body, and from the loss of the investments made in students who drop out of school, have not been considered in this phase of the study.

To estimate public costs, the budget allocations associated with payments of salaries, administrative personnel, teachers, materials, inputs, and payment of services, and the budgets corresponding to student support programmes (meals, supplies, textbooks) and learning support programmes (to improve the quality of education, introduce technologies, etc.) should can taken into account.

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[6]If disaggregated data are not available for each level of education (l), a single estimate for all levels can be made using average costs

For private costs (of educational inputs and materials) it is recommended that the data be based on the average cost per student participating in public programmes that provide these services. The values corresponding to private education are not used in order to avoid overestimating costs with the gains made in each country. Given the diversity and unreliable information of rural transportation, transportation cost have not been included as part of the analysis of educational costs in Africa.

- Lower productivity.

Undernutrition affects productivity in two alternative scenarios, which are presented as opportunity costs for individuals:

i. *Those who survive undernutrition*: it is estimated that they will have less potential income because (a) the lower level of education attained by a population, particularly in non-manual activities, and (b) lower physical productivity associated with the population that has suffered from stunting before the age of five, compared to the population with no undernutrition.

ii. Those that die of causes associated with undernutrition: they have a loss of all potential income (during working life) [7] because of the higher infant mortality rate caused by undernutrition (MMCU). This is equal to the income a person would earn after surviving the first years of life without dying of undernutrition.

Thus, the level for society as a whole is:

$$PC_x^U = ELC_x^U + LMC_x^U + MMC_x^U$$

In which,

ELC_x^U = Lower potential productivity in the year of analysis *(x)* resulting from a lower level of education attained by a person who has suffered from undernutrition before the age of five.

LMC_x^U = Lower potential productivity in the year of analysis *(x)* resulting from the lower wages obtained by a person who suffered from undernutrition before the age of five.

MMC_x^U = Loss of potential productivity for the year of analysis *(x)* due to death associated with undernutrition in boys and girls before the age of five.

- Lower productivity in non-manual activities

The lower potential income (ELC_x^U), corresponds to the sum of average differential wages, for those engaged in non-manual labour, estimated for a year of analysis *(x)*, earned by those who suffered from undernutrition before the age of five, compared to those who did not, due to the impact on their level of education.

In which,

$$ECL_x^{U\widetilde{m}} = \sum_{z=0}^{z} \sum_{j=1}^{j} (\Delta y_{jz}^{U\widetilde{m}})_x$$

---

[7]The working life is assumed to be 50 years, between the ages of 15 and 64 years

$\Delta y_{jzl}^{U\widetilde{m}}$ = Potential income differential of people who has suffered from undernutrition before the age of five in an age group (j), a level of education (z)

> The effect of less schooling on productivity is estimated on the basis of the income differential affecting people who suffered from undernutrition before the age of five. For this purpose, consideration is given to the differences in the distribution of education level associated with undernutrition(estimated for effects on education) and their relationship to average expected income, based on Human Capital Theory and the proposals of Jacob Mincer (1958 and 1962) and Gary Becker (1964),together with the idea that in a competitive market with balanced factors, labour productivity corresponds to the marginal product reflected in wages[8].

Thus,

$$y = f(EDU, EXP)$$

To implement this, the following steps must be taken:

a. Estimate the proportion of population, by age group, in 5 year cohorts, that is engaged in non-manual activities.

b. Using the data from the household survey in each country, create a matrix in which the individuals making up a working-age population (WAP), aged 15 to 64, are classified according to their level of education (0 to 12/13) and age quintiles (as a proxy for experience), and involved in non-manual activities.

c. Estimate the average annual income for each education and experience category, considering only the WAP engaged in non-manual activities, regardless of whether or not it is part of the economically active population (EAP), in order to obtain the expected income for the entire set of individuals in each age-education combination.[9]

d. Estimate the probability of undernutrition to which each age category in the WAP was exposed before the age of five (if the analysis is conducted for the year 2009, the population between 1945 and 1994 would be considered). For this purpose, the historical series must be reconstructed, interpolating data on average undernutrition for each year based on estimates from national surveys[10].

e. Estimate the number of people who, probabilistically, may have had undernutrition in each age group of the WAP, multiplying the population sizes by the prevalence of undernutrition corresponding to each group in the corresponding quintiles (for example:1940-44, 1945-49, ... 1985-890).

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[8]There is ample evidence showing that among the determinants of a worker's productivity – given a certain technology – are years of education (including basic, intermediate, and higher education) and the experience the worker has gained. In this manner, considering differences in average monthly income of workers who have had undernutrition and "normal" workers, controlling for experience based on age, would in fact acknowledge the difference in productivity of these workers

[9]Certain data could be specified considering only the sectors of the economy in which the most vulnerable population typically participates. However, that would skew the estimates, excluding potential sectors of production that might incorporate a person with access to developing the capacity. On the other hand, given the high rates of international migration from some poor urban and rural areas in the countries of our region with the highest levels of undernutrition to neighbouring and developed countries, it could even be argued that an estimator taking this effect into consideration should be included in the alternative cost analysis.

[10]In the absence of reliable data for the period prior to 1960 and lacking a valid estimate of undernutrition trends in preceding decades, the oldest undernutrition rate reported is set as a constant for the previous years.

f. Based on the estimates of the effects on education, estimate the differential probabilities that individuals that suffered from child undernutrition have of being placed in each level of education (0 to12/13), contrasting the frequency distributions of both groups.

g. Apply the distribution of differential probabilities to the total number of potential undernourished individuals in each age group of the WAP.

h. Calculate the differential income for each group by multiplying the aforementioned distribution by the average expected income of each level of education.

i. Add up the results in the matrix.

Thus, if for each level of education the years of experience (EXP) are controlled, the difference in income depends on the difference in the distribution of years of education (EDU)resulting from the effect of undernutrition (e), and therefore:

$$\Delta y_{jz}^{U\widetilde{m}} = y_{jz}^{\widetilde{m}} * \Delta e_z^U * U_j * N_j$$

In which,

$\Delta y_{jz}^{U\widetilde{m}}$ = Estimated income differential of all individuals that suffered from undernourishment in an age group *(j)* and at a level of education (z).

$y_{jz}^{\widetilde{m}}$=Estimated annual income of an individual in the non-manual sector $(\widetilde{m})$ in an age group *(j)* at a level of education *(z)*.

Δe_z^U = Probability differential of having a level of education *(z)* associated with undernutrition.

U_j = Prevalence of undernutrition at 0 to 59 months for the age group *(j)*[11].

N_{jl} = Size of the age group *(j)*

Applying the above procedure in a year of analysis *(x)* for all of the cohorts studied yields an estimate of the total cost of undernutrition on the productivity of persons engaged in non-manual activities, who have survived child undernutrition(ELC_x^U)[12].

- Lower productivity in manual activities

The lower productivity in manual activities (ELC_x^U) corresponds to the sum of average differential wages, estimated for a year of analysis *(x)*, earned by those who suffered from undernutrition before the age of five, compared to those who did not, due to the impact on physical capacity to work.

$$MLC_x^U = \sum_{z=0}^{z} \sum_{j=1}^{j} (\Delta y_{jl}^{Um})_x$$

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[11]The undernutrition rate to use, Uj, corresponds to that applying to the group aged 0-59 months when each cohort was at that age (in each year x+5-j). Since there are normally not extensive enough temporal series, it is recommended that the most representative existing one(s) be used for the different cohorts. It should be emphasized that this could lead to an underestimate of the size of the population suffering from undernutrition, but it is the best available approximation.

Δy_{jl}^{U} = Potential income differential of people who has suffered from undernutrition before the age of five in an age group *(j)* and type of labor *(l)*.

To implement this, the following steps must be taken:

a. Estimate the proportion of population, by age group, in 5 year cohorts, that is engaged in manual activities.

b. Using the data from the household survey in each country, create a matrix in which the individuals making up a working-age population (WAP), aged 15 to 64 ,classified by age quintiles (as a proxy for experience), and involved in non-manual activities.

c. Estimate the average annual income for each experience category, considering only the WAP engaged in manual activities, regardless of whether or not it is part of the economically active population (EAP), in order to obtain the expected income for the entire set of individuals in each age-education combination.[13]

d. Estimate the probability of undernutrition to which each age category in the WAP was exposed before the age of five (if the analysis is conducted for the year 2009, the population between 1945 and 1994 would be considered). For this purpose, the historical series must be reconstructed, interpolating data on average undernutrition for each year based on estimates from national surveys[14].

e. Estimate the number of people who, probabilistically, may have had undernutrition in each age group of the WAP, multiplying the population sizes by the prevalence of undernutrition corresponding to each group in the corresponding quintiles (for example: 1940-44, 1945-49, ... 1985-890).

f. Based on the estimates of the effects on productivity, utilize the factor for lower productivity, to estimate the expected income of the population who did not suffer from child undernutrition and the income of those who were affected from undernutrition as children, for each age group.

g. Add up the results in the matrix.

Thus, if for each age group the differential income is estimated, the equation would be:

$$\Delta y_j^{Um} = y_j^m * \Delta e_z^U * U_j * N_j$$

Δy_j^{Um} = Estimated income differential of all individuals that suffered from undernourishment in an age group *(j)*.

y_j^m = Estimated annual income of an individual in the manual sector *(m)* in an age group *(j)*.

Δe_z^U = Probability differential of having a level of education (z) associated with undernutrition.

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[13]Certain data could be specified considering only the sectors of the economy in which the most vulnerable population typically participates. However, that would skew the estimates, excluding potential sectors of production that might incorporate a person with access to developing the capacity. On the other hand, given the high rates of international migration from some poor urban and rural areas in the countries of our region with the highest levels of undernutrition to neighbouring and developed countries, it could even be argued that an estimator taking this effect into consideration should be included in the alternative cost analysis.
[14]In the absence of reliable historical data and lacking a valid estimate of undernutrition trends, the oldest undernutrition rate reported is set as a constant for the previous years.

U_j = Prevalence of undernutrition at 0 to 59 months for the age group *(j)*[15].

N_{jl} = Size of the age group *(j)*

- Loss in Productivity associated with Mortality

The loss of productivity associated with mortality corresponds to the potential annual income that individuals would have earned if they had not died of undernutrition before 60 months of age. This potential income corresponds to the average income in each cohort according to level of education, type of labour persons who did not suffer from undernutrition.

To analyze the situation in a specific year *(x)*, the number of deaths related to child undernutrition must be estimated for the different age groups that, at the time of the analysis, makeup the working-age population (WAP), as well as the average expected income they might have achieved, considering their type of economic activity. That is:

a. Apply the undernutrition mortality rate most representative for each cohort comprising the WAP at their respective population sizes when they were less than five years of age. Thus, for each cohort *(j)*, use the undernutrition mortality rate for the year x+5 (upper limit of cohort *(j)*+1), from x-15 to x-60.
b. Adjust the number of undernutrition deaths by the probability of survival of those without undernutrition (sNUj) for each cohort *(j)*. That is, the survival rate for each cohort for the year of analysis *(x)*, discounting deaths associated with undernutrition.
c. Distribute the number of deaths in each cohort *(j)*, adjusted by its corresponding survival rate.
d. Estimate and average income per each cohort *(j)*is based on the proportion achieved by those who did not have undernutrition, considering the proportion working in manual labour and non-manual labour.
e. Multiply the result for each cohort *(j)* by the estimated average income for each combination$\bar{y}_{jl}$

Thus,

$$MMC_x^U = \sum_{z=0}^{z} \sum_{j=1}^{j} ((MM_j^U * s_j^{NU} * e_j^{NU}) * \bar{y}_{jl})_x$$

In which,

MM_j^U= Number of deaths associated with undernutrition before the age of 60 months for each age group *(j)* between 15 and 64.

s_j^{NU}= Survival rate of those who did not have undernutrition in each age group *(j)*.

e_j^{NU} = Proportion of non-undernourished individuals by age groups.

$\bar{y}_{jl}$ = Estimated average income of an individual in an age group *(j)* and type of labour *(l)*.

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[15]The undernutrition rate to use, *Uj*, corresponds to that applying to the group aged 0-59 months when each cohort was at that age (in each year x+5-j). Since there are normally not extensive enough temporal series, it is recommended that the most representative existing one(s) be used for the different cohorts. It should be emphasized that this could lead to an underestimate of the size of the population suffering from undernutrition, but it is the best available approximation.

Annex 3: Glossary of Terms

1. **Child Undernutrition:** The result of prolonged low levels of food intake (hunger) and/or low absorption of food consumed. It is generally applied to energy or protein deficiency, but it may also relate to vitamin and mineral deficiencies. Anthropometric measurements (stunting, underweight and wasting) are the most widely used indicators of undernutrition.

2. **Chronic Hunger:** The status of people whose food intake regularly provides less than their minimum energy requirements leading to undernutrition.

3. **Differential Probability (DP):** is the difference between the probability of occurrence of a consequence (i.e., disease, grade repetition, and lower productivity) given a specific condition. In the model, is used specifically to determine the higher risk among those suffering from undernutrition and those not suffering from undernutrition(ECLAC)

4. **Discount rate:** The interest rate used to assess a present value of a future value by discounting (FAO). In the model it is utilized to obtain the present value in the scenarios section.

5. **Drop-out Rate per Grade:** Percentage of students who drop out of a grade in a given school year (UNESCO).

6. **Episodes**: It is the number of disease events occurring for a given pathology. In the model it's based on a 1 year period, i.e. number of times a specific pathology occurs in 1 year(ECLAC)

7. **Food insecurity**: the state in which people are at risk or actually suffering from inadequate consumption to meet nutritional requirements as a result of the physical unavailability of food, their lack of social or economic access to adequate food, and/or inadequate food utilization (Global Forum on Food Security. FAO).

    a. **Chronic food insecurity**: long-term or persistent inability to meet minimum food consumption requirements.

    b. **Transitory food insecurity**: short-term or temporary inability to meet minimum food consumption requirements, indicating a capacity to recover. As a rule of thumb, short periods of food insecurity related to sporadic crises can be considered transitory.

    c. **Cyclical food insecurity**: habitual, most often seasonal, variations in food security.

8. **Hunger:** The status of persons, whose food intake regularly provides less than their minimum energy requirements which about 1800 kcal per day. It is operationally expressed by the undernourishment indicator (FAO).

9. **Incidental retrospective dimension:** is used to estimate of the cost of undernutrition in a country's population for a given year. The model applies it by looking at health costs of preschool children (0 to 5 years) who suffer from undernutrition, the education costs stemming from the children of school age (6 to 18), and the economic costs due to lost productivity by working-age individuals (15-64) (ECLAC).

10. **Intrauterine growth restriction (IUGR):** is a foetal weight that is below the 10th percentile

for gestational age (WHO). In the model, this is the only type of condition considered in the estimation of cost for Low Birth weight children.

11. **Low Birth Weight (LBW):** A new-born is considered to have low birth weight when it weighs less than 2,500 grams (WHO)

12. **Malnutrition**: A broad term for a range of conditions that hinder good health, caused by inadequate or unbalanced food intake or from poor absorption of food consumed. It refers to both undernutrition (food deprivation) and over nutrition (excessive food intake in relation to energy requirements) (FAO)

13. **Productivity/Labour Productivity**: Measures the amount of goods and services produced by each member of the labour force or the output per unit of labour (ILO). In the model, it refers to the average contribution that an individual can make to the economy, and can be measured by consumption or income, depending on data availability.

14. **Prospective or potential savings dimension:** This dimension makes it possible to project the present and future losses incurred as a result of medical treatment, repetition of grades in school, and lower productivity caused by undernutrition among children under the age of five in each country, in a specific year (ECLAC).

15. **Public Social Spending:** Social expenditure is the provision by public (and private) institutions of benefits to, and financial contributions targeted at, households and individuals in order to provide support during circumstances which adversely affect their welfare, provided that the provision of the benefits and financial contributions constitutes neither a direct payment for a particular good or service nor an individual contract or transfer. (OECD).

16. **Relative Risk**: is the risk of an event occurring, given a specific condition. It is expressed as a ratio of the probability of the event occurring in the exposed group versus a non-exposed group. In the model it is used to establish the higher risk of disease, lower educational performance or lower productivity relative to exposure to undernutrition.

17. **Repetition Rate Per Grade:** Number of repeaters in a given grade in a given school year, expressed as a percentage of enrolment in that grade in the previous school year (UNESCO).

18. **Shadow Price:** Opportunity cost of an activity or project to a society, computed where the actual price is not known

19. **Stunting:** Reflects shortness-for-age; an indicator of chronic malnutrition and calculated by comparing the height-for-age of a child with a reference population of well-nourished and healthy children (WFP). In the model it is used as the indicator to analyse the impact on educational performance and productivity.

20. **Survival rate:** A rate calculated for a given geographic area that presents the likelihood that a person will survive in a given period of time.

21. **Undernourishment**: Food intake that is insufficient to meet dietary energy requirements continuously. This term is used interchangeably with chronic hunger, or, in this report, hunger (FAO).

22. **Undernutrition:** The result of prolonged low levels of food intake and/or low absorption of food consumed (undernourishment). Generally applied to energy (or protein and energy) deficiency, but it may also relate to vitamin and mineral deficiencies (FAO).

23. **Underweight:** Is measured by comparing the weight-for-age of a child with a reference population of well-nourished and healthy children (WFP). In the model is utilized to analyse the impact of child undernutrition on health.

24. **Vulnerability to Food Insecurity:** Conditions that increase the susceptibility of a household to the impact on food security in case of a shock. Vulnerability is a function of how a household's livelihood would be affected by a specific hazard and how would manage to cope with this impact

25. **Wasting:** Reflects a recent and severe process that has led to substantial weight loss, usually associated with starvation and/or disease. Wasting is calculated by comparing weight-for-height of a child with a reference population of well-nourished and healthy children (WFP).

Annex 4: Definition of Variables

1. **Average number of days require for hospitalization:** When a child is hospitalized, what is the average number of days he/she will need to stay in the hospital for adequate care.

2. **Average number of days required for ICU:** When a child is put in ICU care, what is the average number of days he/she will need to stay in the ICU for adequate care.

3. **Average number of primary care visits per episode:** When a child experiences a given pathology, he/she may require medical care multiple times. This variable is the average number of visits a child would require per episode to primary (outpatient) medical care.

4. **Average number of disease episodes per year:** When a child experiences a given pathology, what is the average number this pathology is recurrent in one year.

5. **Average waiting time spent at primary care:** When a caretaker brings a child to a primary care facility, how long will the parent and child spend at the facility (including waiting for and receiving care).

6. **Cost of medical inputs per event during hospitalization:** This variable includes the medical materials (medicines, procedures) that are covered by the hospital for treatment for each of the pathologies.

7. **Cost of medical inputs per event in ICU:** This variable includes the medical materials (medicines, procedures) that are covered by the hospital for treatment for each of the pathologies in ICU.

8. **Cost of medical inputs per event in primary care:** This variable includes the medical materials (medicines, procedures) that are covered by the health facility for treatment for each of the pathologies.

9. **Costs not covered by the health system:** This variable includes the value of the inputs (i.e. medications) that are paid for by the family.

10. **Daily cost of hospital bed during hospitalization:** This variable includes the total cost to the hospital per day per patient staying in the hospital. This value includes the cost of staff, facilities, and equipment, as a unit cost per patient.

11. **Daily cost of hospital bed in ICU:** This variable includes the total cost to the hospital per day per patient staying in the ICU. This value includes the cost of staff, facilities, and equipment, as a unit cost per patient.

12. **Daily hours lost due to hospitalization:** When a caretaker brings a child to a primary care facility, how many hours will he/she spend at the hospital each day with the child.

13. **Drop-out Rate per Grade:** Percentage of students who drop out of a grade in a given school year (UNESCO).

14. **Episodes:** It is the number of disease events occurring for a given pathology. In the model it's based on a 1 year period, i.e. number of times a specific pathology occurs in 1 year (ECLAC)

15. **Percentage of cases that attend health services:** This is the proportion of episodes for which a caretaker will bring a child to a primary health facility for treatment.

16. **Proportion of episodes requiring hospitalization:** When a child experiences pathology, they may require in-patient care. This variable identifies the proportion of the episodes for which a child requires hospitalization, by pathology.

17. **Proportion of episodes requiring Intensive Care Unit (ICU):** When a child experiences pathology, they may require care in an ICU facility. This variable identifies the proportion of the episodes for which a child requires ICU care, by pathology.

18. **Public Social Spending:** Social expenditure is the provision by public (and private) institutions of benefits to, and financial contributions targeted at, households and individuals in order to provide support during circumstances which adversely affect their welfare, provided that the provision of the benefits and financial contributions constitutes neither a direct payment for a particular good or service nor an individual contract or transfer. (OECD).

19. **Repetition Rate Per Grade:** Number of repeaters in a given grade in a given school year, expressed as a percentage of enrolment in that grade in the previous school year (UNESCO).

20. **Unit Cost per attention in primary care:** This variable includes the total cost to the health facility per attention. This value includes the cost of staff, facilities, and equipment, as a unit cost per patient.

Annex 5: Assumptions by Country

A. Egypt

1. Brief Description of Data Collection Process

The process of the COHA in Egypt was initiated with a training of the National Implementation Team, held in Cairo in January 2011, with the participation of experts from IDSC, the National Nutrition Institute, Ministry of Agriculture and Ministry of Health. The data collection, processing and analysis were led by IDSC in collaboration with CAMPAS, and with support from the WFP Country Office. Most of the data was collected from secondary data sources; however, a survey amongst health practitioners was conducted for the health protocols and costs portion of the model.

The data used in the study and the preliminary results were validated and nationally specific recommendations were produced, by high-level national stakeholders at a validation workshop held in February 2013, in Cairo.

2. Data Sources

Variable	Source
Economic data	
Gross Domestic Product	International monetary fund data for 2009.
$US exchange rate	International monetary fund data for 2009.
Purchasing power parity	International monetary fund data for 2009.
Social Expenditure	Ministry of finance, Egyptian Economic Monitor, December 2010.
Health Expenditure	World Health Organization.
Education Expenditure	Ministry of finance, Egyptian Economic Monitor, December 2010.
Average transport cost (two public transportation tickets in urban areas in local currency)	Central Agency for Public Mobilization and Statistics (CAPMAS), Household Income, Expenditure and Consumption Survey (HIECS) 2008/ 2009, Table 2-2.
Minimum wage per hour	Egyptian Cabinet, Information and Decision Support Center, Egyptian Food Observatory, the vulnerable household's survey.
Average wage per hour	CAPMAS, Labour Force Survey (LFS), 2009.
Annual Consumer price index	CAPMAS data, (data were obtained by special request).
Average income per years of schooling	CAPMAS, LFS, 2009.
Annual average income related to productive work, manual intensive activities (Agriculture, Forestry, Fishery, Mining) by age	Calculated based on CAPMAS, HIECS 2008/ 2009, and LFS 2009 data.

Variable	Source
Annual average income related to productive work, NON manual intensive activities (Excluding Agriculture, Forestry, Fishery, Mining) per years of schooling and age	Calculated based on CAPMAS, HIECS 2008/ 2009, and LFS 2009 data.
Average working hours per week	Calculated from LFS 2009 data.
Annual worked hours per age group	Calculated from LFS 2009 data based on average working hour per week multiplied by number of weeks in the year.
Employment rate	Calculated based on CAPMAS LFS 2009 data.
Monthly hours worked.	Calculated based on Working hour average per week which was calculated from CAPMAS LFS 2009 data.
Demographic Data	
Volume of Births	CAPMAS, births and deaths bulletin.
Death rate	CAPMAS, births and deaths bulletin.
Distribution of workers by Manual and Non-Manual Labour per age group	Calculated from CAPMAS LFS 2009 data.
Distribution of workers by educational status	Calculated from CAPMAS LFS 2009 data.
Working age population (WAP) by educational level	Calculated from CAPMAS LFS 2009 data.
Health Data	
Underweight prevalence for the year of analysis or last available.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Stunting prevalence for the year of analysis or last available.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Underweight prevalence of children under 5 years old	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Underweight mode prevalence	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Stunting prevalence of children under 5 years old	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Stunting mode prevalence	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Number of annual disease episodes (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group	Estimated by health specialists and experts through in-depth interview.
Average number of primary care visits for each pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group	Estimated by health specialists and experts through in-depth interview.
Proportion of events of pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group requiring hospitalization	Estimated by health specialists and experts through in-depth interview.

Variable	Source
Average number of days of hospital treatment for each event (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group	Estimated by health specialists and experts through in-depth interview.
Proportion of events of pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group requiring intensive treatment (ICU)	Estimated by health specialists and experts through in-depth interview.
Average number of days of intensive treatment UTI / UCI for each event (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group	Estimated by health specialists and experts through in-depth interview.
Average waiting time spent at primary care attention (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group	Estimated by health specialists and experts through in-depth interview.
Daily hours lost due to hospitalization (anaemia, ADS, ARI, Stunting, Underweight, Wasting) by Age group	Estimated by health specialists and experts through in-depth interview.
Average unit cost for attention in primary care by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Average cost of medical inputs for event in primary care by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Average unit cost for attention in hospital by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Average cost of medical inputs for event in hospital by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Average unit cost for attention in hospital intensive care unit by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Average cost of medical inputs for event in hospital intensive care unit by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Average unit private cost by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Average private cost of medical inputs for event by age group and pathology (anaemia, ADS, ARI, Stunting, Underweight, Wasting), for the year of analysis (x) in local currency,	Estimated by health specialists and experts through in-depth interview.
Percentage of low birth weight children	Egypt Demographic Health survey 2008

Variable	Source
Proportion of events of LBW requiring/access hospitalization	Estimated by health specialists and experts through in-depth interview.
Average number of days of hospital treatment	Estimated by health specialists and experts through in-depth interview.
Proportion of events of LBW requiring intensive treatment UTI / UCI	Estimated by health specialists and experts through in-depth interview.
Average number of days of intensive treatment	Estimated by health specialists and experts through in-depth interview.
Average waiting time (in hours) spent by an adult accompanying a child patient requiring hospitalization	Estimated by health specialists and experts through in-depth interview.
Morbidity differential probability for anaemia among healthy versus underweight children by age groups.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Morbidity differential probability for ADS among healthy versus underweight children by age groups.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Morbidity differential probability for ARI among healthy versus underweight children by age groups.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Morbidity differential probability for anaemia among healthy versus stunted children by age groups.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Morbidity differential probability for ADS among healthy versus stunted children by age groups.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Morbidity differential probability for ARI among healthy versus stunted children by age groups.	Calculated from Egypt Demographic Health Survey data, 2005 and 2008.
Probability ratio of death between those who suffered from undernutrition	Calculated from Egypt Demographic Health Survey data 2008.
Probability ratio of death between those who suffered from stunting.	Calculated from Egypt Demographic Health Survey data 2008.
Average travel time for ambulatory care.	Calculated from SYPE 2009 data.
Education Data	
Initial enrolment by years of education	Data were obtained from Ministry of Education.
Final enrolment by years of education	Data were obtained from Ministry of Education.
Number of passes by years of education	Data were obtained from Ministry of Education.
Number of dropouts (rate) by years of education	Data were obtained from Ministry of Education.
Number of population repeating grades (rate) by years of education	Data were obtained from Ministry of Education.
Private cost per student / year by educational grade	Data were obtained from CAPMAS HIECS 2008/ 2009 data and were assumed constant for different grades.
Total Number of students year 2009	Ministry of Education, Statistical Yearbook.
Public cost per student	Estimated based on "Education Public Expenditure Tracking Survey (PETS)" prepared by ministry of finance, ministry of education and the European Union, December 2009.

Variable	Source
Higher Probability (relative risk) of stunted of repeating grades.	Calculated from SYPE 2009 data.
Higher Probability (relative risk) of stunted of dropping out.	Calculated from SYPE 2009 data.

B. Ethiopia

1. Brief Description of Data Collection Process

The process of the COHA in Ethiopia was initiated with a training of the National Implementation Team, held in Ethiopia Nutrition and Health Research Institute (ENHRI) in January 2011, with the participation of experts from ENRHI, the Ministry of Finance and Economic Development and Ministry of Education, in January 2011.

Prior to engaging in the data collection activity, the NIT submitted the COHA methodology to the EHNRI Scientific and Ethical Review Committee for approval. The committee thoroughly examined the methodology and approved it for its scientific and ethical merits.

The data collection on the health protocols and costs was led by a Health Economist within the NIT. St. Paul Hospital was selected for the data collection because it is one of the federal hospitals in Addis with very high number of patients (both in OPD and IPD) and it receives all referral cases from nearby government hospitals, private hospitals as well as health centres on a regular basis. Even though challenges were faced during this particular process due to lack of secondary data on health costs, the team developed a strong health costing tool which was applied in the analysis.

Productivity data was provided by the members of the NIT based in CSA. In the process, several alternative models for productivity estimation were proposed by the NIT during the consultation process, which also contributed significantly towards the development of the adapted COHA model for Africa. Most of the data collection on Education was led by the NIT based in EHNRI in collaboration with the Ministry of Education.

Finally, the data used in the study and the preliminary results were validated in December 2012, by high-level national stakeholders at a validation workshop held in Addis.

Economic data

Variable	Method	Data sources	Assumptions
Average wage per hour	Total wage per person expressed as a ratio of the number of hours worked	CSA	The value is estimated on minimum wage of Public service.
Average income per years of schooling	Individual income was computed as proportion of household consumption by	Central Statistical Agency; Ethiopia Household Income	Data on consumption will be a proxy for income productivity;

	each of the working age individuals in the household	economic activities are categorized in the manual and non-manual activities
Average income for manual activities	Income for individuals: based on a categorization of activities reported in the EHICE that are 'mostly' manual	Consumption & Expenditure Survey (EHICE) 2010/11. Federal Democratic Republic Government of Ethiopia. 2012
Average income for non-manual activities	Income for individuals: based on a categorization of activities reported in the EHICE that are 'mostly' non-manual	
Average working hours	Data collected based on references	2005 National Labour Force Survey

Demographic data

Variable	Source
Volume of Births	
Death rate	
Distribution of workers by Manual and Non-Manual Labour per age group	
Distribution of workers by educational status	Calculated from CSA data.
Working age population (WAP) by educational level	Calculated from CSA data.

Health data

These data are based on expert interviews with the following key informants and experts from St. Paul Hospital in Addis Ababa.

St. Paul Hospital was selected for the data collection because it is one of the federal hospitals in the country with very high number of patients both in OPD and IPD. All referral cases from the nearby governmental hospitals, private hospitals as well as health centres will be sent to St. Paul hospital. A total of six health professionals working in OPD, IPD & ICU and two non -health professionals from finance and planning units of St. Paul were interviewed.

- Financial documents were reviewed - St. Paul Hospital Budget report for MoFED (2009) and the hospital Goods Receiving Voucher (GRV).
- Performance Evaluation Report to FMoH was reviewed.
- Ethiopian Clinical Protocols Guideline
- Costs on the medical supplies from the St Paul Hospital pharmacy and main store were collected.
- Since the HMIS does not have disaggregated data for the sub-cohorts (28 days-11 months, 12-23 months, 24-59 months, it was assumed that all values were the same for all sub-cohorts.

(a) Number of Disease Episodes

Pathology	Assumptions	Methods	Data source
Anaemia	Moderate and severe cases were considered; averages were considered	Key informant interviews and expert consultations; WHO fact sheet	EDHS 201; expert Interviews
ADS	Diarrhoea defined as an average of passage of watery/loose stool for more than 3 times in a period of 24 hours; averages were considered		
ARI	Defined as cough accompanied by short rapid breathes that is chest-related, considered as a proxy for pneumonia; averages were considered		
Malaria	Given its a common symptom, all fevers were considered as malaria	Key informant interviews and expert consultations; Review of secondary data/ hospital records	EDHS 201; expert Interviews
Underweight	Defined as moderate or severe if below minus two standard deviations from median weight for age of reference population; severe below minus three standard deviations from median weight for age of reference population; moderate and severe cases were considered.	Review of secondary data; key informant interviews and expert consultations	Expert interview

(b) Average number of primary care visits per episode

Pathology	Assumptions	Methods	Data source
Anaemia	A child with anaemia will receive the full dosage of medications on the first visit to the hospitals and health facilities.	Key informant interviews and expert consultations; Review of secondary	DHS 2011; interviews; hospital records/OPD/
ADS	Each child with moderate ADS is treated on outpatient basis and given full dosage medications once,		

	without follow up	data/ hospital records	
ARI	Although a full dosage of antibiotics is usually provided to a child on the first visit, on average, the child is expected to come for two follow-up visits; health facilities have capacity to diagnosis and treat ARI		
Malaria	A child diagnosed with first line Malaria is treated on an outpatient basis and with the full dosage of malaria medications without follow-up visits; facilities have capacity to diagnosis, classify and treat Malaria		DHS 2011; interviews with the malaria research team; hospital records/OPD/
Underweight	Considered children who have visited primary care as out-patients; considered follow-up visits of discharged hospitalized cases as new episodes		EDHS 2011; interviews with the health professionals; hospital records/OPD/

(a) Proportion of episodes requiring hospitalization

Pathology	Assumptions	Methods	Data source
LBW	Estimations were made based on the proportion of admitted cases out of total OPD	Key informant interviews and expert consultations; review of secondary data	EDHS 2011; review of secondary data/ hospital records; interviews
Anaemia	Severe cases were hospitalized; health facilities have the capacity to diagnose and treat anaemia		Interviews; hospital records/ IPD/
ADS	All severe cases were hospitalized; all children given intravenous solutions were those who were hospitalized; health facilities have capacity to diagnose and treat ADS		
ARI	All severe cases were hospitalized; health facilities have capacity to diagnose and treat ARI		
Malaria	All severe malaria cases were hospitalized; health facilities have capacity to diagnose and treat Malaria		EDHS 2011; Interviews
Underweight	All severe cases were hospitalized; health facilities have the capacity to assess and manage underweight		EDHS 2011; interviews

(c) **Average number of days require for hospitalization:** the average number of days required for hospitalization estimated for each pathology. The average value was taken for this analysis.

(d) **Proportion of episodes requiring ICU**

Pathology	Assumptions	Methods	Data source
LBW	An estimated Proportion of cases going to ICU out of the cases in IPD was considered ; the estimation made for all the episodes are assumed to be the same; despite the different pathologies, the estimated proportion of episodes requiring ICU will not have significance difference.	Key informant interviews in the hospital and expert consultations; review of secondary data/ hospital records	EDHS 2011; hospital records; interviews
Anaemia, ADS, ARI, Malaria	The average was considered without taking into account the number of times the child has been hospitalized previously; health facilities have the capacity to diagnose and treat Anaemia, ARI, ADS with severe complications, but there are only a few hospitals with ICU services.		EDHS 2011; hospital records; interviews
Underweight	A few hospitals have the capacity to diagnose and manage underweight with severe complication in ICU; according to the ICU nurses, information on the underweight was assumed to be similar with the other pathology.		Hospital records; interviews

(e) **Average number of days required for ICU:** According to the experts at the ICU, the average number of days for the LBW was assumed to be similar for all the pathologies. Data collected from expert interviews.

(f) **Average waiting time spent at primary care:** Average waiting time to receive the OPD service/ diagnosis and treatment for all pathologies is two hours. Data collected from expert interviews.

(g) **Daily Hours lost due to hospitalization:** When a child admitted in the hospital (IPD), at least one parent will spent the full day with that child. Data collected from expert interview.

(h) **Primary Care: Unit Cost per attention:** Human resource costs of health care professionals at OPD and registration fees of patients were considered.

(i) **Primary Care: Cost of medical inputs per event**

Pathology	Assumptions	Methods	Data source
LBW, Anaemia, ADS, ARI, Malaria	Every resource component utilized (e.g., tests, supplies, drugs, personnel time) is considered and total costs were estimated using unit costs (Drummond et al); prices are set by the government and are much lower than the current market value and they are not affected by the inflation; the recurrent medical supplies such as laboratory tests (CBC, CXR, RBS.), medications like antibiotics (Gentamicin, Ampicline, Crystaline) and ART drug costs was analysed using the micro-costing approach; the fixed cost of items such as O_2 was analysed considering the rate of utilization by the unit cost of the item	Key informant interviews and expert consultations; review of secondary data	Ethiopian clinical protocol guide; expert opinions; St Paul Hospital pharmacy and main store price catalogue and hospital records
Underweight		Review of secondary data	CMAM

(j) **Hospitalization: Daily cost of hospital bed:** Cost is standard across pathologies for the sample hospital; hospital bed charges are inclusive of health professional labour cost (in IPD), daily bed cost and utility costs; the labour cost and the daily bed cost was estimated using the micro-costing ingredient based costing approach, while the utility cost was estimated using top-down costing approach.

(k) **Hospitalization: Cost of medical inputs per event:** Methods/Assumptions: Hospitalization charges included cost of medicines (e.g Antibiotics, (Gentamicin, Ampicline, Crystaline) and ART medicines etc) and laboratory tests, (e.g CBC, CXR, RBS). In addition, the fixed medical inputs (e.g oxygen) utilization cost was estimated.

(l) **ICU: Daily cost of hospital bed:** Standard cost across pathologies for the sample hospital; hospital bed charges are inclusive of health professional labour cost (in ICU), daily bed cost and utility costs. The labour cost and the daily bed cost were estimated using the micro-costing/ingredient based costing approach, while the utility cost was estimated using top- down costing approach.

(m)**ICU: Cost of medical inputs per event:** Cost of the medical inputs in ICU includes the cost of medicines (e.g Antibiotics, (Gentamicin, Ampicline, Crystaline) and ART drugs etc, laboratory tests, (e.g CBC, CXR, RBS). In addition, the fixed medical inputs (e.g oxygen) utilization cost was estimated.

(n) **Costs not covered by the health system:** This includes all out of pocket expenses like registration card, lab tests, medicines, etc.

(o) **Percent of Cases that Attend Health Services:** This data was estimated based on data presented in the DHS Report for 'seeking professional medical assistance' or proxies.

Education Data

Variable	Method	Data source
Enrolment	The education system in Ethiopia defines final enrolment as the number of students approved (i.e. Numerical count of existing students/pupils in a school at a particular time)	Estimated by NIT, based on Education Statistics Annual Abstract 2001 E.C. /2008-09 G.C./ EMIS, Planning and Resource Mobilization
Initial enrolment	Count of students/pupils as per admission forms	
Final enrolment	Count of students/pupils as per end of term exam sitting	
Number of passes	Count of students/ pupils who acquire the minimum desirable pass grade	
Number of dropouts (rate)	Difference between initial enrolment and final enrolment	
Number of population repeating grades (rate)	Count of students/pupils who don't acquire the minimum required grade to pass to the next class	
Education costs		
Private cost	Summation of the itemized education costs incurred by households per student/pupil	Estimations of NIT
Public cost	Computed using a unit allocation cost as per the UPE and USE guidelines	Education Public Expenditure Review (i) MoFED, Audited Finance Accounts, (ii) EMIS

C. Swaziland

The health information obtained mainly from expert interviews with senior health officials:

- Ms. Maria Dlamini, IMCI Coordinator, Ministry of Health
- Ms. Danisile Vilakati, Director, Swaziland National Nutrition Council, Ministry of Health
- Mr. Thulane Maphosa, Chief Programmes Officer, International Breast Feeding Action Network
- Ms.Fortunate Fakudze, Pharmacist, Central Medical Stores, Ministry of Health
- Dr. Mazibuko, Senior Medical Officer, Mbabane Government Hospital
- Dr. T. Fynn, Medical Officer, Manzini Clinic (private)
- Ms. Philile Shabangu, EPI Programme Manager, MOH
- Ms. Nomsa Dube, EPI Surveillance Officer, MOH
- Ms. Zanele Simelane, Health Management Information Systems Unit , MOH
- Ms. Bonisile Nhlabatsi, PMTCT Coordinator, MOH
- Ms. Teclar Maphosa, Malaria Health Promotion Officer, MOH

The NIT also consulted and extracted information from health protocols and policies such as:

- National Health Strategic Plan
- Integrated Management of Childhood Illness (IMCI) Clinical Guidelines
- Sexual and Reproductive Health Strategic Plan
- Paediatric HIV and AIDS Guidelines
- Integrated Management of Acute Malnutrition (IMAM) Guidelines

Secondary data was extracted from:

- DHS 2006-2007
- National Nutrition Survey 2008
- MICS 2000
- HIV Sentinel Surveillance reports (2010)
- HIV Projection and Estimates reports (2010)

Underweight and stunting prevalence by age were extracted from DHS 2006, MICS 2000 and the National Nutrition Survey 2008.

Pathology	Source	Definition
Anaemia	IMCI guidelines	Symptoms include palmar pallor. This refers to unusual paleness of the skin on the hands.
ADS (acute diarrhoeal syndrome)	WHO Recommended Surveillance Standards, 2nd	Diarrhoea is defined as the passage of three or more loose or watery stools in the past 24 hours, with or without dehydration and with or without blood in the stool. The DHS defines a case of ADS as a mother's estimation of whether the child has had diarrhoea in

	Edition/IMCI guidelines	the previous two weeks.
ARI (acute respiratory infection)	WHO Recommended Surveillance Standards, 2nd edition/IMCI guidelines	Symptoms include cough or difficult breathing, and rapid short breathing.
Underweight	IMAM guidelines	Is a condition in which a child fails to get enough of the nutrients that the body needs to stay healthy and function properly. Underweight is a composite of low weight for height (acute malnutrition or wasting) and low weight for height (chronic malnutrition or stunting), and is defined as weight for age is below the third percentile (NCHS references) or the Z-score for weight for age is below two standard deviations of the median (WHO standards).
Malaria	IMCI guidelines	Parasitic disease that involves high fevers, shaking chills, flu-like symptoms, and anaemia.
Other 2	n/a	The NIT excluded the 'other' category, no pathologies were included.

Treatment assumptions: Table 2 defines the assumptions made about medicines and treatment requirements for each pathology as laid out in respective guidelines.

Pathology	Source	Treatment assumptions
Anaemia	IMCI guidelines	- Children with severe palmar pallor are hospitalized and given the relevant treatment - Children who are not severely anaemic are given supplements and relevant drugs at outpatient and are followed up in 14 days.
ADS	IMCI guidelines	- Diarrhoea is treated at the ORS and IV therapy and re-assessed in health facilities according to IMCI guidelines and if no improvement refers to hospital for further management.
ARI	IMCI guidelines	- Children are managed according to IMCI guidelines. If severe pneumonia refer to hospital for further management.
Under-nutrition	IMAM guidelines	- Severely acutely malnourished children are hospitalized and given therapeutic food and appropriate medical treatment according to IMAM guidelines. - Moderately malnourished children are given therapeutic food and medical treatment at out-patient according to guidelines.
Malaria	IMCI guidelines	- Children with severe malaria are hospitalized and treated with quinine according to IMCI protocols and Malaria guidelines

HIV	Paediatrics guidelines	- Children who have tested HIV positive are given prophylaxis and are treated for opportunistic infections according to Paediatric guidelines
Measles	IMCI guidelines	- For uncomplicated measles children are treated according to IMCI guidelines. - For severe complicated measles children are hospitalized and treated according to IMCI guidelines.
Other 2	n/a	The NIT excluded the 'other' category, no pathologies were included.

Health cost estimations

1. The NIT interviewed health care workers to estimate average number of disease episodes per year. One episode of for example, anaemia, is defined as the likelihood of a child having that pathology (anaemia) once in a period of one year. If the child has the same condition multiple times, each instance is counted as one episode.
2. For average number of primary care visits for each pathology, the NIT asked primary care physicians from Mbabane Government Hospital Public Health Unit to estimate number of visits associated with each pathology.
3. The proportion of events of pathology requiring hospitalization was estimated using health records from Mbabane Government Hospital. The denominator is the number of clients with a particular condition; the numerator is the number of clients admitted/hospitalized as a result of that condition.
4. Average number of days of hospital treatment for each event was calculated using the average length of stay in the hospital for each condition, also using health records from Mbabane Government Hospital.
5. Estimations of proportions of pathologies requiring Intensive care treatment were also taken from health records from Mbabane Government Hospital.

Estimations of Health Costs in Hours

Waiting times were determined by expert interviews with health staff, and interviewing patients' parents at Mbabane Government Hospital. The health facilities do not differentiate between pathology or age group for primary care visit wait times, so the NIT assumed the same wait times across all pathologies and age groups. This estimation does not include wait times estimates from emergency room visits, only primary health care visits.

Newborns with Low Birth Weight

Low birth weight prevalence was estimated from inpatient maternity records from Mbabane Government Hospital for the year 2011.

Average Cost per Type of Attention, Age Group and Pathology

Estimates of the cost of care for primary visits only include cost of medication and staff time, estimated from health care records. For hospitalization costs, the NIT used the previously calculated length of stay as well as cost of medicines, bed, food and average staff time, collected through expert interviews with the Central Medical Store and physicians. All examples are from Mbabane Government Hospital. NIT triangulated these estimates of length of stay and medicines with IMCI guidelines for treatment. ICU care cost estimates included hospital costs with the addition of extra inputs from more advanced equipment, additional staff time and increased costs related to more rigorous measures for infection control.

Private sector costs included charges for doctor fees, medication costs, and similar costs from the public sector. These charges were calculated using health records from Manzini Clinic, a private clinic and an expert interview with Dr. Fynn.

Methods and Assumptions for Education Data

All data except absenteeism and private costs were collected from the Ministry of Education's Education Management Information System (EMIS) using 2009 as the reference year. Final enrolment is the number of students approved in the system at the end of the term. Absenteeism reports were followed-up at school level. Basic education includes primary education. Secondary education includes students up to Form 5. The direct public cost of education includes salaries, utilities in schools, infrastructure expenses, taken from the Ministry of Education budget estimate reports for 2010, which give actual expenditure in Swazi Emalangeni for 2009.

Public expenditures on school supplies were limited to orphans and vulnerable children. In 2009 the Government did not yet offer free primary education to orphans and vulnerable children so these costs are not included. Public expenditure on the OVC education programme was calculated through information from the Deputy Prime Minster's Office, including grant funding from the European Union.

Private costs of education include basic supplies, transportation, and a school uniform. These costs were estimated to be the same across primary and secondary students.

D. Uganda

Health Protocols and Prevalence Data

The following information illustrates the variables used to estimate health costs. ADS is an acronym for acute diarrhoeal syndrome, ARI stands for acute respiratory infection, LBW – low birth weight and ICU is intensive care unit. In most cases, values were the same across the age groups.

Methods: These data are based on expert interviews with the following experts:

- Dr. Mugala Jamu, Medical Doctor in the General Special Care Unit, Mulago National Referral Hospital, Kampala, Uganda

- Dr. Nyombi Nata, Medical Doctor in the General Special Care Unit, Mulago National Referral Hospital, Kampala, Uganda

- Medical Doctor in the Private Special Care Unit, Mulago National Referral Hospital, Kampala, Uganda SCU - Private

- Dr. Kiguli , College of Health Sciences, Makerere University

- Dr. Elizabeth Kiboneka, Consultant Paediatrician, Mwana Mugimu Nutrition Rehabilitation Unit, Mulago National Referral Hospital, Kampala, Uganda

- Nurse in Charge, Acute Care Unit, Mulago National Referral Hospital, Kampala, Uganda

- Consultant Paediatrician, Acute Care Unit, Mulago National Referral Hospital, Kampala, Uganda

- The Planning Unit, Mulago National Referral Hospital, Kampala, Uganda

- Others e.g. USAID, MOH, MoES, MAAIF, UBOS

Additionally, some data are based on the Uganda Clinical Guidelines protocol and the Integrated Management of Acute Malnutrition (IMAM), developed by USAID.

1. Number of Disease Episodes (a)

Pathology	Assumptions	Methods	Data source
Anaemia	Considered moderate and severe case; considered averages	Cost of Hunger (COH) model; key informant interviews and expert consultations	Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; interviews
ADS	Diarrhoea defined as passage of watery/loose stool more than 3 times in a period of 24 hours; considered averages		
ARI	Respiratory Infection defined as cough accompanied by short rapid breathes. It is chest-related and is considered as a proxy for pneumonia; considered averages		
Malaria	Given that Malaria is a common symptom, all types of fever were considered as Malaria; considered averages	Cost of Hunger (COH) model; key informant interviews and expert consultations; review of secondary data	Uganda Nutrition PROFILES 2009; Uganda Malaria Indicator Survey (UMIS); Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; interviews

Pathology	Assumptions	Methods	Data source
Underweight	Follow-up visits to the facility after discharge not considered as new episodes	Cost of Hunger (COH) model; review of secondary data; key informant interviews and expert consultations	Uganda Nutrition PROFILES 2009; Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; guideline on the Integrated Management of Acute Malnutrition (IMAM); relevant biomedical records at Mwana Mugimu National Nutrition Rehabilitation Unit; interviews

2. Average number of primary care visits per episode (b)

Definition: When a child experiences a given pathology, he/she may require medical care multiple times. This variable is the average number of visits a child would require per episode to primary (outpatient) medical care.

Pathology	Assumptions	Methods	Data source
Anaemia	- A child with moderate anaemia will receive the full dosage of medications on the first visit to the primary health care facility - All facilities are testing for anaemia at the outpatient department	Cost of Hunger (COH) model; key informant interviews and expert consultations; review of secondary data	Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; Uganda Clinical Guideline 2010; interviews
ADS	- Each child with moderate ADS is treated on outpatient basis and is given full dosage medications at once, without follow up		
ARI	- Although a full dosage of antibiotics is usually provided to a child on the first visit, on average, the child is expected to come for two follow-up visits - Facilities have capacity to diagnose and treat ARI		
Malaria	- A child diagnosed with first-		Uganda Malaria Indicator

Pathology	Assumptions	Methods	Data source
	line Malaria is treated on an outpatient basis and with the full dosage of malaria medications without follow-up visits - Facilities have capacity to diagnose, classify and treat Malaria		Survey (UMIS); Uganda Clinical Guideline 2010; Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; interviews
Underweight	- Considered children who have visited primary care as outpatients - Considered follow-up visits of discharged hospitalized cases as new episodes		Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; guideline on the Integrated Management of Acute Malnutrition (IMAM); relevant biomedical records at Mwana-Mugimu National Nutrition Rehabilitation Unit; interviews

3. Proportion of episodes requiring hospitalization (c)

Definition: When a child experiences pathology, they may require in-patient care. This variable identifies the proportion of the episodes for which a child requires hospitalization, by pathology.

Pathology	Assumptions	Methods	Data source
LBW	- All children born with low birth weight were hospitalized	Key informant interviews and expert consultations; review of secondary data	Uganda Nutrition PROFILES 2009; Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; WHO protocol on LBW; interviews
Anaemia	- All severe cases were hospitalized - Health facilities have capacity to diagnose and treat Anaemia		Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; Uganda Clinical Guideline 2010; interviews
ADS	- All severe cases were hospitalized; all children given intravenous solution were those who were hospitalized - Health facilities have		

Pathology	Assumptions	Methods	Data source
	capacity to diagnose and treat ADS		
ARI	- All severe cases were hospitalized Health facilities have capacity to diagnose and treat ARI		
Malaria	- Children given quinine treatment were those who were hospitalized - Health facilities have capacity to diagnose and treat Malaria		Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; Uganda Clinical Guideline 2010; interviews
Underweight	- All severe cases were hospitalized - Health facilities have capacity to assess and manage underweight		Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; guideline on the Integrated Management of Acute Malnutrition (IMAM); Uganda Clinical Guideline 2010; Uganda Nutrition PROFILES 2009; interviews

4. **Average number of days required for hospitalization (d)**

Methods and Assumptions: Averages based on cases without complications.

5. **Proportion of episodes requiring ICU (e)**

Pathology	Assumptions	Methods	Data source
LBW	- All LBW cases go to the ICU - Health facilities have capacity to diagnose and treat LBW in ICU	Key informant interviews and expert consultations; review of secondary data	Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; WHO protocol on LBW; interviews
Anaemia, ADS, ARI, Malaria	- From a paediatrics expert, on average, without consideration of number of times the child has been hospitalized previously - Health facilities have capacity to diagnose and treat Anaemia, ARI, ADS with severe complications		Uganda Demographic and Health Survey (UDHS) report of 2006 and 2011; Uganda Clinical Guideline 2010; interviews

Pathology	Assumptions	Methods	Data source
Underweight	- All cases of underweight with severe complications are considered as ICU cases - Health facilities have capacity to diagnose and manage underweight with severe complication in ICU		Uganda Nutrition PROFILES 2009; guideline on the Integrated Management of Acute Malnutrition (IMAM); Uganda Clinical Guideline 2010; interviews

6. **Average number of days required for ICU (f)**

   Assumptions: Average stay in ICU for all pathologies in the hospital was added to the number of days in the hospital.

7. **Average waiting time spent at primary care (g)**

   Assumptions: Average waiting time to receive treatment for all pathologies is three hours.

8. **Daily hours lost due to hospitalization (h)**

   Assumptions: When a child is in the hospital, at least one parent will spent a full day with that child.

Costing Data

1. **Primary Care: Unit Cost per attention (j)**

   Assumptions: Including the cost of human resources for medical workers caring for child on out-patient basis.

2. **Primary Care: Cost of medical inputs per event (k)**

Pathology	Assumptions	Methods	Data source
LBW, Anaemia, ADS, ARI, Malaria	- Prices are consistent and not affected by inflation. Limited by data collection process carried-out in 2012.	Key informant interviews and expert consultations; review of secondary data	Catalogues on drug prices from National Medical Stores and Joint Medical Stores; Uganda Clinical Guideline 2010; hospital drug, consumables and equipment test lists; interviews
Underweight		Review of secondary data	UNICEF procurement; interviews

1. **Hospitalization: Daily cost of hospital bed (l)**

   Assumptions: (i) Standard cost across pathologies for the sample hospital, (ii) Hospital bed charges includes costs for human resources.

2. **Hospitalization: Cost of medical inputs per event (m)**

   Assumptions: Hospitalization charges include cost of drugs, sundries and laboratory tests.

3. **ICU: Daily cost of hospital bed (n)**

   Assumptions: (i) Standard cost across pathologies for the sample hospital, (ii) Hospital bed charges includes costs for human resources.

4. **ICU: Cost of medical inputs per event (o)**

   Assumptions: ICU charges include cost of drugs, sundries, oxygen and laboratory tests.

5. **Costs not covered by the health system (p)**

   Assumptions: Public hospitals cover at least 50% of the patient costs.

6. **Percentage of cases that attend health services (q)**

   Assumptions: Information provided from UDHS, 2011, expert opinion, and the Ministry of Health Statistical Abstract Report, 2010.

<u>Variables for Health Costing</u>

Process of costing of the pathologies	
Cost treating severe acute malnutrition	**Comments and Sources**
To estimate the costs of managing Severe Acute Malnutrition, Mulago Referral Hospital (Mwana Mugimu Nutrition Unit) retrieved primary data from the client files from 2009, where variables like age, weight, height, whether or not the child had oedema, whether the child was taken to the intensive care unit and the days of stay for treatment were recorded. This helped to extract data on average number of hospital stay for hospitalized children.	The costs of treating stunting or underweight cannot be calculated, so only SAM was calculated.
The costs for hospitalized cases included costs of drugs, feeds, laboratory tests, sundries and human resources was based on Mulago and NMS and JMS catalogues for medicine/equipment prices.	Source: expert opinion on costs, Director/Paediatric Doctor and Nutritionist Mwana Mugimu Nutrition Unit (MNU), Mulago Hospital.
Unit cost for attention	Uganda Clinical Guidelines protocol and the IMAM Guidelines to get the standard treatment of malnourished children for the different age category.
This includes the cost of human resources, i.e. for the time a medical worker dedicates to a child on an outpatient basis.	
Primary care - Medical inputs	
For outpatient cases, only the cost of drugs (multi-vitamins, RUTF) was included for the 6 times the child goes to complete the treatment.	

Process of costing of the pathologies	
Hospitalized - Medical inputs	
This included costs of drugs, sundries and laboratory tests for the 22 days the child is in the health facility.	
Intensive Care Unit - Medical inputs	
This included costs of drugs, sundries, laboratory tests and oxygen related requirements for the 22 days the child is in the health facility.	
Daily cost of a hospital bed	
The cost of a hospital bed is a standard cost for all the pathologies.	
Cost of medical inputs not covered by the health system	
It was assumed that public hospitals provide at least 50% of the cost of outpatient medical inputs, while the other 50% is borne by the caretaker of the child.	
Percentage of cases who attend health services	
Data compiled from sources like UDHS, 2011, expert opinion and the percentage of deliveries in government and NGO hospitals (source: MoH Statistical Abstract Report, 2010).	
Cost of treating; Malaria, Anaemia, ADD, ARI and LBW	**Comments and Sources**
For malaria, anaemia, ADS and ARI, the Acute Care Unit (ACU), Mulago Hospital was consulted for information and the Special Care Unit (SCU) was contacted for information on low birth weight (LBW); both Units are under the Paediatrics department, Makerere University School of Public Health.	The key experts included Officers in Charge of the different units since they have hands-on experience (Paediatric department-Acute Care Unit and Special Care Unit), Mulago Hospital.
The same tool, as with undernutrition, was used to get information for the other pathologies.	.
The cost of medical inputs for outpatients included costs of drugs, laboratory tests and sundries for malaria, ARI, ADS and anaemia, considering also the multiple visits a child needs to make to the health facility for treatment, (one visit for malaria, 3 for ARI, 2 for ADS and one for anaemia) .	Uganda Clinical Guidelines, 2010 for disease treatment protocols.
The cost of medical inputs for hospitalized cases included costs of drugs, sundries and laboratory tests for the days the child is	

Process of costing of the pathologies
hospitalized in the health facility due to malaria, anaemia, ADS and ARI, (8 days for malaria, 3 days for anaemia, 2 days for ADS and 7 days for ARI).
The cost of ICU was estimated as the one for malnutrition included drugs, sundries, laboratory tests and oxygen related requirements..
The unit cost for attention for all pathologies includes the cost of human resources for the time the medical worker dedicates to a child on an outpatient basis.
Daily cost of a hospital bed is a standard cost for all the pathologies.
Cost of medical inputs not covered by the health system: it was assumed that public hospitals provide at least 50% of the cost of outpatient medical inputs, while the other 50% is borne by the caretaker of the child.
Percentage of cases who attend health services: This was compiled from sources like UDHS, 2011, expert opinion and the percentage of deliveries in government and NGO hospitals (source: MoH Statistical Abstract Report, 2010).
To determine ARI costs, the cost for treating severe pneumonia was computed since ARI's symptoms are used as proxy for pneumonia.

Number of annual disease episodes (incidence)	Comments and Sources
LBW: 1 represents the one time a child has LBW (<2.5kg) when he/she is born.	Source: Expert opinion
Malnutrition: The assumption was that a child gets malnourished only once a year.	Dr. Kiboneka Elizabeth, Director Dr. Mugala Jamu, Special Care Unit (SCU), General Mulago Hospital
Malaria: On average it is considered that a child has only 1.5 episodes of malaria in a year. Depending on the geographical area some areas have 3 episodes while others one.	Dr. Nyombi Nata, SCU, General Mulago HospitalDr. Anita SCU-Private
Anaemia: Included only moderate and severe cases of anaemia. It is assumed that a child gets only one episode of Anaemia per year.	Dr. Kiguli, Head of Paediatric Department, Mulago Hospital
ADS: It is assumed that a child gets about 2 episodes of ADS per year.	

Process of costing of the pathologies	
ARI: It is assumed that a child gets 3 episodes of ARI in a year.	
Average number of primary care visits for each event	**Comments and Sources**
The primary care visits refer to the number of times a child is brought to the health facility, followed up after being discharged and brought back to the outpatient department because of an illness.	Source: This is based on the actual average number of days a child would usually spend on oxygen, (Mulago Hospital, IMAM Guidelines).
SAM: A child who has been discharged from the hospital or referred receives six follow-up visits (as outpatient) per event. A child visits the primary health care once a year with a new case of malnutrition.	
Malaria: Each child with first line malaria is treated on outpatient basis and is given anti-malarial drugs – a full dosage **once –** the day he/she comes to the health facility. Follow-up is not usually done. A child visits the primary care once a year.	
Anaemia: Each child with moderate anaemia is treated on outpatient basis and is given drugs – full dosage (folic acid/iron supplements etc) **once –** the day he/she comes to the health facility. Follow-up is not usually done. A child visits the primary care once a year.	
ARI: Each child with mild pneumonia is treated on outpatient basis and is given drugs – full dosage of antibiotics **once –** the day he/she comes to the health facility. Follow-up is not usually done. A child visits the primary care 3 times a year.	
ADS: Each child with moderate ADS is treated on outpatient basis and is given drugs – full dosage **once –** the day he/she comes to the health facility. Follow-up is not usually done. A child visits the primary health care twice a year.	
Proportion of events requiring hospitalisation	**Comments and Sources**
LBW: It is assumed that almost all cases of LBW are hospitalized, (expert opinion, Mulago Hospital).	Source: Nutrition PROFILES, 2009 and expert opinions from Mulago Hospital.
SAM: It is assumed that SAM cases are hospitalized, (Nutrition PROFILES, 2009 and expert opinion).	Expert opinions included: Officers in Charge; Nurses and Paediatric Doctors of Acute Care Unit for
Malaria: It is assumed that children with severe malaria who were given quinine treatment are hospitalized cases.	

Process of costing of the pathologies	
Anaemia: Only severe cases of anaemia are hospitalized. Anaemia is considered to be severe when <8/gDL, (UDHS, 2011).	SAM, malaria, anaemia, ARI and ADS, and Special Care Unit for LBW, (Mulago Hospital).
ARI: The figure was based on expert opinion.	
ADS: It is assumed that children with ADS, who received intravenous solution as treatment for diarrhoea, were hospitalized (UDHS, 2011).	
Average number of days of hospital treatment for each event	**Comments and Sources**
This was based on protocols from the Uganda Clinical Guidelines, 2010, IMAM Guidelines and experience on the ground, especially for SAM cost estimations.	Uganda Clinical Guidelines, 2010, IMAM Guidelines.
LBW: 14 days for full-term LBW infants.	
SAM: The average length of stay is of 22 days, which corresponds to the number of days used in calculating SAM cost for medical inputs.	
For cases of **Malaria** - 8 days; **Anaemia**– 3 days; **ARI** – 7 days; and **ADS** – 2 days on average, if without complications.	
Proportion of events requiring intensive treatment UTI/ICU	**Comments and Sources**
LBW: For all hospitalized cases of LBW only about 3% don't go in the Intensive care unit (ICU), i.e. approximately 97% are usually admitted into ICU.	**Source**: Expert opinion from Acute Care Unit and Mwana Mugimu Nutrition Unit, Mulago Hospital.
SAM: Information retrieved from PROFILES, 2009 and expert opinion.	
Malaria, Anaemia, ARI and ADS: Information was received from a Paediatrics expert who indicated number of cases irrespective of the number of annual disease or proportion of events requiring hospitalization.	
Average number of days of intensive treatment UTI/ICU for each event.	**Comments and Sources**
The average length of stay in ICU is 4 days for all the pathologies.	Based on the actual number of days on average a child spends on oxygen, Mulago Hospital.

Process of costing of the pathologies	
Average waiting time (in hours) to receive health services at primary care centre	**Comments and Sources**
The waiting time to receive health services for an outpatient is 3 hours on average for all the pathologies. For SAM cases caretakers/mothers receive health and nutrition education (within 3 hours), before going for a review/check-up by a Doctor or Nurse.	Based on various expert opinions and observations, Mulago Hospital.
Daily hours lost due to hospitalisation	**Comments and Sources**
It is assumed that an individual works 8 hours per day.	The length of the work day (whether formal or informal) was determined by the Constitution.
Percentage of cases who attend health services	**Comments and Sources**
Refers to the percentage of cases who went to the health facility following different pathologies.	Expert opinion given by Dr. Wamani Henry, Head of Department School of Public Health, MoH Statistical Abstract Report, 2010, UNICEF and UDHS.

Variables for Education Section

Variable	Method	Data source
Enrolment	The education system in Uganda defines final enrolment as the number of students approved (i.e. numerical count of existing students/pupils in a school at a particular time)	Education management information system (EMIS)
Initial enrolment	Count of students/pupils as per admission forms	EMIS
Final enrolment	Count of students/pupils as per end of term exam sitting	EMIS
Number of passes	Count of students/pupils who acquire the minimum desirable pass grade	EMIS
Number of dropouts (rate)	Difference between initial and final enrolment	EMIS
Number of population repeating	Count of students/pupils who do not acquire the minimum required passing grade	EMIS

grades (rate)		
Absenteeism	Count of students/pupils who do not attend lessons for more than 2 days in a week	EMIS
Number of teachers hired by government	Count of teachers employed in schools as per the government payroll	EMIS
Education costs		
Private cost	Summation of the itemized education costs incurred by households per student/pupil	UNHS 2009-2010
Public cost	Computed using a unit allocation cost as per the UPE and USE Guidelines	Ministry of Finance

Variables for productivity costing

Variable	Method	Data sources	Assumptions
Average wage per hour	Total wage per person expressed as a ratio of the number of hours worked	UNHS 2009-2010	There is a known number of hours worked per person
			There is a known wage paid per person for a standard period of time (weekly, monthly)
Consumer price index	Obtained from UBOS monthly consumer price index press release	UBOS	
Average income per years of schooling	Individual income was computed as proportion of household income per number of working hours contributed by each of the working individuals in the household	UNHS 2009-2010	For an individual to have completed a level of education, he/she must have passed that level of education
			Number of years of schooling is equal to the education levels attained
Average income for manual activities	Income for individuals engaged in the subsectors of agriculture, forestry, fishery and mining	UNHS 2009-2010	Manual activities were restricted to the subsectors of agriculture, forestry, fishery, and mining.
Average income for non-manual activities	Income for individuals engaged in other subsectors excluding agriculture, Forestry, fishery and mining	UNHS 2009-2010	Non-manual activities were restricted to other subsectors excluding agriculture, forestry, fishery and mining
Average working hours	Total hours worked in a week by an individual as a ratio of number of days worked in a week	UNHS 2009-2010	

Annex 6: Consulted References and Annotations

I.   HEALTH

	Title	Author	Brief Description	Universe of analysis
1.	Maternal and child undernutrition: consequences for adult health and human capital (Lancet series: 2008)	Cesar G Victora et al.	This paper reviews the associations between maternal and child undernutrition with human capital and risk of adult diseases.	Children aged under five years and women of reproductive age(15-44)
2.	Maternal and child undernutrition: global and regional exposures and health consequence (Lancet series: 2008)	Robert E. Black et al.	This paper estimates the effects and the risks related to stunting, severe wasting, and intrauterine growth restriction as well as to suboptimum breastfeeding practices on mortality and disease.	Children aged under five years
3.	Undernutrition as an underlying causes of malaria morbidity and mortality in children less that five years old.(2004)	Laura E. Caulfield et al.	This review examines the global burden of malaria associated with various nutrient deficiencies as well as underweight status in children 0–4 years and recommended that nutrition programs be integrated into existing malaria intervention programs.	children 0–4 years
4.	Maternal and child undernutrition and overweight (the Lancet series:2013)	Robert. E.Black	This paper estimates the causal relationship between undernutrition in the aggregate and child deaths.	Children aged under five years
	WHO Global Database on child growth and malnutrition http://www.who.int/nutgrowthdb/en/ (2011)	Mercedes de Onis et al.	This document is the organized collection and standardization of information on the nutritional status of the world's under-five population.	Children aged under five years

4.	Levels and Trends in Child malnutrition: Joint Child Malnutrition Estimates. (2011)	UNICEF, WHO, WB	Estimates of prevalence and numbers for child stunting, underweight, overweight and wasting and trends of malnutrition since 1990.	Children aged under five years
7.	Undernutrition & risk of infections in preschool children(2009)	Prema Ramachandran et al.	Low BMI for age and wasting indicate current energy deficit; early detection and correction of the current energy deficit might reduce the risk of infection and also enable the child to continue in his/her growth trajectory for weight and height.	pre-school children (India)
8.	Report on the global AIDS epidemic (2012)	UNAIDS	A summary of the current situation in the effort to reach the 2015 targets set forth in the 2011 Political Declaration.	Adults and children
9.	Nutritional Care of HIV- Positive Children in Kenya, Malawi and Zambia: A progress review (2008)	WHO and UNICEF	An assessment of the integration of HIV and Nutrition programs and policies in the three countries.	HIV positive children
	Nutrition and HIV infection (2002)	J. Salomon et al.	Assesses the relationship between HIV and malnutrition (wasting syndrome).	HIV positive patients
11.	Nutrition Management of the Very Low-birthweight Infant II. Optimizing Enteral Nutrition and Post discharge Nutrition (2008)	David H. Adamkin	Explain the most appropriate diets and their benefits for preterm infants after hospital discharge.	LBW infants
12.	Cost of illness handbook: CHAPTER III.2. COST OF LOW BIRTH WEIGHT	United States Environmental Protection Agency (USEPA)	This chapter discusses the methods used and the results of estimating the direct medical costs incurred by individuals with low birth weight (LBW).	LBW infants

13.	Integrated Management of Pregnancy and Childbirth- Pregnancy, Childbirth, Post-partum and newborn care- (2006)	WHO, UNICEF, UNFPA& WB	This is a guide for practitioners.	Pregnancy and children 0-28 days
14	Comparative Quantification of Health Risks : Chapter 2-Childhood and maternal Underweight(2004)	WHO, Steven M. Fishman et al.	Meta-analyses, in order to determine the relative risk of disease and death attributable to underweight status.	children aged 0-4 years and women of reproductive age (15-44)
16	Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries(2000)	Amy L. Rice et al.	An analyses which confirms a strong and consistent relation between malnutrition and an increased risk of death between diarrhoea and acute respiratory infection and a potentially increased risk for death from malaria.	children aged under five years
17	Estimates of the Duration of Untreated Acute Malnutrition in Children From Niger (2010)	Sheila Isanaka, et al.	An estimation of the duration of untreated moderate acute malnutrition (MAM) and severe acute malnutrition (SAM, which can be used along with the incidence to improve projections of program needs and estimates of the global burden of acute malnutrition.	children aged under five years
18	Ending Child Hunger and Undernutrition Version2(2009)	REACH	The document provides highly condensed information and lessons learned for scaling up REACH-promoted interventions to support field practitioners and other interested parties	children aged under five years

| 19 | WHO Child growth standard and the identification of severe acute malnutrition in infants and children (2009) | WHO | This paper presents the recommended cut-offs, summarizes the rationale for their adoption and advocates for their harmonized application in the identification of 6–60 month old infants and children for the management of severe acute malnutrition (SAM). | breastfed infants and appropriately fed children of different ethnic origins |
| 20. | Symposium: Causes and Etiology of Stunting(1999) | Edward A. Frongillo et al. | It assesses why and how stunting in children occurs. | Children aged under five years |

II.   GENDER

	Title	Author	Brief Description	Universe of Analysis
1.	Nutrition and Gender (2002)	Ruth Oniango'o et al.	This policy brief presents the increased attention to nutrition status of girls and adolescents will contribute towards the strengthening of policies related to women's status.	Girls and adolescents
2.	Gender and Nutrition	FAO	Explores the unique position of women to reduce malnutrition as the largest threat to public health in the world.	Women in rural settings

III.   EDUCATION

	Title	Author	Brief Description	Universe of analysis
1.	Severity and Timing of Stunting in the First Two Years of Life Affect Performance on Cognitive Tests in Late Childhood (1999)	Michelle A. Mendez et al	This paper assesses the relationship between stunting in the first 2 y of life and later cognitive development.	school age children

2.	The Impact of Dietary Intervention on the Cognitive Development of Kenyan School Children(2003)	Shannon E. Whaley et al.	Explores the relationship between diet containing animal protein and cognitive development.	school age children
3.	Growth in Young Filipino Children Predicts Schooling Trajectories through High School (2004)	Melissa C. Daniels et al.	Explores the association between height-for-age Z-score (HAZ) at 2 y and schooling trajectory.	school age children
4.	Child Malnutrition and School performance in China(1986)	Dean T. Jamison	This paper estimates the effect of stunting on school advancement.	school age children
5.	Malnutrition and poor academic performance: critical contributions(2006)	Sandra Maria Sawaya	Assesses the relationship between poor academic performance and malnutrition in children from poor families.	School aged children
6.	Effects of early childhood psychosocial stimulation and nutritional supplementation on cognition and education in growth-retarded Jamaican children: prospective cohort study(2005)	Susan P Walker et al.	Assesses the association of stunting in early childhood and cognitive and educational deficits in late adolescence, which are reduced by stimulation at a young age.	Children 9-24 months and 17-18 years
7.	Weight Gain in the First Two Years of Life Is an Important Predictor of Schooling Outcomes in Pooled Analyses from Five Birth Cohorts from Low- and Middle-Income Countries(2010)	Reynaldo Martorell, et al.	Explores the relative importance of birth weight and postnatal weight gain for schooling attainment.	school age children
8.	Long-Term Impact of Health and Nutrition Status on Education Outcomes for Children in Rural Tanzania(2010)	Lucia Luzi	Investigated the long-term impact of early childhood malnutrition and education attainment.	school age children

IV.   PRODUCTIVITY

	Title	Author	Brief Description	Universe of analysis
1	Long-term consequences of stunting in early life (2011)	Kathryn G. Dewey et al., USA	A summary of the impact of stunting, highlighting recent research findings, policy and programme implications and research priorities	
2	Long –term consequences of early childhood malnutrition (2011)	Harold Alderman et al.	Assesses the link between stunting and lower education attainment and lower earning capacity.	0-5 children, adolescents and adults
3	Stunted children gain less lean body mass and more fat mass than their non-stunted counterparts: a prospective study(2004)	P. A. Martins et. al.	Analysis of the changes in body composition of stunted children during a follow-up period and to test the hypothesis of a tendency to accumulate body fat as a consequence of undernutrition early in life resulting in adult obesity.	adolescents
4.	Long-Term Consequences of Early Linear Growth Retardation (Stunting) in Swedish Children(2000)	Liu, Youxue et al.	Explores stunting in early life and its lifelong effects on final height in a normal healthy population in a developed country.	Adults (urban)
5.	Preschool Stunting, Adolescent Migration, Catch-Up Growth, and Adult Height in Young Senegalese Men and Women of Rural Origin(2006)	Aminata Ndiaye Coly et al.	Assess the amount of catch-up growth from preschool stunting and the effect of migration (change in environment) during adolescence	preschool age (1–5 y) children to adulthood (18–23 y) from rural areas
6.	Long-term effects of the 1959-1961 China Famine: Mainland China and Hong Kong (2007)	Douglas Almond et al.	Analysis of the long term impacts of foetal exposure to famine on literacy, labour market status, wealth and marriage market outcomes.	adult men and women , who suffered from famine in vitro
7.	Reversibility of Stunting : Epidemiological Findings from children in developing countries(2004)	R, Martorell et al.	Assesses the extent to which stunting, which is an early childhood phenomenon can be reversed in later childhood	Children under five years of age and

			and adolescence. It was found that interventions for catch up growth were more effective in early childhood.	adolescents
8.	The Impact of Nutritional Status on Agricultural Productivity: Wage Evidence from the Philippines(1991)	Lawrence J. Haddad et al.	An assessment of the impact of individual nutritional status on agricultural wage rates. A positive relationship has been found between nutritional status and labour productivity in the agriculture sector.	farmers
9.	Valuing the Future: the social discount rate in cost-benefit analysis(2010)	Mark Harrison	To establish whether a particular project has a present value of benefits greater than its costs, and to rank viable alternatives. In August 2007, the Office of Best Practice Regulation	
10	International Standard of Industrial Classification of All Economic Activities Rev-4((2008)	UN HQ Department of Economic and Social Affairs	Consists of a coherent and consistent classification structure of economic activities based on a set of internationally agreed concepts, definitions, principles and classification rules.	
11	PROFILES Guidelines: Calculating the Effects of Malnutrition on Economic Productivity, Health and Survival	Jay Ross and Helen Stiefel The Academy for Educational Development Washington, DC	Model used to estimate the effects of malnutrition in society	Children under 5

When a child is undernourished, the negative consequences follow that child for his or her entire life. These consequences also have grave effects on the economies where he or she lives, learns and works.

The Cost of Hunger in Africa Study quantifies the social and economic impact of undernutrition. The results provide an important advocacy tool towards creating policies and encouraging investments in Africa that help prevent losses of human and economic potential due to undernutrition.

With Africa's present economic advancement, now is the time for governments to seize the window of opportunity to ensure a generation free from stunting in the foreseeable future. Then, and only then, can the continent achieve the inclusive economic development desired.

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