

# The Cost of HUNGER in AFRICA

Implications for  
the Growth and  
Transformation  
of Ethiopia



**The Social and Economic Impact of  
Child Undernutrition in Ethiopia**

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Transformation of Ethiopia

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Impacts of Child  
Undernutrition in Ethiopia**





**When a child is undernourished, the negative consequences follow that child for his/her entire life. These negative consequences also have grave effects on the economies where s/he lives, learns and works.**

# Contents

Foreword by the State Minister of Health .....	6
Foreword by the Director-General of EHNRI .....	7
Acknowledgements .....	8
Acronyms.....	10
Executive Summary.....	12
<b>Section I: Brief Socio-Economic Background.....</b>	<b>15</b>
<b>Section II: Cost of Hunger in Africa Methodology.....</b>	<b>21</b>
A. Introduction: Why is it important?.....	22
B. Brief description of the model.....	24
i. Conceptual framework .....	24
ii. Causes of undernutrition .....	24
iii. Consequences of undernutrition .....	25
iv. Dimensions of analysis.....	27
v. Methodological aspects .....	28
<b>Section III: Effects and Costs of Child Undernutrition.....</b>	<b>31</b>
A. Social and economic cost of child undernutrition in the health sector.....	32
i. Effects on Morbidity.....	32
ii. Stunting levels of the working-age population .....	34
iii. Effects on mortality.....	34
iv. Estimation of public and private health costs.....	35
B. Social and economic cost of child undernutrition in education.....	37
i. Effects on retention .....	38
ii. Estimation of public and private education costs .....	39
C. The social and economic cost of child undernutrition in productivity.....	41
i. Losses from non-manual activities due to reduced schooling.....	41
ii. Losses in Manual Intensive Activities .....	43
iii. Opportunity cost due to higher mortality of undernourished children.....	43
iv. Overall productivity losses .....	44
D. Summary of Effects and Costs.....	45
<b>Section IV: Analysis of Scenarios.....</b>	<b>47</b>
<b>Section V: Conclusions and Recommendations.....</b>	<b>51</b>
A. Child Undernutrition: Implications for Ethiopia's Growth and Transformation Plan .....	52
B. Recommendations of the Study .....	53
<b>Section VI: Annexes.....</b>	<b>57</b>

Annex 1. Glossary of Terms.....	58
Annex 2. Methods and Assumptions.....	61
Annex 3. Brief Description of COHA Data Collection Process.....	67
Annex 4. Consulted References .....	68



# Foreword

State Minister of Health, Federal Democratic Republic of Ethiopia

**In the last decade, we have made significant strides in addressing nutrition issues in Ethiopia. Interventions have been scaled-up targeting women and children; rates of underweight and stunting have decreased. The Growth and Transformation Plan has identified nutrition as a key goal for 2015. Many sectors have committed to implementing interventions that specifically address nutrition.**

If we invest in nutrition, we will see social and economic gains. Improved nutrition can have a positive effect for individuals and communities in all areas of life — health, education, and productivity — and there are no negative consequences of investing in improved nutrition.

It is known that child undernutrition has long-term negative effects on people's lives, most notably in health, education, and productivity, and seriously affects the human capital of a country on which the economy relies. The study on the Cost of Hunger in Ethiopia has allowed us to quantify the negative impacts of child undernutrition in both social and economic terms.

The study is undoubtedly a call to action, and it is thus appropriate that the study has been launched simultaneously with the National Nutrition Plan (NNP). This program outlines some of the key efforts that must be undertaken in the next few years to address the causes and effects of malnutrition and provides a basis for future nutrition policy. The study illustrates the need for all partners to work together to implement the NNP and collaborate to improve nutrition broadly. Specifically, the critical support required to address the issue of undernutrition is through health and agriculture extension services and through continues research. Moreover, community sensitization and awareness-raising activities on nutrition must be implemented. By doing this, we can reduce the burden of child undernutrition on communities and enhance social and economic growth.

I would like to thank the African Union Commission for leading this important initiative, the UN Economic Commission for Africa for their technical leadership, and the UN World Food Programme for their financial support. Further, I wish to commend the multi-sectoral implementers and supporters of the study including the Federal Ministry of Health, the Ethiopian Health and Nutrition Research Institute, as well as the Ministry of Education, the Ministry of Finance and Economic Development, the Central Statistics Agency, St. Paul Hospital Millennium Medical College, the World Health Organization, and the UN Children's Fund. Studies of this kind can empower us to develop informed policy and provide evidence to support our existing interventions.



**Kebede Worku (MD)**

State Minister of Health  
Federal Democratic Republic of Ethiopia

# Foreword

Director-General of the Ethiopian Health and Nutrition Institute

**The year, Ethiopia was proud to be elected as the chair of the African Union during the year of Pan-Africanism and the African Renaissance and the 50<sup>th</sup> anniversary of this continental organization. In the past fifty years, Ethiopia, and the entire continent, has experienced remarkable growth and achievement. We look forward to another fifty years of growth and success.**

As this study shows, however, we cannot rely solely on traditional drivers of growth. Our economy is struggling under the burden of child undernutrition. We must invest not only in roads and bridges and enterprise, but also in the nutrition of the youngest Ethiopians.

In order to achieve improve child nutrition at national level, we must be able to bring together a coordinated inter-sectoral response that is able to address the direct determinant of undernutrition, beyond just the health sector. The Cost of Hunger Study continues to be contribution in bringing together the will and actions necessary for a decisive response to address this issue.

We have always suspected the high economic and social impact of malnutrition in Ethiopia. But now we know how much. This study is ground-breaking, as it is able to establish an economic value on this impact.

We are proud that the data used for COHA is national data from Ethiopian Ministries. This study illustrates that we can effectively use our data to evaluate the economic and social situation in our country. This can then be used to develop tailored policy to address specific challenges. Further, the data was processed by a skilled team of professionals from the Ethiopian Nutrition and Health Research Institute and the Federal Ministry of Health who had the opportunity to expand their capacity in data analysis through the process. The systematic approach of data analysis used in COHA can be replicated to other aspects of the activities that are undertaken by the Federal Ministry of Health and other ministries.

As the Government of Ethiopia moves forward in the implementation of the Growth and Transformation Plan, we need to emphasize the importance of eliminating undernutrition. In the context of the COHA results, the FMOH has developed a comprehensive National Nutrition Plan, which has the possibility of bringing together actions that can reduce the barriers that are imposed in undernourished children, from an early age, up until they become productive members of society.

As we congratulate the African Union on the monumental 50<sup>th</sup> anniversary and celebrate the successes of the past 50 years, we look forward to an exciting new era that will focus on human capital, and specifically nutrition, as a key element for Ethiopia's development.



**Dr. Amha Kebede**  
Director-General

Ethiopian Health and Nutrition Research Institute



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The Steering Committee highlights the special contributions by the EHNRI in supporting the adaptation of the Model to Estimate the Social and Economic Impact of Child Undernutrition in Africa. Their contributions indicate Ethiopia’s commitment to regional collaboration.





# Acronyms

ACGSD	African Centre for Gender and Social Development
ACS	African Centre for Statistics
ADFNS	Africa Day for Food and Nutrition
ADS	Acute Diarrheal Syndrome
AfDB	African Development Bank
ARI	Acute Respiratory Infection
ARNS	Africa Regional Nutrition Strategy
ATYS-VMD	Africa Ten Year Strategy for the Reduction of Vitamin and Mineral Deficiencies
AU	African Union
AUC	African Union Commission
CAADP	Comprehensive Africa Agriculture Development Programme
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
ECCAS	Economic Community of Central African States
ECLAC	Economic Commission for Latin America and the Caribbean
ECOWAS	Economic Community of West African States
EMIS	Education Management Information System
EDND	Economic Development and NEPAD Division/ UNECA
EHICES	Ethiopia Household Income, Consumption and Expenditure Survey
EHNRI	Ethiopian Health and Nutrition Research Institute
ETB	Ethiopian Birr
FAFS	Framework for African Food Security
FAO	Food and Agriculture Organization
FMoH	Federal Ministry of Health
FTF	Feed the Future
GDP	Gross Domestic Product
GNI	Gross National Income
ICU	Intensive Care Unit
IFAD	International Fund for Agricultural Development
IGAD	Intergovernmental Authority for Development
ILO	International Labour Organization
IMAM	Integrated Management of Acute Malnutrition
IUGR	Intra Uterine Growth Retardation
LBW	Low Birth Weight
MDGs	Millennium Development Goals
MoFED	Ministry of Finance and Economic Development
MoE	Ministry of Education
NCHS	National Centre for Health Statistics
NEPAD	The New Partnership for Africa's Development
NIT	National Implementation Team
NPCA	NEPAD Planning and Coordinating Agency



OECD	Organization for Economic Cooperation and Development
PANI	Pan- African Nutrition Initiative
P4P	Purchase for Progress
PSS	Public Social Spending
REACH	Renewed Efforts Against Child Hunger
REC	Regional Economic Community
SADC	Southern African Development Community
SAM	Severe Acute Malnutrition
SUN	Scaling Up Nutrition Initiative
UMA	Union du Maghreb Arabe
UNECA	United Nations Economic Commission for Africa
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WAP	Working-age Population
WFP	World Food Programme
WHO	World Health Organization



# Executive Summary

The Cost of Hunger in Africa (COHA) is an African Union Commission (AUC) led initiative through which countries are able to estimate the social and economic impacts of child undernutrition. Twelve countries are participating in the study. Ethiopia is part of the four first-phase countries, the first to carry out the study and present results.

The COHA study illustrates that child undernutrition is not only a social, but also an economic issue, as countries are losing significant sums of money as a result of current and past child undernutrition. To that end, in March 2012 the regional COHA study was presented to African Ministers of Finance, Planning and Economic Development who met in Addis Ababa, Ethiopia. The Ministers issued a resolution confirming the importance of the study and recommending it continue beyond the initial stage.

The COHA study in Ethiopia is led by the Federal Ministry of Health (FMoH), through the Ethiopian Health and Nutrition Research Institute (EHNRI), Ministry of Education (MoE), Ministry of Finance and Economic Development (MoFED), Central Statistics Agency (CSA), the country office for the World Health Organization (WHO) and the World Food Programme (WFP). At regional level, the COHA project is being led by the African Union Commission (AUC) with technical leadership from the United Nations Economic Commission for Africa (UNECA) and support from WFP.

During the process, all data for the study were collected from national data sources including the Ethiopia Household Income, Consumption and Expenditure Survey 2010/11 (EHICES), CSA Databases, Demographic and Household Survey (DHS) 2011, previous DHS studies, the African Centre for Statistics (ACS), UN Population Division as well as primary data collection.

## Methodology

The COHA model is used to estimate the additional cases of morbidity, mortality, school repetitions, school dropouts and reduced physical capacity that can be directly associated to a person's undernutrition status before the age of five. In order to estimate these social impacts for a single year, the model focuses on the current<sup>1</sup> population, identifies the percentage of that population who were undernourished before the age of five, and then estimates the associated negative impacts experienced by the population in the current year. Using this information and the economic data provided by the Ethiopian National Implementation Team (NIT), the model then estimates the associated economic losses incurred by the economy in health, education and in potential productivity in a single year.

## Trends in Child Stunting

Ethiopia has also made important progress in the reduction of child undernutrition in the last decade. According to the 2011 DHS survey, approximately 44.2% of Ethiopian children under-five were suffering from low height for their age (stunting), which represents an important improvement from the 50.7% reported by DHS in 2005. Additionally, the prevalence of underweight children has also improved from 34.5% to 29.2%. For that same period, low birth weight (LBW) in children has also improved from 14% (2005) to 11% (2011). In spite of these positive trends, stunting still remains a critical challenge to the country as 2 out of every 5 children in Ethiopia remains stunted.

## Initial Results: The Social and Economic Cost of Child Undernutrition in Ethiopia

Overall results in Ethiopia show that an estimated 55.5 billion Ethiopian birr (ETB) was lost in the year 2009 as a result of child undernutrition. This is equivalent to 16.5% of GDP.

- For 2009, there were an estimated 4.4 million additional clinical episodes associated with undernutrition in children under five, which incurred a cost of an estimated ETB 1.8 billion. Cases of diarrhoea, fever, respiratory infections and anaemia totalled 1.3 million episodes in addition to the 3.1 million cases of underweight children. According to the estimated data, only 3 out of every 10 of all episodes received proper health attention.

<sup>1</sup> The model set 2009 as the base year, given the availability of data for that year and in order to insure the continuity of the study. As it is the most recent possible study year, it is referred to as "current" in this report.

- Undernutrition was associated with 24% of all child mortalities which represented 379,000 in the period from 2004 to 2009.
- In primary education, stunted children have a higher grade repetition rate, at 15.1% than non-stunted children, at 11.2%, based on statistics for 2009. This incremental rate generated 152,000 additional cases of grade repetition in 2009, in which the education system and families incurred a cost of ETB 93 million.
- Stunted children in Ethiopia are also more likely to drop out of school. Based on information from the EHICES 2010/11, the model estimated that for 2009 the average schooling achievement for a person who was stunted as a child is 1.07 years lower than for a person who was never undernourished. The resulted disadvantage in the labour market is estimated to have generated private costs of ETB 625 million in potential productivity loss for that single year.
- 67 percent of adults in Ethiopia suffered from stunting as children. This represented more than 26.1 million people of working-age who were not able to achieve their potential, as a consequence of child undernutrition. In rural Ethiopia, where most people are engaged in manual activities, it is estimated that in 2009 alone, ETB 12.9 billion were not produced due to a lower capacity of this group.
- Lastly, an estimated 4.8 billion working hours were lost in 2009 due to absenteeism from the workforce as a result of nutrition-related mortalities. This represents ETB 40.1 billion, which is equivalent to 11.9% of the country's GDP.

## Analysis of Scenarios

In addition to calculating a retrospective cost for 2009, the model can also highlight potential savings, based on three scenarios. The three scenarios are described by the chart and graph below. These scenarios are constructed based on the estimated net present value of the costs of children born in each year, from 2009 to 2025. The methodology follows each group of children and, based on each scenario, estimates a progressive path towards its achievement.

Scenario	Baseline: The Cost of Inaction by 2025	Scenario #1: Halving the Prevalence of Child Undernutrition by 2025	Scenario #2: The 'Goal' Scenario: "10 and 5 by 2025"
Description	Prevalence of stunted and underweight children stops at the level recorded in 2009 (46.4% and 31% respectively)	Prevalence of stunted and underweight children is reduced to half of 2009. (to 23.2% and 15.5% respectively)	Prevalence of stunted children is reduced to 10% and underweight children of less than five years of age, to 5%
Implications	No increase or decrease in percentage points but an increase in total number of stunted children and a higher burden on the society	A constant annual reduction of <b>1.5% points in the prevalence of stunting</b> is required	A constant annual reduction of <b>2.3% points in the prevalence of stunting</b> is required
Estimated Change in period	Total cost increase of up to 39% by 2025 compared to the values in 2009	Accumulated savings of ETB 70.9 billion for the period from 2009 to 2025	Accumulated savings of ETB 148 billion for the period from 2009 to 2025
Annual Average Savings	None	ETB 4.4 billion ETB (\$US 376 million)	ETB 9.2 billion (\$US 784 million)

## Summary of Conclusions and Recommendations

The Cost of Hunger in Africa (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. In Ethiopia the results of the study strongly suggest that, 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 study estimates that child undernutrition generates health costs equivalent to 0.5% of the

total public budget allocated to health and that only 3 out of every 10 children are estimated to be receiving proper health attention. The study further demonstrates that 28% of all cases of child mortality are associated with the higher risk of undernutrition. With regards to education, the results show that 16% of all grade repetitions in school are associated to the higher incidence of repetition experienced by stunted children.

Some of the key findings of the study indicate the need for scaling-up current interventions and developing innovative solutions to fight child undernutrition in Ethiopia. Going forward, it is recommended that the Government of Ethiopia promotes access to and the utilization of nutrition sensitive health services; scales up complementary feeding practices and local food processing; explores further opportunities in bio-fortification; sets aggressive targets for the reduction of stunting; delivers nutrition services to adolescents; and addresses bottlenecks in policy and practice, that undermine the efficiency of existing nutrition interventions.

# Section I: Brief Socio- Economic Background



# Brief Socio-Economic and Nutritional Background

In the year 2009, the gross domestic product (GDP) of the Federal Democratic Republic of Ethiopia (hereafter referred to as Ethiopia) was ETB 335.4 billion<sup>2</sup>. The gross national income (GNI) per capita in 2011 was equivalent to approximately \$US370 which is below the average for sub-Saharan Africa and the average for other low income countries. High food insecurity with a Global Hunger Index<sup>3</sup> categorized at “alarming” due to high undernourishment, child undernutrition and child mortality and high unemployment rate, especially among the young population, present serious challenges for the country’s development.

**TABLE I.1**  
**SOCIO-ECONOMIC INDICATORS**

Indicators	2000-2002	2005-2007	2009-2011
GDP, total in billions of ETB <sup>4</sup>	66.56	172	335.4
GNI Per Capita (Atlas Method current \$US)	120	230	370
Poverty - \$1.25 a day (PPP) (% of population)	56%	39%	30%
GINI Index	30	29.8	...
Labour Force, total (in millions)	31.2	37.1	41.7
Rural Population, percentage	85%	84%	83%
Percentage of Population in Agriculture	...	...	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<sup>5</sup>

The country has also made important progress in the reduction of poverty. According to available data, the country has reduced the population living under the poverty line, is less than US1.25 a day, from 56% for 30% in the last decade. Also, the population growth rates have had a stable reduction tendency from 2.5% to 2.1% in the last decade. Ethiopia’s main economic activity is

<sup>2</sup> "World Economic Outlook Database October 2012," World Economic Outlook Database October 2012, October 2012, <http://www.imf.org/external/pubs/ft/weo/2012/02/weodata/index.aspx>.

<sup>3</sup> Klaus Von. Grebmer, "Financial Crisis Adding to the Vulnerabilities of the Hungry," in *2009 Global Hunger Index: The Challenge of Hunger, Focus on Financial Crisis and Gender Inequality* (Bonn: Welthungerhilfe, 2009), pg. 18.

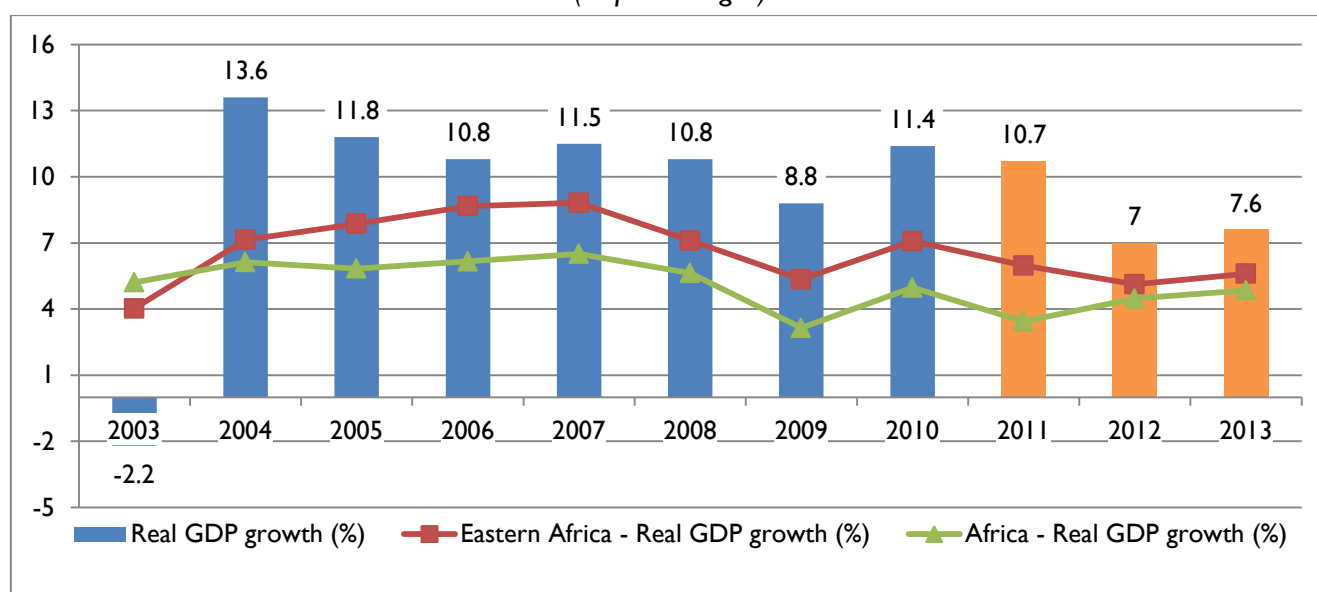
<sup>4</sup> "World Economic Outlook Database," IMF, accessed March 15, 2013, <http://www.imf.org/external/pubs/ft/weo/2012/02/weodata/index.aspx>.

<sup>5</sup> "Ethiopia," Data, accessed March 15, 2013, <http://data.worldbank.org/country/ethiopia>.

agriculture, with approximately 79% of the population working in agriculture. According to the World Bank, 35% of Ethiopia's land is considered agricultural land.

There is also a positive economic outlook of 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<sup>6</sup> illustrates, the positive trend is expected to continue through 2013, though with slightly slower growth than in the past few years.

**FIGURE I.1**  
**TRENDS IN REAL GDP GROWTH, 2003-2013**  
(In percentages)



Source: African Economic Outlook, Figures for 2010 are estimates; for 2011 and later are projections

Public investment in the social sector has also varied in levels in the last 10 years. Public spending of education has increased its proportion of the national budget, from 17% to 25%, above the regional average level for Sub-Saharan Africa, with a higher per capita investment on students enrolled in primary education. On the other hand, expenditure in health as a proportion of the GDP is below the regional averages, but with an incremental tendency in the last few years<sup>7</sup>.

**TABLE I.2**  
**SOCIAL INVESTMENT INDICATORS**

Indicators	2005-06	2007-08	2009-10	Sub-Saharan Africa*
Public spending on education, total (% of 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 \$US)	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%

<sup>6</sup> "Ethiopia," African Economic Outlook, 2012, <http://www.africaneconomicoutlook.org/en/countries/east-africa/ethiopia/>.

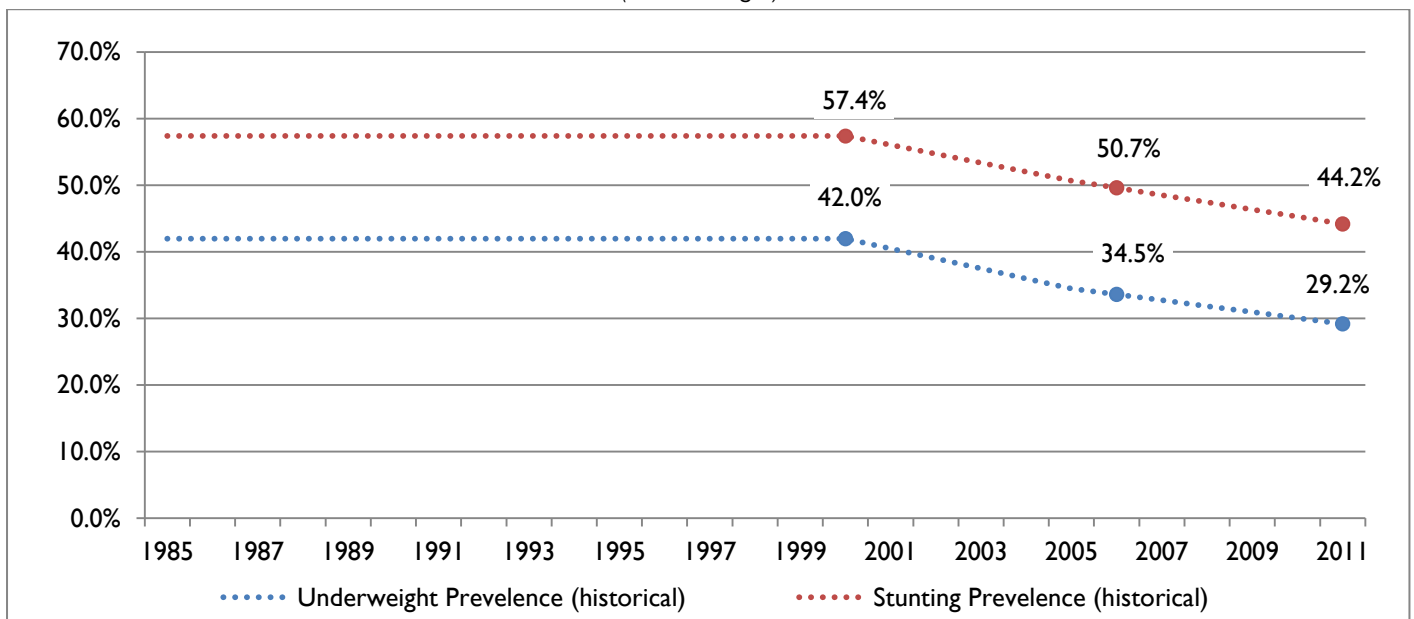
<sup>7</sup> "Public spending on Education, total % of GDP," Data, accessed March 13, 2013, <http://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS>.

Source: World Bank Database<sup>8</sup>, most recent year available

\* Developing countries only - Latest data available

Ethiopia has also made important progress in the reduction of child undernutrition in the last decade. According to the 2011 DHS<sup>9</sup> survey, approximately 44.2% of Ethiopian children under-five were suffering from low height for their age (stunting), which represents an important improvement from the 50.7% reported by DHS<sup>10</sup> in 2005. Additionally, the prevalence of underweight children has also improved from 34.5% to 29.2%. For that same period, low birth weight (LBW) in children has also improved from 14% (2005) to 11% (2011).

**FIGURE I.2**  
**ESTIMATED UNDERNUTRITION TRENDS IN CHILDREN UNDER-FIVE, 2000-2011**  
(In Percentages)



Source: Prepared based on information from DHS 2000/2005/2011

Nevertheless, the current levels of child undernutrition evidence the challenges forward in the reduction of child hunger. As showed in Table 1.3, it is estimated that 4.3 million the 12.1 million children under the age of five in 2009 are affected by growth retardation and nearly 3 million of children were underweight. This situation is especially critical for children between 12 and 24 months, where half of all children are affected by growth retardation.

<sup>8</sup> "Ethiopia," Data, accessed March 15, 2013, <http://data.worldbank.org/country/ethiopia>.

<sup>9</sup> Central Statistical Agency [Ethiopia] and ICF International. Ethiopia demographic and health survey 2011. Demographic and Health Surveys. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International, 2012 (and additional analysis).

<sup>10</sup> General Statistical Agency [Ethiopia] and ORC Macro. Ethiopia demographic and health survey 2005. Demographic and Health Surveys. Addis Ababa, Ethiopia and Calverton, Maryland, USA: General Statistical Agency and ORC Macro, 2006 (and additional analysis).

**TABLE I.3**  
**POPULATION AND CHILD UNDERNUTRITION, 2009<sup>c</sup>**  
(Population in thousands)

Age groups	Population size	Low Birth Weight		Underweight		Stunting	
		Population affected	Prevalence	Population affected	Underweight prevalence	Population affected	Stunting prevalence
Newborn (IUGR) <sup>a</sup>	2,484	148	6.0%				
0 to 11 months				455	18%	497	20%
12 to 23 months	2,454			793	32%	1,186	48%
24 to 59 months	7,161			1,743	24%	2,650	37%
<b>Total</b>	<b>12,100</b>	<b>148</b>		<b>2,992</b>	<b>31%</b>	<b>4,333</b>	<b>44%</b>

Source: Estimated based on DHS Surveys 2005/2011 and demographic projections

<sup>a</sup> In a given year, the new-born population is the same as the 0-11 month's age group.

<sup>b</sup> Estimated on the basis of the equation of De Onis et al, 2003.

<sup>c</sup> Data estimated from the most recent undernutrition prevalence figure available.





# Section II: Cost of Hunger in Africa Methodology



# III

## Cost of Hunger in Africa

### Methodology

#### A. Introduction: Why is it 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 GDP growth on the continent has doubled in the last decade and six of the world's fastest growing economies are in Africa.<sup>11</sup>

Growth has been recorded despite some of the highest rates of child undernutrition in the world.

Human capital is the foundation of economic development. 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.<sup>12</sup> 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. The World Bank estimates that undernourished children are at risk of losing more than 10 per cent of their lifetime earning potential, affecting thus national productivity. Recently, a panel of expert economists at a Copenhagen Consensus Conference concluded that fighting malnourishment should be the top priority for policy makers and philanthropists.<sup>13</sup> At that conference, Nobel Laureate Economist, Vernon Smith described that, "One of the most compelling investments is to get nutrients to the worlds undernourished. The benefits from doing so – in terms of increased health, schooling, and productivity – are tremendous."<sup>14</sup> 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 interventions, investments with apparent shorter term returns are prioritized in social budgets. 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 do not continue to suffer from undernourishment in Africa.

<sup>11</sup> "World Economic Outlook Database October 2012", World Economic Outlook Database October 2012, October 2012, <http://www.imf.org/external/pubs/ft/weo/2012/02/weodata/index.aspx>.

<sup>12</sup> Robert E. Black et al., "Maternal and child undernutrition: global and regional exposures and health consequences," *The Lancet* 371, No. 9608, 2008, doi:10.1016/S0140-6736(07)61690-0.

<sup>13</sup> Copenhagen Consensus 2012, *Top economists identify the smartest investments for policy-makers and philanthropists*, 14 May 2012, <http://www.copenhagenconsensus.com/Default.aspx?ID=1637>.

<sup>14</sup> *Ibid.*

Positioning nutrition interventions as a top priority for development and poverty reduction is often difficult, partly due to the lack of credible country-specific data on short-term returns. There is not enough country-specific evidence to demonstrate how improved nutrition would have a direct impact on school performance and eventually in improving opportunities in the labour market and physical work. Additionally, nutrition is often looked at as a health issue, without considering the rippling social impact that it has on other areas of development.

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*, the *Comprehensive Africa Agriculture Development Programme (CAADP)*, especially CAADP Pillar III, which focuses on reducing hunger and improving food and nutrition security, the *Pan African Nutrition Initiative (PANI)*, *Framework for African Food Security (FAFS)*, *Africa Ten Year Strategy for the Reduction of Vitamin and Mineral Deficiencies (ATYS-VMD)*, and *African Day for Food and Nutrition Security (ADFNS)*. At the global level, initiatives include *REACH*, *Purchase for Progress (P4P)*, *Scaling Up Nutrition (SUN)*, *Feed the Future (FTF)*, the “1,000 Days” partnership, as well as the *Abuja Food Security Summit of 2006*. 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 (2005-2015)*<sup>15</sup>, the objectives of the African Task Force on Food and Nutrition Development<sup>16</sup> 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 (UNECA), 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.

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<sup>15</sup> African Regional Nutrition Strategy (2005-2015). Objectives I-III: I. To increase awareness among governments of the region, regional and international development partners and the community on the nature and magnitude of nutrition problems in Africa and their implications for the development of the continent and advocate for additional resources for nutrition. II. To advocate for renewed focus, attention, commitment and a redoubling of efforts by member states, in the wake of the worsening nutrition status of vulnerable groups. III. To stimulate action at the national and regional level that lead to improved nutrition outcome, by providing guidance on strategic areas of focus.

<sup>16</sup> African Union, “CAHMS Moves into gear with meeting on food and nutrition development”, 14 April 2011, <http://www.au.int/en/sites/default/files/task%20force%20on%20food%20and%20nutrition%20development.pdf>



## B. Brief description of the model

### i. 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.

#### DEFINITION OF TERMS

1. **Chronic Hunger:** The status of people, whose food intake regularly provides less than their minimum energy requirements leading to undernutrition.<sup>17</sup>
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.<sup>18</sup>
3. **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).<sup>19</sup>
4. **Food insecurity:** Exists when people lack access to sufficient amounts of safe and nutritious food, and therefore are not consuming enough for an active and healthy life. This may be due to the unavailability of food, inadequate purchasing power or inappropriate utilization at household level.<sup>20</sup>
5. **Food vulnerability:** Reflects the probability of an acute decline in food access or consumption, often in reference to some critical value that defines minimum levels of human wellbeing.<sup>21</sup>

Nutrition security therefore, depends on a person’s food security or insecurity. Specifically, nutrition security can be described as, “appropriate quantity and combination of food, nutrition, health services and care taker’s time needed to ensure adequate nutrition status for an active and healthy life at all times for all people.”<sup>22</sup> A direct and measurable consequence of nutrition insecurity is low birth weight, underweight and/or lower than normal 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 life, infancy and pre-school, school years or adult life. This is because the nutrient requirements and the needs are different for each stage<sup>23</sup>.

Below is the discussion of the 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.<sup>24</sup>

### ii. Causes of undernutrition

<sup>17</sup> "Hunger statistics", FAO Hunger Portal, Undernourishment or Chronic Hunger, FAO, accessed March 14, 2013, <http://www.fao.org/hunger/en/>.

<sup>18</sup> "Hunger statistics", FAO Hunger Portal, Undernutrition, FAO, accessed March 14, 2013, <http://www.fao.org/hunger/en/>.

<sup>19</sup> *Ibid.*

<sup>20</sup> *Ibid.*

<sup>21</sup> WFP, *VAM Standard analytical framework*, World Food Programme, 2002.

<sup>22</sup> USAID, *USAID Commodities reference guide*, Annex I: Definitions, January 2006, , [http://transition.usaid.gov/our\\_work/humanitarian\\_assistance/ffp/crg/annex-1.htm](http://transition.usaid.gov/our_work/humanitarian_assistance/ffp/crg/annex-1.htm).

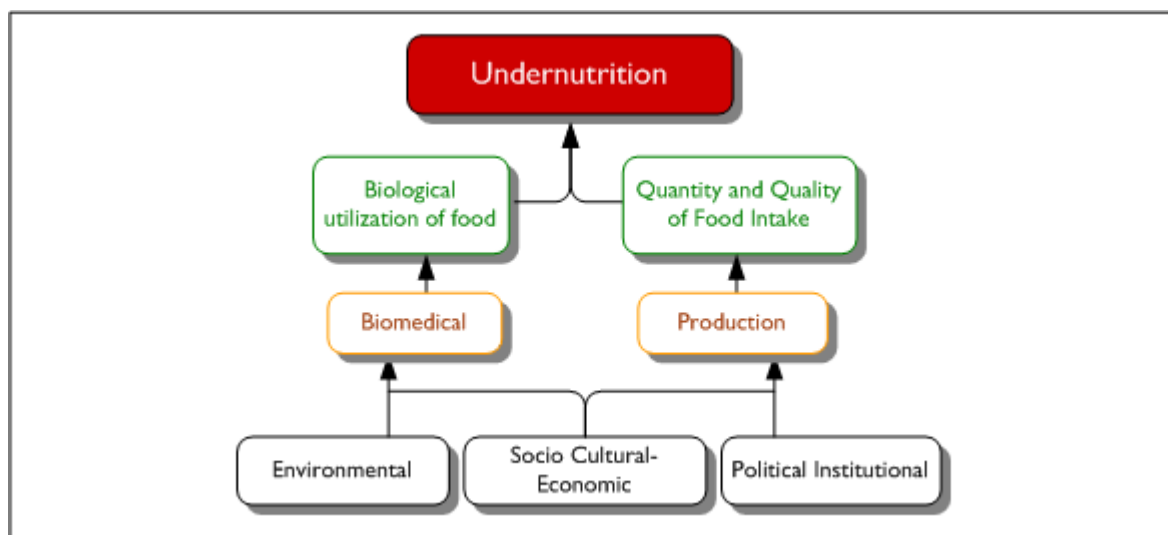
<sup>23</sup> Rodrigo Martínez and Andrés Fernández, *Model for analysing the social and economic impact of child undernutrition in Latin America*, Naciones Unidas, CEPAL, Social Development Division, Santiago De Chile, 2007.

<sup>24</sup> A summarized version of the theoretical background and the basic characteristics considered in the model of analysis are presented. For a more detailed discussion of the model, see 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.

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 and productivity vulnerabilities, through which they determine the quantity and quality of dietary intake and the absorption capacity, which constitute the elements of undernutrition.<sup>25</sup>

Each of these factors helps increase or decrease the likelihood of a person to suffer from undernutrition. 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 vulnerability to undernutrition.

**FIGURE II.1**  
**CAUSES OF UNDERNUTRITION**



Source: Rodrigo Martínez and Andrés Fernández, *Model for analysing the social and economic impact of child undernutrition in Latin America* (see footnote) based on consultations carried out by authors.<sup>26</sup>

Environmental factors define the surroundings in which the subject and his or her family live, including the risks stemming from the natural environment itself and its cycles (from floods, droughts, frosts, earthquakes, and other phenomena), and those produced by humans themselves (such as the contamination of water, air, and food, the expansion of agriculture into new territories, etc.). The socio-cultural-economic determinants include elements associated with poverty and equality, 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.

Production factors include those directly associated with the production of food, as well as the access that the at-risk population has to them. 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.

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).

### iii. Consequences of undernutrition

Child undernutrition has long-term negative effects on people's lives<sup>27</sup>, most notably in the aspects of health, education, and productivity, quantifiable in costs and expenditures to the public and private sectors. Consequently, these effects exacerbate problems in social integration and increase or intensify poverty. A vicious cycle is perpetuated as vulnerability to undernutrition grows.

<sup>25</sup> 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.

<sup>26</sup> Idem.

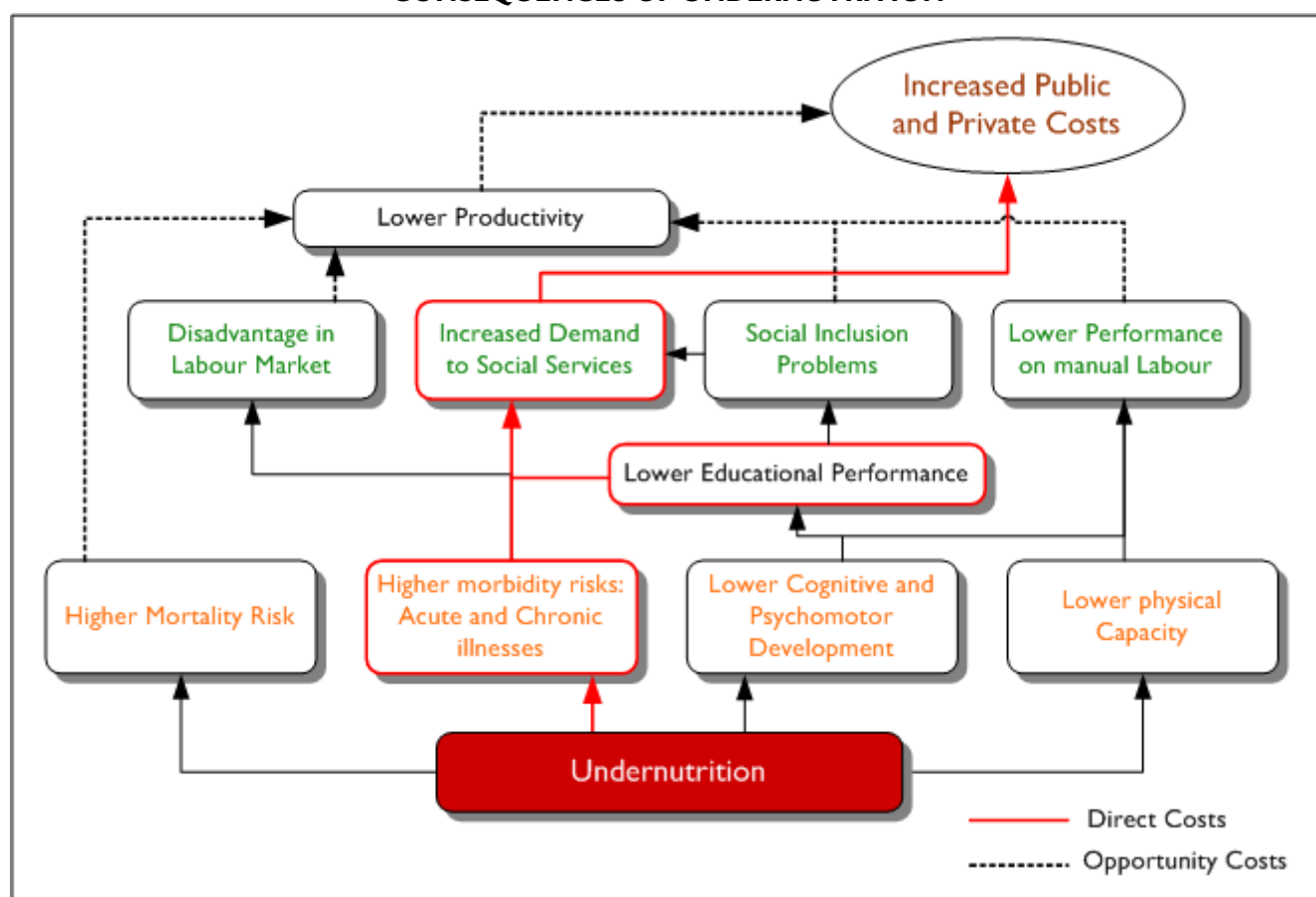
<sup>27</sup> Alderman H., et al., "Long-term consequences of early childhood malnutrition", FCND Discussion Paper No. 168, IFPRI, 2003.

Undernutrition may have immediate or evolving impacts throughout a person's lifetime, although individuals who suffered from undernutrition during early years of their life cycle (including intrauterine) are more likely to be undernourished later in life. 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.<sup>28</sup> The nature and intensity of the impact of undernutrition on pathologies depends 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.<sup>29</sup> 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.

Later in life, individuals may experience lower physical capacity in manual labour as a result of stunting.<sup>30</sup> 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.

**FIGURE II.2**  
**CONSEQUENCES OF UNDERNUTRITION**



Source: Rodrigo Martínez and Andrés Fernández, *Model for analysing the social and economic impact of child undernutrition in Latin America* (see footnote) based on consultations carried out by authors.<sup>31</sup>

Undernutrition and its effects on health and education also translate into heavy economic costs for society at large. Each of the negative impacts in health, education and productivity described above, lead to a social, as well as an economic, loss to the individual or the society.

<sup>28</sup> Amy L. Rice et al., "Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries," *Bulletin of the World Health Organization* 78, No. 2000, 2000.

<sup>29</sup> Melissa C. Daniels and Linda S. Adair, "Growth in young Filipino children predicts schooling trajectories through high school," *The Journal of Nutrition*, March 22, 2004, [jn.nutrition.org](http://jn.nutrition.org).

<sup>30</sup> Lawrence J. Haddad and Howarth E. Bouis, "The impact of nutritional status on agricultural productivity: wage evidence from the Philippines," *Oxford Bulletin of Economics and Statistics* 53, No. 1, February 1991, doi:10.1111/j.1468-0084.1991.mp53001004.x.

<sup>31</sup> Idem.

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:

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

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 the 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 ( $IHC^U$ ). 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 ( $ESC^U$ ). 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 malnourished 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 deaths caused by undernutrition ( $MMC^U$ ). 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.

#### iv. Dimensions of analysis

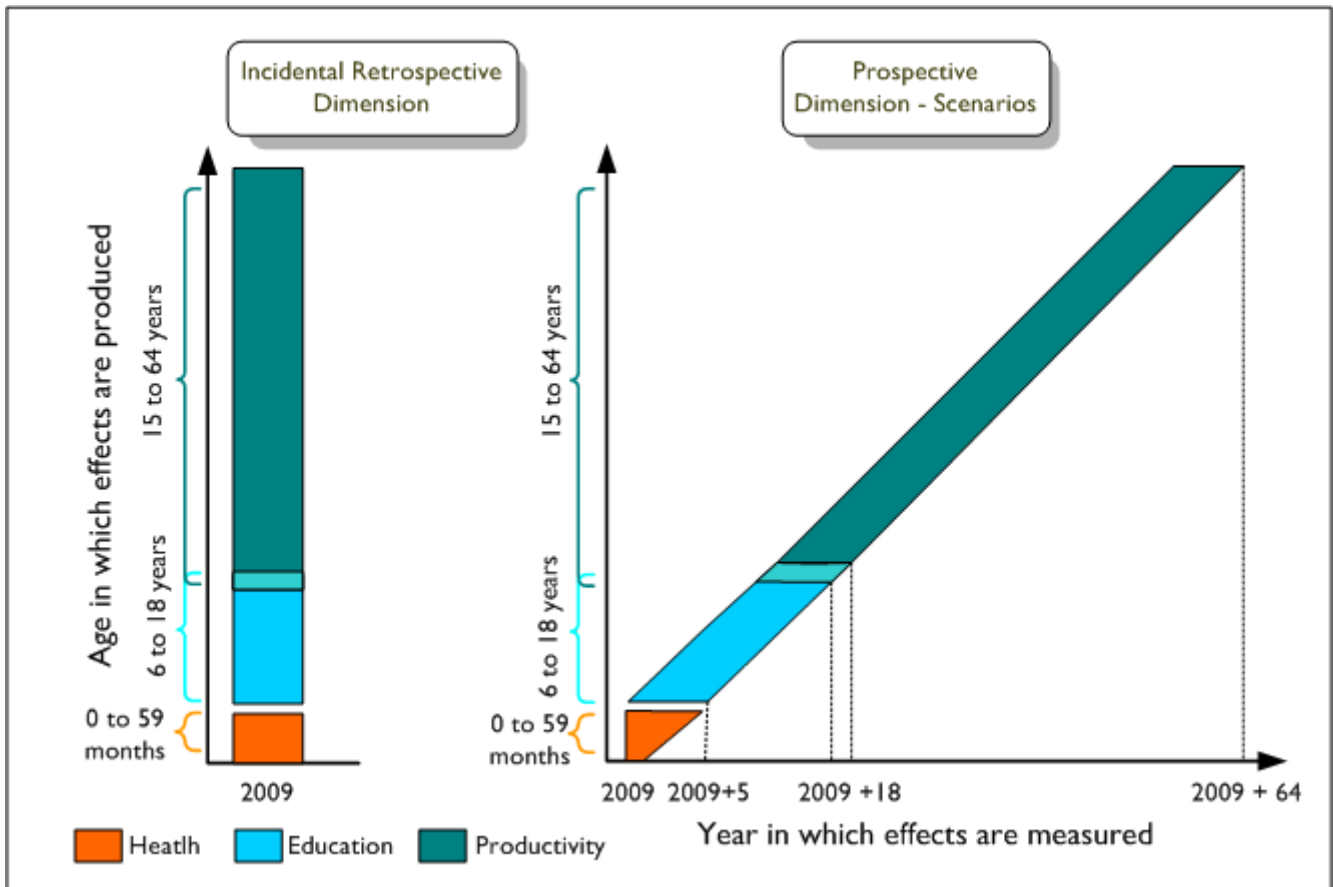
Considering that a country's undernutrition situation and the consequences thereof reflect a specific epidemiological and nutritional transition process, a comprehensive analysis involves estimates of the current situation extrapolated from previous transitional stages as well as estimates of the future to predict potential cost and saving scenarios based on prospective interventions to control or eradicate the problem.

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

1. **Incidental retrospective dimension** focuses on the population in the study year, including mortality cases of those who would have been alive in the study year. The retrospective dimension estimates the nutritional situation of individuals under the age of five to identify the related economic costs in the study year. Thus, 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.
2. **Prospective, or potential savings, dimension.** This dimension focuses on children under five in a given 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. Based on this analysis, potential savings derived from actions taken to achieve nutritional objectives can be estimated.

As shown in Figure II.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 II.3**  
**DIMENSIONS OF ANALYSIS BY POPULATION AGE AND YEAR WHEN EFFECTS OCCUR**



Source: Rodrigo Martínez and Andrés Fernández, *Model for analysing the social and economic impact of child undernutrition in Latin America* (see footnote) based on consultations carried out by authors.<sup>32</sup>

#### v. 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.<sup>33</sup> 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 (weight-for-height scores below -2 standard deviations) are used, with reference, where possible, to the World Health Organization (WHO) distribution for comparison purpose.<sup>34</sup>

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, as its application has specific characteristics in each case, they are detailed separately in this document.

<sup>32</sup> Idem.

<sup>33</sup> In the original design, the idea of analyzing direct information on the nutritional and health situation of pregnant women was considered, but the lack of reliable information on the incidence of undernutrition led to its exclusion from the analysis.

<sup>34</sup> In the estimation of stunting, a complementary analysis is done based on NCHS Standard in order to estimate the relative risk of lower productivity.



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).

The methodological approach presented here considers the most detailed and complete set of causes and effects of child undernutrition. Further, consideration has been made to ensure that certain causes and effects are not overemphasized or double counted. The methodological framework is based on strong research as well as institutional support from international organizations, and has been deemed a strong basis for the purpose of the research described in this report.







# Section III: Effects and Costs of Child Undernutrition

# III

## Effects and Costs of Child Undernutrition

Undernutrition is mainly characterized by wasting - a 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. 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. During schooling years, stunted children are more likely to repeat grades and drop out of school, reducing thus, their income-earning capability later in life. Furthermore, adults who were stunted as children are less likely to achieve their expected physical and cognitive development, thereby impacting on their productivity.

In addition to identifying the physical, psychological and social effects of undernutrition, the economic costs for the direct consequences of undernutrition have been estimated for 2009. The retrospective dimension of the analysis of education, health and productivity effects is presented below together with costs resulting from undernutrition.

### A. Social and economic cost of child undernutrition in the health sector

Undernutrition at an early age predisposes children to higher morbidity and mortality risks. 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), acute diarrheal syndrome (ADS) and fever/malaria associated with undernutrition in children under the age of five.

#### i. Effects on Morbidity

Undernourished children are more susceptible to recurring illness<sup>35</sup>. Based on the differential probability analysis undertaken with DHS data, <sup>36</sup> in Ethiopia, underweight children are more affected by anaemia (12% more), more from diarrhoea (5% more) and more from fever (4% more), than healthy children. Acute respiratory infections are also more common in underweight children, particularly for children between 12 and 24 months of life at an incremental rate of 6%.

The study estimated that in 2009 in Ethiopia, there were almost 4.4 million more episodes of illness related to diseases that could be associated to being underweight. The highest occurrence of episodes was found in ADS with 527,000 more episodes in underweight children, followed by anaemia with over 365,000 annual episodes.

In addition, pathologies related to calorie and protein deficiencies and low birth weight associated with Intrauterine Growth Restriction (IUGR), totalled more than 3.1 million episodes in 2009, and as indicated in Table III.I, acute and chronic illness due to diseases such as ADS, anaemia, fever and ARI, on the other hand, represents 1.3 million episodes annually.

<sup>35</sup> Ramachandran P. & Gopalan H., "Undernutrition & risk of infections in preschool children", Indian J Med Res 130, November 2009, pp. 579-583.

<sup>36</sup> Central Statistical Agency [Ethiopia] and ICF International. Ethiopia demographic and health survey 2011. Demographic and Health Surveys. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International, 2012 (and additional analysis).

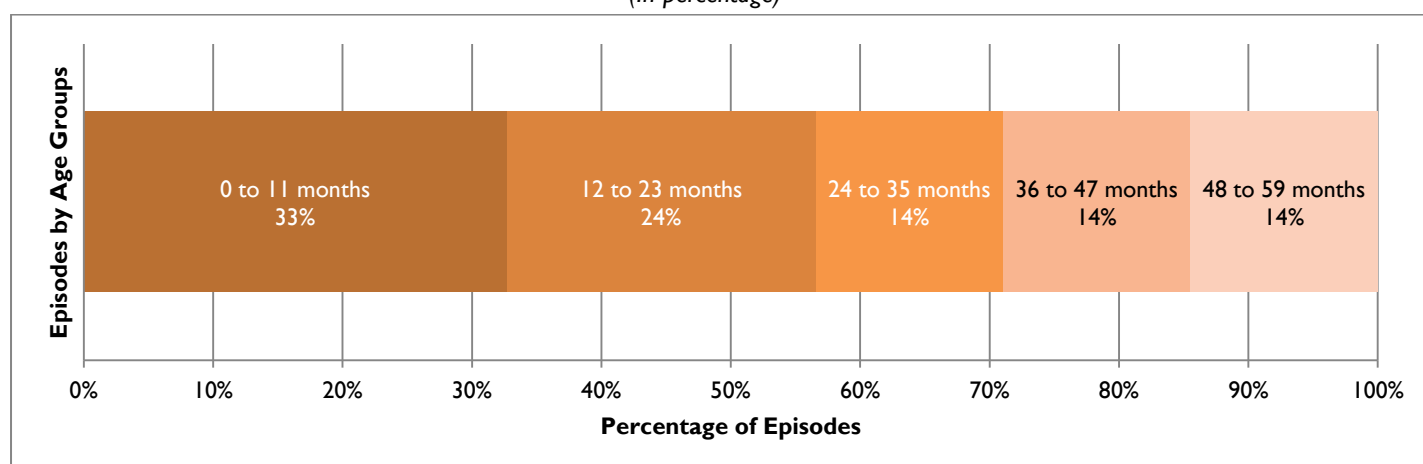
**TABLE III.I**  
**UNDER-FIVE CHILD MORBIDITY ASSOCIATED WITH UNDERWEIGHT, BY PATHOLOGY, 2009**

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

Source: Model estimations based on DHS 2005/2011, and demographic information.

Most episodes of incremental illness associated with 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 Ethiopia, 33% of all incremental episodes occur in children under 12 months, and 20% of these cases being associated with children born with low birth weight. 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 III.I.**  
**NUMBER OF INCREMENTAL EPISODES DUE TO UNDERNUTRITION BY AGE GROUP**  
(In percentage)



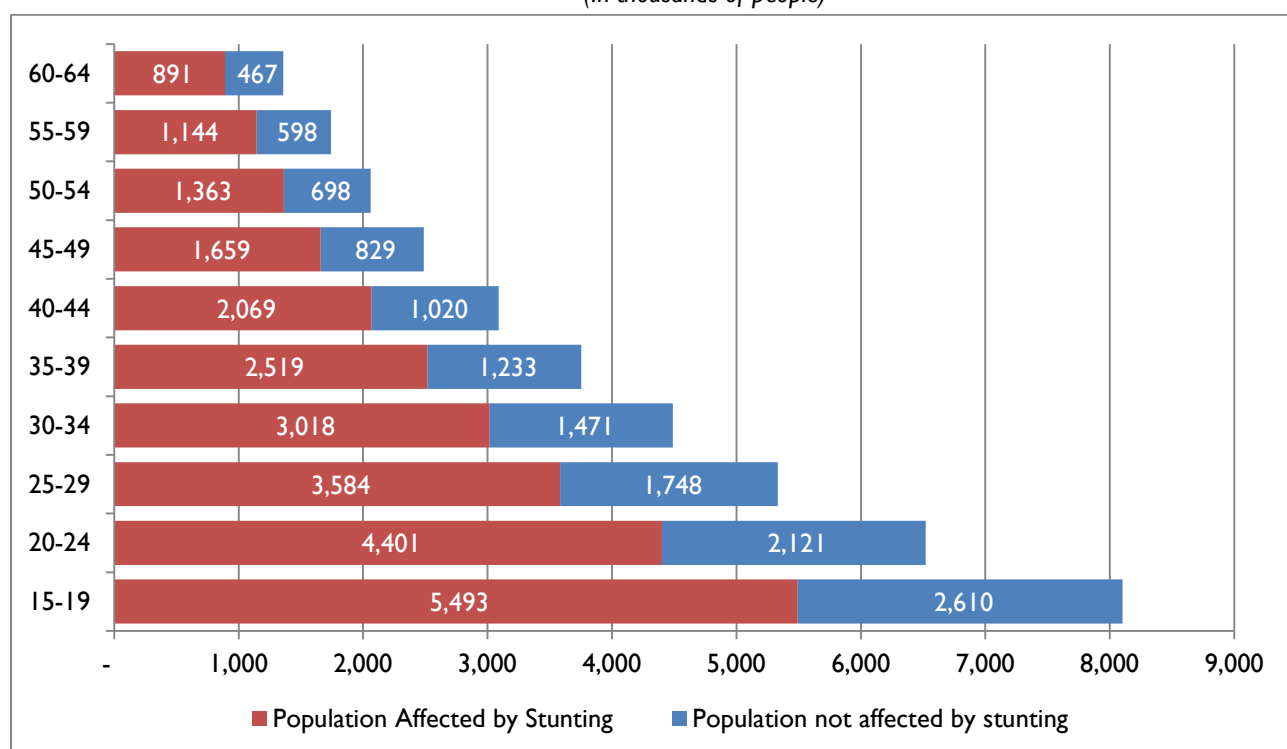
Source: Model estimations based on DHS 2005/2011, and demographic information.

The number of episodes is estimated based on the differential probability that a child has of becoming ill due to undernutrition. To estimate the costs of the pathologies, data from epidemiological follow-up studies and official health statistics for Ethiopia have been consulted. In addition, interviews with national specialists provided further information. A complete list of assumptions and sources has been annexed to this report.

## ii. 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<sup>37</sup>. 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 rates that reached more than half of the population before the year 2000<sup>38</sup>. As illustrated in Figure III.2, this analysis estimates that over 67% of the adult population in Ethiopia, aged 15-64, suffered from growth restriction before reaching the age of five. Currently this would represent more than 26.1 million people, who are in a disadvantaged position as compared to those who had healthy childhoods.

**FIGURE III.2**  
**WORKING-AGE POPULATION AFFECTED BY CHILDHOOD STUNTING, BY AGE**  
(In thousands of people)



Source: Model compilation based on EHICES 2010/11 and WHO.

According to data from the latest EHICES<sup>39</sup>, most of the working-age population in Ethiopia are involved in manual activities. The physical consequences of childhood stunting have affected these adults by reducing their productive capacity in manual intensive activities, as compared to people who were not affected by growth retardation as children. Additionally, the proportion of the population involved in non-manual activities, who was affected by undernutrition, tends to have a lower educational level and hence, a lower productive level than those who were nourished as children. The effect of these stunting levels on the productive capacity of the country will be analysed in the productivity section of this report.

## iii. Effects on mortality

Child undernutrition can lead to increased cases of mortality most often associated with incidences of diarrhoea, pneumonia and malaria<sup>40</sup>. 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<sup>41</sup> to

<sup>37</sup> K.G. Dewey and K. Begum, *Long-term consequences of stunting in early life*. *Maternal and Child Nutrition* (2011), 7 (Suppl. 3), pp. 5–18

<sup>38</sup> WHO Global Database on Child Growth and Malnutrition." WHO. Accessed March 13, 2013 <http://www.who.int/nutgrowthdb/en/>

<sup>39</sup> 2010/11 Ethiopian Households Income, Consumption and Expenditure Survey (EHICES). Report. Central Statistical Agency, 2012.

<sup>40</sup> Robert E. Black et al., "Maternal and child undernutrition: global and regional exposures and health consequences," *The Lancet* 371, No. 9608, 2008, doi:10.1016/S0140-6736(07)61690-0.

<sup>41</sup> *Ibid.*



estimate the risk of increased child mortality as a result of child undernutrition. Using these factors, abridged life tables<sup>42</sup> were used to estimate the incidence of higher mortality risk due to undernutrition.

The model estimates that in Ethiopia nearly 1 out of every 4 reported deaths of children is associated with undernutrition. As indicated in Table III.2, in the last 5 years alone, it is estimated that 378,000 deaths, representing 28%, occurred in children whose diminished nutritional condition increased their mortality risk. 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 III.2**  
**IMPACT OF UNDERNUTRITION ON CHILD MORTALITY, ADJUSTED BY SURVIVAL RATE, 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
<b>Total</b>	<b>4,521,818</b>

Source: ECA on the basis of life tables provided by UN Population Division<sup>43</sup> and Population data provided by CSA.

These mortality rates witnessed over the years have an impact on national productivity. The model estimated that an equivalent of 8.3% of the current workforce was lost due to the impact of undernutrition on child mortality from 1945 to 2009. This represents more than 3.2 million people who would have currently been 15 to 64 years old, and part of the working-age population of the country. In effect, besides this problematic reality, the findings suggest that undernutrition reduces the productivity and the development potential of the country.

#### iv. Estimation of public and private health costs

The treatment of undernutrition and related illness is a critical recurrent cost for the health system. Treating a severely underweight child for example, requires a comprehensive protocol<sup>44</sup> that is often most costly than the monetary value and effort needed to prevent undernutrition, especially when other diseases are present in parallel. 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 4.4 million clinical episodes in Ethiopia in 2009 were associated with the higher risk present in underweight children. As indicated in Table III.3<sup>45</sup>, these episodes generated an estimated cost of ETB 1.8 billion.

**TABLE III.3**  
**HEALTH COST OF UNDERNUTRITION-RELATED PATHOLOGIES, 2009**  
(In millions of ETB)

Pathology	Cost	% of episodes	% of Cost
LBW/IUGR	563	3%	31%
Anaemia	130	8%	7%
ADS	144	12%	8%

<sup>42</sup> Data provided by the UN Population Division, <http://www.un.org/esa/population/unpop.htm>.

<sup>43</sup> "World Population Prospects, the 2010 Revision," World Population Prospects, the 2010 Revision, accessed March 13, 2013, <http://esa.un.org/wpp/Model-Life-Tables/download-page.html>.

<sup>44</sup> WHO, *Management of severe malnutrition: a manual for physicians and other senior health workers* ISBN 92 4 154511 9, NLM Classification: WD 101, 1999.

<sup>45</sup> Estimations based of data provided by the National Implementation Team, DHS 2008, and cost analysis carried-out by NIT

ARI	61	3%	3%
Underweight	693	68%	38%
Fever/Malaria	231	6%	13%
<b>Total Cost</b>	<b>1,822</b>		

Source: Estimations based of data provided by the National Implementation Team, DHS 2006/2011, and cost analysis carried out by the NIT.

Most of these costs incurred were associated with the protocol required to bring an underweight child back to a proper nutritional status, which often involves therapeutic feeding<sup>46</sup>. An important element to highlight is the particular costs generated by the treatment of low birth weight children. These cases represented 3% of all the episodes but generated 31% of the total cost, making it the highest per capita element analysed. This is due to the special management protocol applied to LBW children; implying hospitalization and often requiring time in intensive care<sup>47</sup>.

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. 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.

An important 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%, but the effective coverage of the individual programmes is estimated to be much lower<sup>48</sup>. Of particular concern is data on the % of birth in proper health facilities, as about 85% of women deliver at home, and about one in three use traditional birth attendants while the others assisted by relatives and family members<sup>49</sup>. Addressing this important element might be a critical to continue reducing the child mortality rates in the country.

This 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 Table III.4, in Ethiopia it is estimated that families carry 90% of the costs associated with undernutrition, ETB 1.6 billion, while the public system carries 10% of the burden at ETB 185 million.

**TABLE III.4**  
**DISTRIBUTION OF HEALTH COST OF UNDERWEIGHT, 2009**  
(In millions of ETB)

Pathology	Cost to Families	Cost to System	Total Cost
Underweight	575	117	693
LBW/IUGR	563	1	572
Fever/Malaria	216	15	231
ADS	122	22	144
Anaemia	113	17	130
ARI	48	13	61
<b>Total Cost</b>	<b>1,646</b>	<b>185</b>	<b>1,831</b>
<b>Distribution of Cost</b>	<b>90%</b>	<b>10%</b>	

Source: Estimations based on data provided by DHS 2005/2011

<sup>46</sup> WHO. Management of severe malnutrition: a manual for physicians and other senior health workers. ISBN 92 4 154511 9 (NLM Classification: VD 101). 1999.

<sup>47</sup> WHO. Integrated Management of Pregnancy and Childbirth. ISBN 92 4 159084 X. 2009

<sup>48</sup> "MOH - Fact Sheets." MOH - Fact Sheets. Accessed March 15, 2013. [http://www.moh.gov.et/English/Information/Pages/Fact Sheets.aspx](http://www.moh.gov.et/English/Information/Pages/Fact%20Sheets.aspx)

<sup>49</sup> MOH – Maternal Health Services." MOH – Maternal Health Services. Accessed March 15, 2013. <http://www.moh.gov.et/English/Information/Pages/MaternalHealthServices.aspx>

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% of the total budget allocated to health. As a whole, the economic impact of undernutrition in health-related aspects is equivalent to 0.55% of the GDP of that year.

## B. Social and economic cost of child undernutrition in education

There is no single cause for repetition and dropout; however, there is substantive research<sup>50</sup> that shows that students who were stunted before the age of five are more likely to underperform in school. 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.

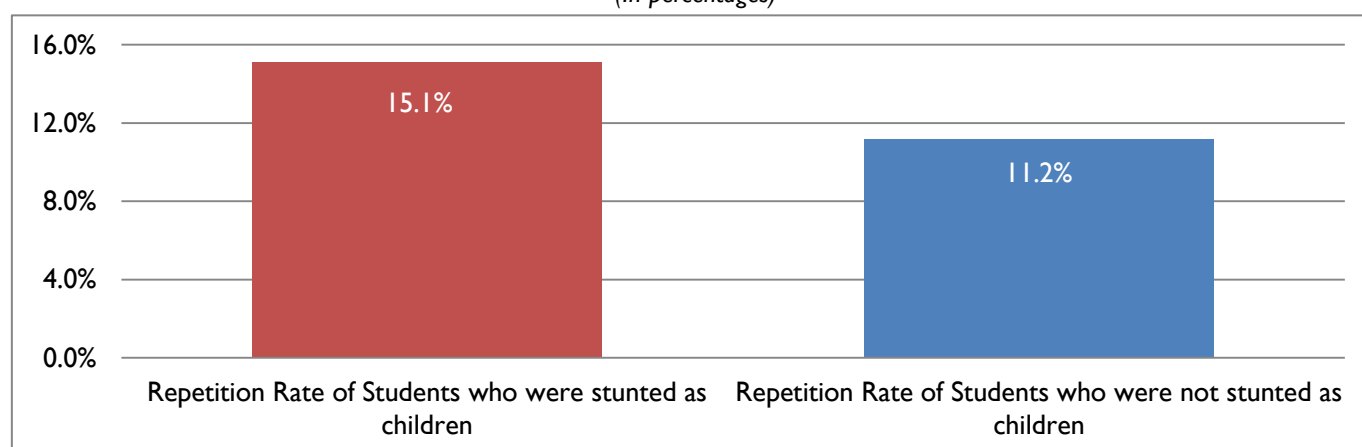
The number of repetition and dropout cases considered in this section of the report result from applying a differential risk factor associated to stunted children, as well as to the official government information on grade repetition and dropouts in the educational system in 2009. The cost estimations 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.

### i. Effects on repetition

Children who suffered from undernutrition before the age of five are more likely to repeat grades, compared to those were not afflicted by undernutrition.<sup>51</sup> Currently, an estimated 168,000 children of school age are stunted, which represents 40% of the total population aged between 6 and 18 years in the country.

Based on official information provided by Ministry of Education & Training (MOET)<sup>52</sup>, the effective average repetition rate in primary for public schools in the country was estimated at 15%, with 47,000 having repeated in 2009. Considering the higher risk of undernourished children to repeat grades, the model distributed the stunted and non-stunted school aged population and calculated the specific repetition rates for both groups. It is estimated that the repetition rate for stunted children was higher than the national average (18.9%), while the repetition rate for non-stunted children was estimated at 14%, establishing a differential risk of 4.9% for stunted children to repeat.

**FIGURE III.3**  
**REPETITION RATES IN PRIMARY EDUCATION, BY NUTRITIONAL STATUS, 2009**  
(In percentages)



Source: Estimations based on data provided by NIT from Ministry of Education, Education Statistics Annual Abstract 2008-09

<sup>50</sup>Melissa C. Daniels and Linda S. Adair, "Growth in young Filipino children predicts schooling trajectories through high school," *The Journal of Nutrition*, March 22, 2004, pp. 1439-1446, accessed September 11, 2012, Jn.nutrition.org.

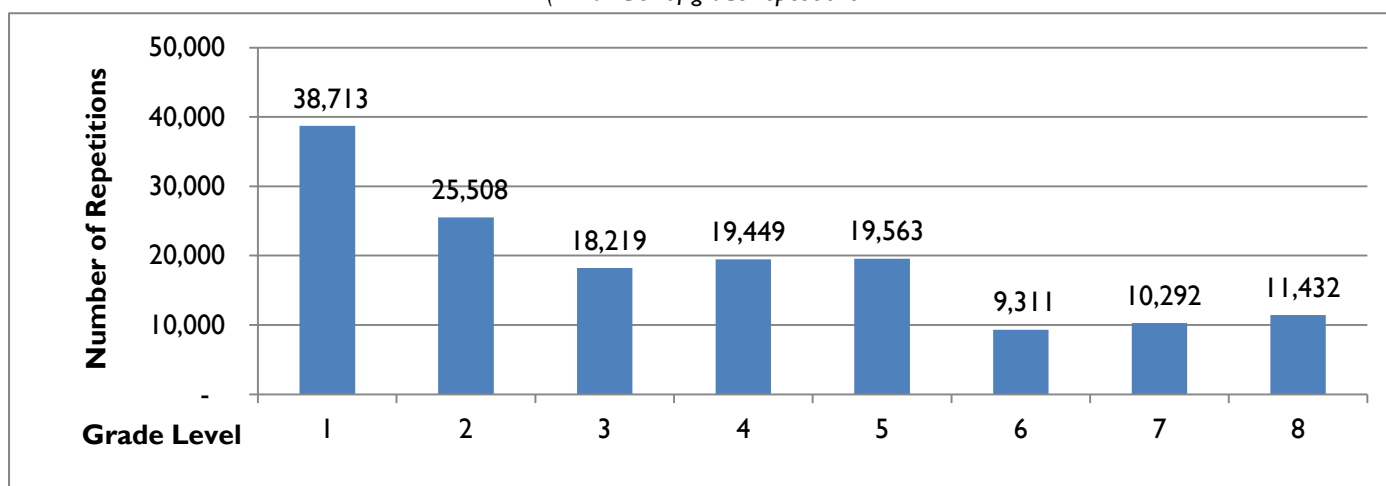
<sup>51</sup> Ibid.

<sup>52</sup> MOET planning data provided to the NIT.

As a result, from the 963 million cases of grade repetition reported in primary by the Ministry of Education in 2009, 152,000 (16% of all cases) are estimated to be repetition cases induced by stunting. These children are currently generating an incremental cost to the education system, as they require twice as many resources having to repeat the year. In addition, the caretakers also have to cater to their educational cost for an extra year.

As shown in Figure III.4, most of these grade repetitions happen during the first five years of schooling, particularly during 1st grade in which the highest rate of repetition is reported. Typically, there are far fewer children who repeat grades during secondary school; this is largely due to the fact that many stunted children would have dropped out of school before reaching secondary education.

**FIGURE III.4**  
**GRADE REPETITION OF UNDERWEIGHT CHILDREN, BY GRADE, 2009**  
(In number of grade repetitions)



Source: Estimations based of data provided by NIT (Ministry of Education – Education Management Information System for 2009)

#### i. Effects on retention

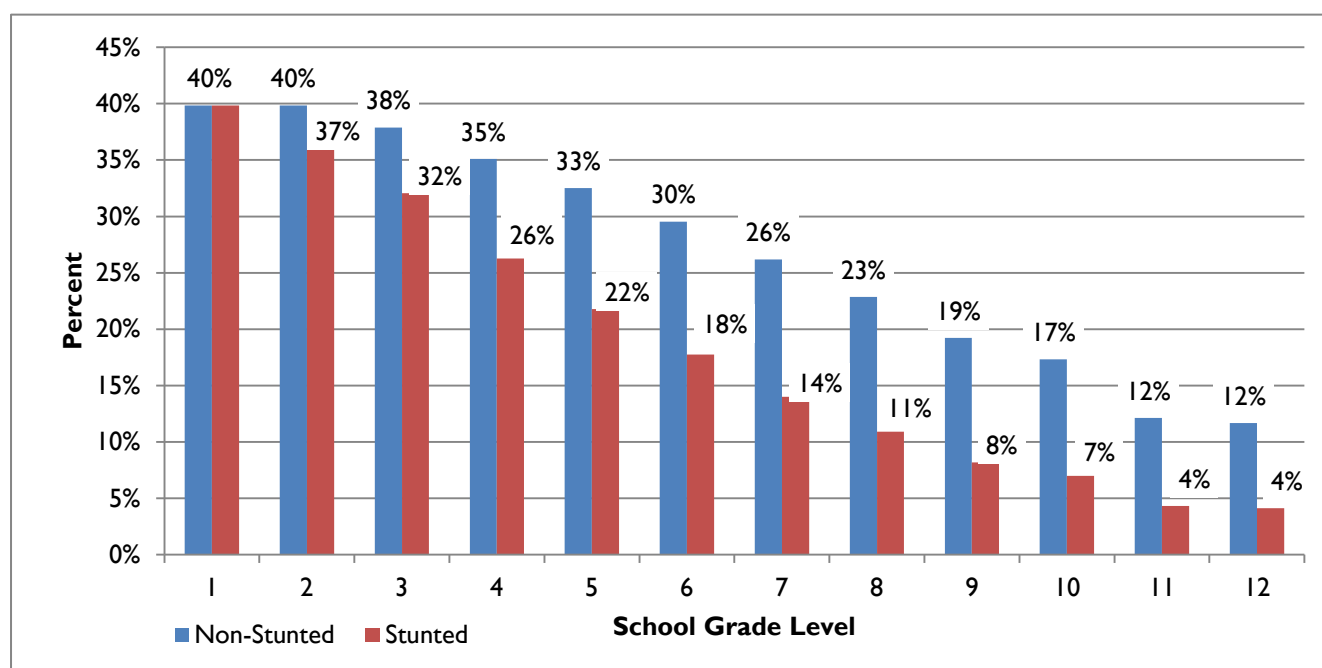
The cost associated with school dropouts is derived from the differential in achievements between stunted and non-stunted working-age population. These costs are reflected in the productivity losses experienced by individuals searching for opportunities in the labour market. As such, the impact is not evident in the school-age population but in the working-age population (WAP), particularly in non-manual activities. Hence, in order to assess the social and economic costs for 2009, the analysis needs to focus on the differential in schooling levels achieved by the population who suffered from stunting as children and the education levels achieved by the non-stunted population.

In 2009 in Ethiopia, enrolment rates have experienced an important expansion from with primary from 5.7 million to 17 million and secondary rising from 0.5 to 1.6 million<sup>53</sup>. Nevertheless, stunting still represents a barrier for the equitable provision of education in the country.

According to available data and relative risks of stunting on education, it can be estimated that 19% of non-stunted population completed primary school, compared to only 8% of stunted children. Similar trends exist for school completion, where an estimated 12% of non-stunted completed secondary school, while 4% of the stunted population completed secondary school. Figure III.5 shows the estimated grade achievement of the population, based on their nutritional status. These differences in education become notable when considering gaps in labour opportunities and income, specifically for non-manual labour.

<sup>53</sup> Ravishankar, V. J., Abdulhamid Kello, and Alebachew Tiruneh. *Adequacy and Effectiveness of Public Education Spending in Ethiopia*. Report. 2010.

**FIGURE III.5**  
**GRADE ACHIEVEMENT BY NUTRITIONAL STATUS, 2009**  
(In percentages)



Source: Estimations based from the EHICES 2010/11, Report. Central Statistical Agency, 2012

ii. 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 152,190 students who repeated grades following their state of being undernourished in primary level incurred a cost of ETB 93 million. 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, the per-pupil costs are higher in secondary than in primary education<sup>54</sup>. The following table summarizes costs.

**TABLE III.5**  
**COSTS OF GRADE REPETITION ASSOCIATED TO STUNTED CHILDREN, 2009**

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

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

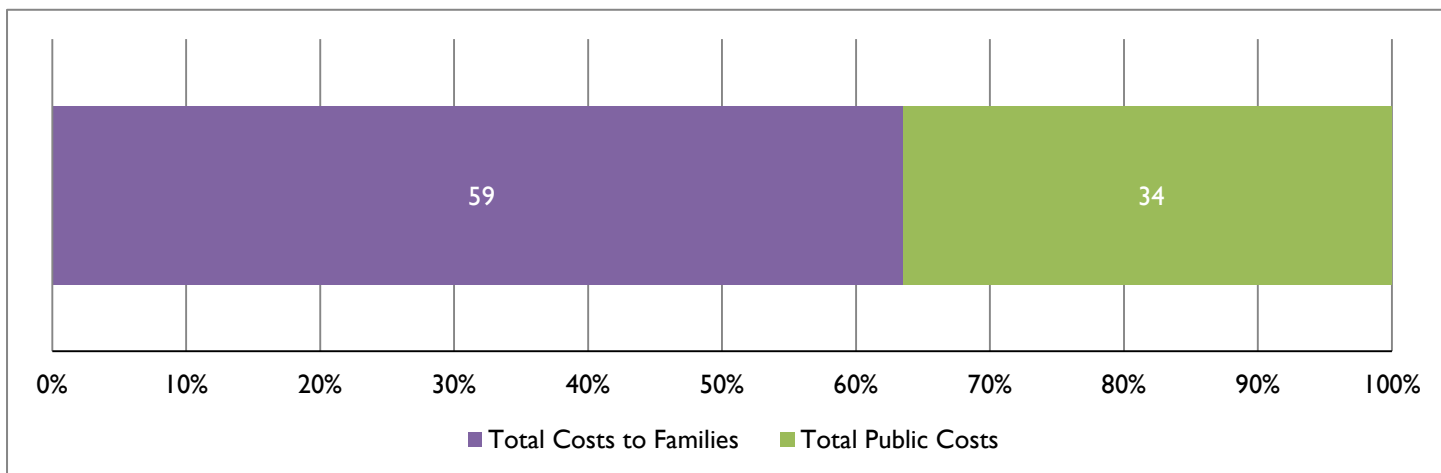
As in the case of health, the social cost of undernutrition in education is shared between the public sector and the families. As showed in Figure III.6, of the total costs, 64%, a total of ETB 59 million was covered by the care takers, while the other 36%,

<sup>54</sup> Ravishankar, V. J., Abdulhamid Kello, and Alebachew Tiruneh. *Adequacy and Effectiveness of Public Education Spending in Ethiopia*. Report. 2010.



ETB 34 million is borne by the public education system. There was no information available to carry-out a similar analysis for secondary education.

**FIGURE III.6**  
**DISTRIBUTION OF COSTS FOR REPETITIONS, PRIMARY EDUCATION**  
(In millions of ETB)



Source: Model estimations.

### C. The social and economic cost of child undernutrition in productivity

Child undernutrition affects human capital and productivity in several dimensions<sup>55</sup>. Children who suffered from undernutrition are more likely to achieve lower educational levels than healthy children. The low education levels attained, often makes them less qualified for work, thus reducing their income-earning potential for non-manual work. Adults who suffered from stunting as children tended to have less lean body mass and are therefore more likely to be less productive in manual intensive activities than those who were never affected by growth retardation. Moreover, the population lost in a country due to child mortality hinders economic growth, as they could have been healthy productive members of the society.

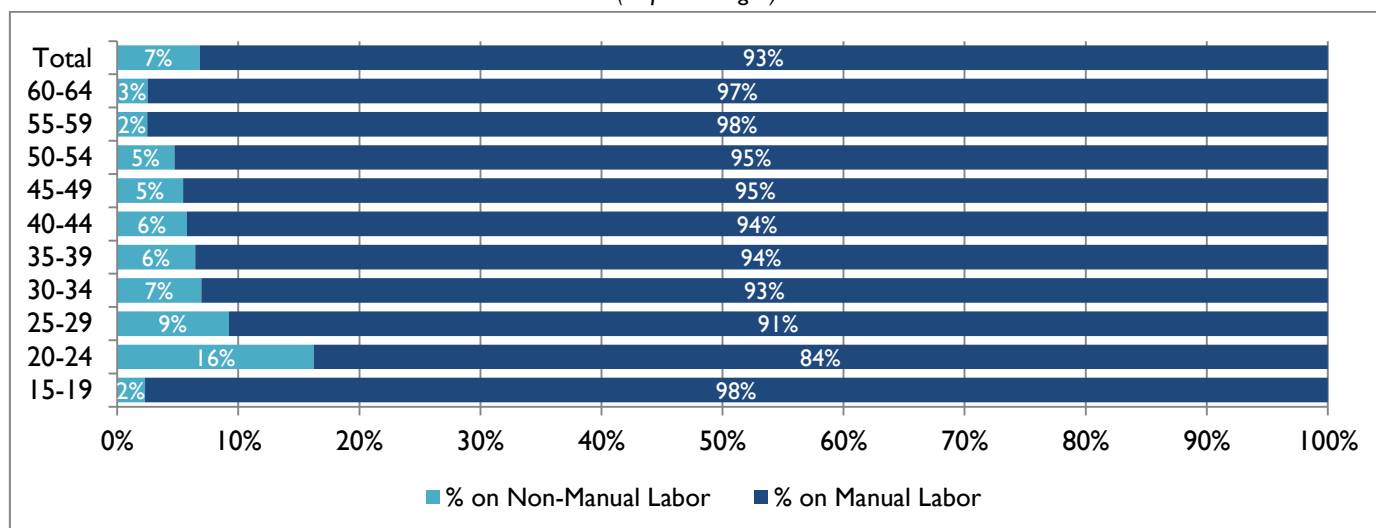
The estimation of the population whose labour productivity is affected as a consequence of child undernutrition is based on historical nutritional information, in-country demographics projections, and consumption reported in the EHICES 2010/11<sup>56</sup>. The workforce lost due to higher mortality risk of undernourished children is based on mortality rates estimated in the health section of this report.

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 intensive 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/she been part of the workforce in 2009.

#### i. Losses from non-manual activities due to reduced schooling

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 III.7, 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.

**FIGURE III.7**  
**MANUAL AND NON-MANUAL LABOUR DISTRIBUTION, BY AGE, 2009**  
(In percentages)



Source: Central Statistical Agency. Ethiopia Household Income, Consumption and Expenditure Survey (EHICES) 2010/11. Federal Democratic Republic Government of Ethiopia. 2012.

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

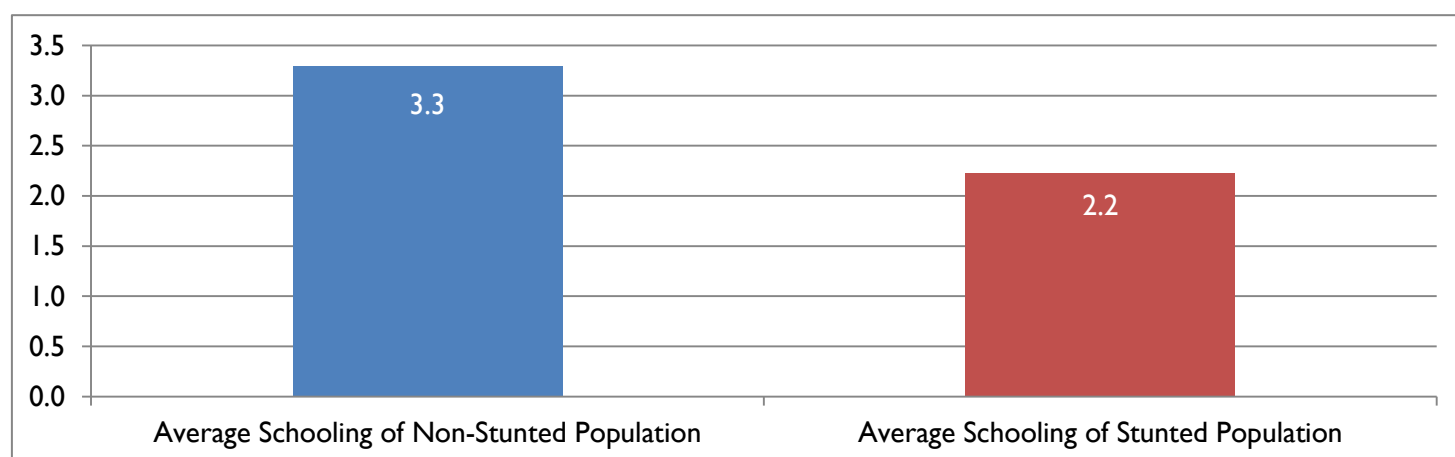
<sup>55</sup> Alderman H., et al. Long-Term Consequences of Early Childhood Malnutrition. FCND Discussion Paper No. 168 IFPRI, 2003.

<sup>56</sup> Central Statistical Agency. Ethiopia Household Income, Consumption and Expenditure Survey (EHICES) 2010/11. Federal Democratic Republic Government of Ethiopia. 2012.

activities, in which a higher academic education leads to improved income. In the case of Ethiopia, 7% of the working-age population are the population engaged in non-manual activities<sup>57</sup>. As showed in Figure III.8, the average schooling of the non-stunted population is estimated at 3.3 years, while people who suffered from childhood stunting achieved only 2.2 years.

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 show an average level of school education of 0.7 years, the cohort aged 20-24 shows an average of 4.4 years of education, demonstrating an important improvement of the educational level of the population.

**FIGURE III.8**  
**AVERAGE SCHOOLING YEARS FOR STUNTED AND NON-STUNTED POPULATION**  
(In years of education)



Source: Estimated from EHICES 2010/2011. CSA 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. For Ethiopia, the stunted population working in non-manual activities is estimated to represent 5% of the country's labour force. The estimated annual losses in income for this group, due to lower schooling are ETB 625 million, which are equivalent to 0.2% of the GDP in 2009.

**TABLE III.6**  
**REDUCED INCOME IN NON-MANUAL INTENSIVE ACTIVITIES DUE TO STUNTING, 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)
15-19	129.5	-
20-24	738.9	78
25-29	343.2	123
30-34	218.0	89
35-39	168.6	67
40-44	123.9	141
45-49	94.6	70
50-54	68.1	65
55-59	30.0	12
60-64	23.7	-
<b>Total</b>	<b>1,939</b>	<b>625</b>

<sup>57</sup> Central Statistical Agency. Ethiopia Household Income Consumption & Expenditure Survey (EHICE) 2010/11. Federal Democratic Republic Government of Ethiopia. 2012

Age in 2009	Population working in non-manual sectors who were stunted as children ( <i>In thousands of people</i> )	Income Losses in non-manual labour ( <i>In millions of ETB</i> )
<b>% GDP</b>		<b>0.2%</b>

Source: Model estimations based on income EHICES 2010/2011 CSA and DHS 2006/2011.

### ii. Losses in Manual Intensive Activities

Manual intensive activities, mainly in agriculture, employ more than 70% of the population. In this type of activity, people who were stunted as children are less physically capable than those who did not suffer from growth retardation. As such, they are expected to be less productive<sup>58</sup>.

The model estimates that 36.2 million Ethiopians work in manual activities, of which 24.3 million were stunted as children. This represented an annual loss that surpasses ETB 12.8 million, equivalent to 3.8% of GDP, in potential income lost due to lower productivity. (Table III.7).

**TABLE III.7**  
**LOSSES IN POTENTIAL PRODUCTIVITY IN MANUAL INTENSIVE ACTIVITIES DUE TO STUNTING, 2009**

Age in 2009	Population working in manual labour who were stunted as children ( <i>In thousands</i> )	Loss in productivity due to stunting ( <i>In millions of ETB</i> )
15-19	5,367	2,353
20-24	3,686	1,898
25-29	3,254	1,790
30-34	2,808	1,665
35-39	2,357	1,404
40-44	1,950	1,104
45-49	1,568	912
50-54	1,299	701
55-59	1,116	560
60-64	868	470
<b>Total</b>	<b>24,273</b>	<b>12,857</b>
<b>% GDP</b>		<b>3.8%</b>

Source: Estimations based on data from CSA/ EHICES 2010/2011 and WHO/NCHS Database information and relative risk information.

### iii. Opportunity cost due to higher mortality of undernourished children

As indicated in the health section of this report, there is an increased risk of child mortality associated with undernutrition. The model estimates that the 3.2 million people of working-age who could have been part of the economy in 2009 could have increased national productivity by over 4.8 billion 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 ETB 40 billion, which represented 1.9% of the country's GDP for 2009.

<sup>58</sup> Lawrence J. Haddad and Howarth E. Bouis, "The Impact of Nutritional Status on Agricultural Productivity: Wage Evidence from the Philippines," *Oxford Bulletin of Economics and Statistics* 53, no. 1 (February 1991), doi:10.1111/j.1468-0084.1991.mp53001004.x.

**TABLE III.8**  
**PRODUCTIVITY LOSSES DUE TO INCREMENTAL CHILD MORTALITY**  
(In millions)

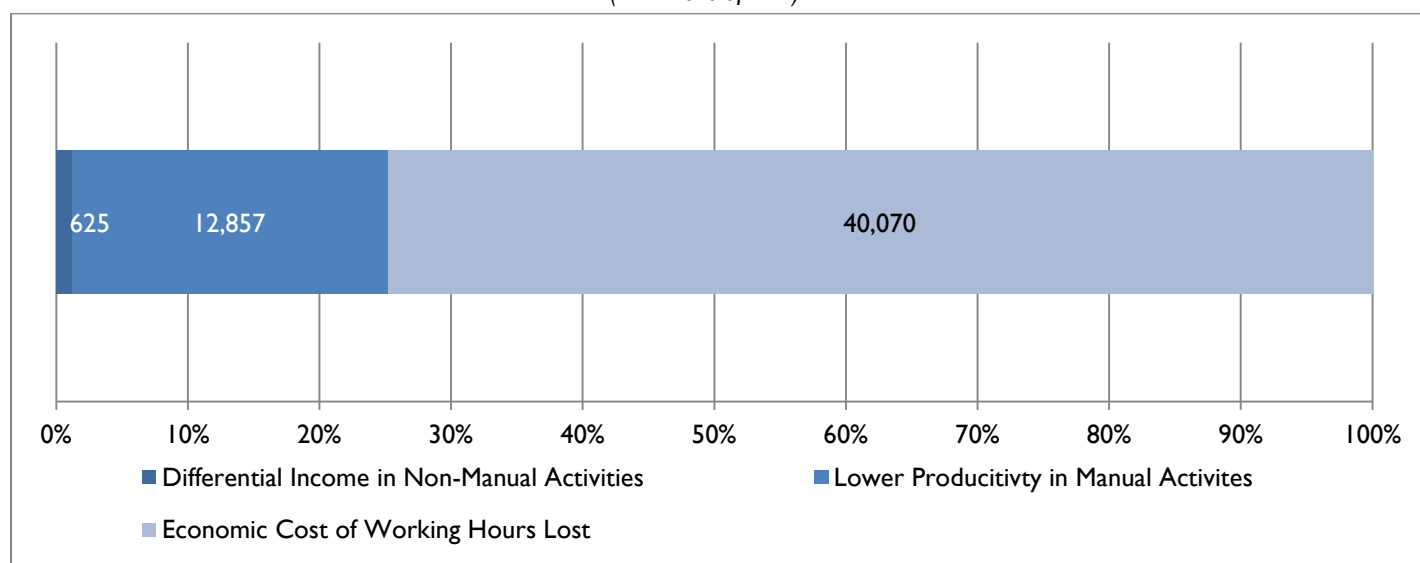
Age in 2009	Working hours lost due to higher mortality of underweight children (in millions of hours)	Loss in productivity (in millions of ETB)
15-19	623	4,412
20-24	575	4,827
25-29	587	4,736
30-34	531	4,780
35-39	482	4,399
40-44	435	3,640
45-49	387	3,497
50-54	389	3,269
55-59	389	3,124
60-64	389	3,387
<b>Total</b>	<b>4,786</b>	<b>40,070</b>
<b>% GDP</b>		<b>11.9%</b>

Source: Model estimations based on EHICES 2010/2011 and DHS 2005/2011.

#### iv. Overall productivity losses

The total losses in productivity for 2009 are estimated at approximately ETB 53.6 billion, which is equivalent to 16% of Ethiopia's GDP. Figure III.9, below, illustrates the distribution of losses. The largest share of productivity loss, amounting to 75%, is due to working hours lost from individuals who died, before reaching the age of five, due to high rates of undernutrition. Lower productivity in manual activities represents 24% 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% of the total productivity losses.

**FIGURE III.9**  
**DISTRIBUTION OF LOSSES IN PRODUCTIVITY, BY SECTOR, 2009**  
(In millions of ETB)



Source: Model Compilation.



## 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 Ethiopia, the total losses associated with undernutrition are estimated at ETB 55.5 billion, or \$US 4.7 billion for the year 2009. These losses are equivalent to 16.5% of GDP of that year. The highest element in these costs relates to the lost working hours due to mortality associated with undernutrition.

**TABLE III.9**  
**SUMMARY OF COSTS OF CHILD UNDERNUTRITION, 2009**  
(In millions)

	Episodes	Cost (in ETB)	Cost (in \$US)	Percentage of GDP
<b>Health Costs</b>				
LBW and Underweight	3,139,682	1,256	106.4	
Increased Morbidity	1,270,996	566	48.0	
<b>Total for Health</b>	<b>4,410,678</b>	<b>1,822</b>	<b>154</b>	<b>0.54%</b>
<b>Education Cost</b>				
Increased Repetition - Primary	152,488	93	7.9	
Increased Repetition - Secondary	0	0	0.0	
<b>Total for Education</b>	<b>152,488</b>	<b>93</b>	<b>7.9</b>	<b>0.03%</b>
<b>Productivity Costs</b>				
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	
<b>Total for Productivity</b>	<b>29,442,124</b>	<b>53,552</b>	<b>4,538</b>	<b>15.97%</b>
<b>TOTAL COSTS FOR ETHIOPIA</b>		<b>55,468</b>	<b>4,701</b>	<b>16.54%</b>

Source: Model compilation.



# Section IV: Analysis of Scenarios

# IV

## 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.

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 model generates a baseline that allows development of various scenarios based on nutritional goals established in each country using the prospective dimension. The generated outcomes can be used to advocate for increased investments in proven nutritional interventions. These scenarios are constructed based on the estimated net present value of the costs of children born in each year between 2009 and 2025. The methodology follows each group of children and, based on each scenario, estimates a progressive path towards achieving the set nutritional goals.

The scenarios developed for this report are as follows:

### 1. **Baseline. The Cost of Inaction. Progress in reduction of stunting and underweight child stops.**

For the baseline, the progress of 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.

### 2. **Scenario #1. Cutting by Half the Prevalence of Child Undernutrition by 2025.**

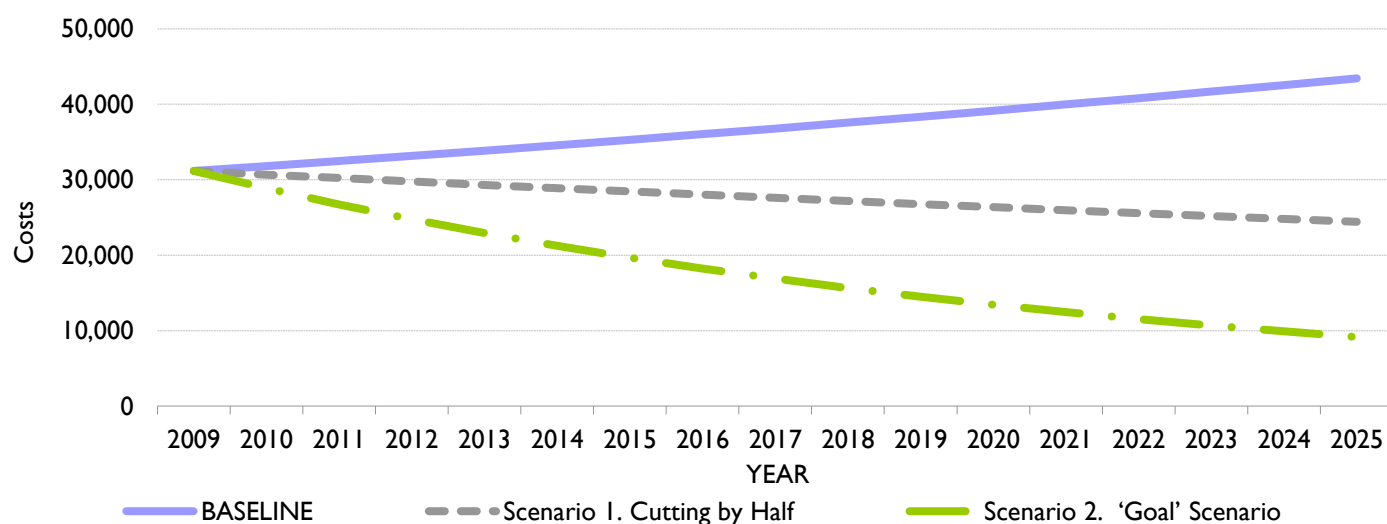
In this scenario, the prevalence of underweight and stunted children would be reduced to half of the 2009 values corresponding to the reference year. In the case of Ethiopia this would mean a constant reduction of 1.5% points annually in the stunting rate, from 46.4% (estimate for 2009) to 23.2% in 2025. 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%, which is close to the progress rate required in achieving this scenario.

### 3. **Scenario #2. The 'Goal' Scenario. Reduce Stunting to 10% and Underweight children to 5%, by 2025.**

In this scenario, the prevalence of stunted children would be reduced to 10% and the prevalence of underweight children under the age of five, to 5%. Currently, the global stunting rate is estimated at 26%, with Africa having the highest prevalence at 36%. This Goal Scenario, would require a true call to action, and would represent an important regional challenge in which countries of the region could collaborate jointly in its achievement. The progress rate required to achieve this scenario would be 2.3% annual reduction for a period of 16 years, from 2009 to 2025.

As shown in Figure IV.1, 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 in each scenario.

**FIGURE IV.1**  
**TRENDS OF ESTIMATED COSTS OF CHILD UNDERNUTRITION, 2009-2025**  
(In millions of ETB)



In the baseline, where the progress of reduction of child undernutrition would stop at the level of 2009, the total cost would increase by 39%, from ETB 31 to 43 billion, in the period leading to 2025. Nevertheless, in Scenario #1 in which a reduction of half of the current prevalence is achieved, the total cost would reduce 22% to ETB 24 billion. In the case of the Goal Scenario (Scenario #2), on the other hand, there would be a 71% reduction in the estimated costs to ETB 9 billion.

**TABLE IV.1**  
**ESTIMATED TOTAL COSTS OF CHILD UNDERNUTRITION, BY SCENARIOS, 2009**  
(In millions of ETB)<sup>a</sup>

	2009	Scenarios for the Year 2025		
		Baseline	S1. Cutting by Half	S2. Goal Scenario
<b>Health Costs</b>				
Increased Morbidity	959	1,337	605	418
<b>Education Cost</b>				
Increased Grade Repetition	66	92	46	20
<b>Productivity Costs</b>				
Lower Productivity in Non-Manual Activities	285	397	137	52
Lower Productivity in Manual Activities	3,466	4,834	2,417	1,042
Lower Productivity due to Mortality	26,379	36,785	21,232	7,640
<b>Total Costs</b>	<b>31,155</b>	<b>43,445</b>	<b>24,436</b>	<b>9,171</b>

Source: Model estimations

<sup>a/</sup> All values in net present values at an 8% social discount rate

The potential economic benefits of reducing undernutrition are a key element in making a case for nutrition investments. The reduction in clinical cases in the health system, lowered grade repetition and improved educational performance as well as physical capacity are elements that contribute directly to the national productivity.



As presented in Table IV.2, cutting undernutrition by half by 2025 would represent a reduction in costs of over ETB 70 billion, equivalent to \$US6 billion for the period of 16 years, from 2009 to 2025. Although the tendency of savings would not be linear, as they would increase over time with the achieved progress, a simple average of the annual savings would represent \$US376 million per year. In the case of the Goal Scenario, the savings would increase to ETB148 billion, or \$US 12 billion, which represent a simple average of \$US 784 million annually.

**TABLE IV.2**  
**ESTIMATED SAVINGS FOR EACH SCENARIO, 2009**  
(In millions of ETB)<sup>a/</sup>

	Cutting Undernutrition by Half by 2025	Goal Scenario
<b>Health Costs</b>		
Reduced Morbidity	2,825	3,753
<b>Education Cost</b>		
Reduced Grade Repetition	178	315
<b>Productivity Costs</b>		
Higher Productivity in Non-Manual Activities	1,048	1,583
Higher Productivity in Manual Activities	9,179	16,319
Increased Working Hours	57,688	126,054
<b>Total Savings</b>	<b>70,918</b>	<b>148,023</b>
<b>Total Savings in millions of \$US</b>	<b>6,010</b>	<b>12,544</b>

Source: Model estimations

<sup>a/</sup> All values in net present values at an 8% social discount rate

In addition to the scenarios presented, an additional analysis has been carried out for Ethiopia. The National Nutrition Plan has established a target of achieving 30% stunting by the year 2015. If this target were to be achieved, the model estimates that the annual average savings of this scenario would be an average of \$US106 Million, and would require a progress of 2.7% annually from the values estimated for 2009.

# Section V: Conclusions and Recommendations

# Conclusions and Recommendations

## A. Child Undernutrition: Implications for Ethiopia's Growth and Transformation Plan

The Cost of Hunger 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). This plan, that projects a sustained GDP growth of 11% to 15% 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 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% 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% 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 be 40% 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 3.9% higher repetition rate in primary school. As a result, 16% 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% 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 ETB 4.4 billion (\$US 376 million). An additional scenario shows that a reduction to 10% stunting and 5 % underweight for that same period could yield annual average savings of ETB 9.2 billion (\$US784 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.

## 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. This analysis was been presented in 2 dimensions:

### i. Recommendations for On-going Interventions

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 been 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 r 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 programs:** 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, **programs that address the nutritional needs of adolescents should be implemented.**

#### i. Addressing the bottlenecks that undermine the efficiency of existing interventions.

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 programs.
- This study encourages countries not to be content with “acceptable” levels of stunting; equal opportunity should be the aspiration of every country in 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% 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.







# Section VI: Annexes

# VI

## Annexes

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### Annex I. Glossary of Terms

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 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).
5. **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.
6. **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.
7. **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.
8. **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.
9. **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.
10. **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.
11. **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.
12. **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)

13. **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.
14. **Drop-out Rate per Grade:** Percentage of students who drop out of a grade in a given school year (UNESCO).
15. **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)
16. **Food insecurity:** Exists when people lack access to sufficient amounts of safe and nutritious food, and therefore are not consuming enough for an active and healthy life. This may be due to the unavailability of food, inadequate purchasing power, or inappropriate utilization at household level (FAO).
17. **Food vulnerability:** Reflects the probability of an acute decline in food access, or consumption, often in reference to some critical value that defines minimum levels of human wellbeing (WFP).
18. **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).
19. **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).
20. **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.
21. **Low Birth Weight (LBW):** A newborn is considered to have low birth weight when it weighs less than 2,500 grams(WHO)
22. **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)
23. **Mortality rate:** The proportion of individuals in a population that die in a given period of time, usually a year and usually multiplied by a 10th population size so it is expressed as the number per 1,000, 10,000, 100,000, individuals per year.
24. **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.
25. **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.
26. **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.



27. **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.
28. **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)
29. **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).
30. **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
31. **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).
32. **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.
33. **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.
34. **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).
35. **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).
36. **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.
37. **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.
38. **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 2. Methods and Assumptions

### Health Protocols and Prevalence Data

**Information about this annex:** The following information illustrates the variables used to estimate health costs. In most cases, values were the same across age groups.

**Methods:** 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.
  - Dr. Geset (Paediatrician),
  - Dr. Genet , GP,
  - Ms. Haimanot (Senior nurse) ,
  - Ms. Tewabech (Senior Nurse),
  - Ms. Semeles(Senior pharmacist)
  - Ms. Muluwork (nurse).
  - Ms. Muluwork, Finance and planning,
  - Mr. Mulgeta, Finance and Planning
  - Ms. Ashenfi , Associate researcher, EHNRI
  - Ms. Yonas , assistant researcher, EHNRI
  - Ms. Gemechu , assistant researcher EHNRI
- 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

## I. Number of Disease Episodes

Pathology	Methods	Data source	Assumptions
Anaemia	Cost of Hunger (COH) model; key informant interviews and expert consultations; WHO fact sheet	EDHS 201; expert Interviews	Moderate and severe cases were considered; averages were considered
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	Cost of Hunger (COH) model; key informant interviews and expert consultations; Review of secondary data/ hospital records	EDHS 201; expert Interviews	Given its a common symptom, all fevers were considered as Malaria
Underweight	Cost of Hunger (COH) model; review of secondary data; key informant interviews and expert consultations	Expert interview	Defined as moderate and severe, 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.

## 2. Average number of primary care visits per episode

Pathology	Methods	Data source	Assumptions
Anaemia	Cost of Hunger (COH) model; key informant interviews and expert consultations; Review of secondary data/ hospital records	DHS 2011; interviews; hospital records /OPD/	A child with anaemia will receive the full dosage of medications on the first visit to the hospitals and health facilities.
ADS			Each child with moderate ADS is treated on outpatient basis and given full dosage medications 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; health facilities have capacity to diagnosis and treat ARI
Malaria		DHS 2011; interviews with the malaria research team; hospital records /OPD/	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

Underweight		EDHS 2011; interviews with the health professionals (ICU); hospital records /OPD/	Considered children who have visited primary care as out-patients; considered follow-up visits of discharged hospitalized cases as new episodes
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### 3. Proportion of episodes requiring hospitalization

Pathology	Methods	Data source	Assumptions
LBW	Key informant interviews and expert consultations; review of secondary data	EDHS 2011; review of secondary data/ hospital records; interviews	Estimations were made based on the proportion of admitted cases out of total OPD
Anaemia		Interviews; hospital records/ IPD/	Severe cases were hospitalized; health facilities have the capacity to diagnose and treat anaemia
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		EDHS 2011; Interviews	All severe malaria cases were hospitalized; health facilities have capacity to diagnose and treat Malaria
Underweight		EDHS 2011; interviews	All severe cases were hospitalized; health facilities have the capacity to assess and manage underweight

### 4. Average number of days require for hospitalization

- Definition: When a child is hospitalized, what is the average number of days he/she will need to stay in the health facility for adequate care and treatment;
- Methods/Assumptions: the average number of days required for hospitalization estimated for each pathology. The average value was taken for this analysis.

## 5. Proportion of episodes requiring ICU

Pathology	Methods	Data source	Assumptions
LBW	Key informant interviews in the hospital and expert consultations; review of secondary data/ hospital records	EDHS 2011; hospital records; interviews	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.
Anaemia, ADS, ARI, Malaria		EDHS 2011; hospital records; interviews	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, and ADS with severe complications, but there are only a few hospitals with ICU services.
Underweight		Hospital records; interviews	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.

## 6. Average number of days required for ICU

- **Definition:** When a child is at the ICU either transferred from IPD or from delivery ward, what is the average number of days he/she will need to stay in the ICU for adequate care and treatment?
- **Methods/Assumptions:** According to the experts at the ICU, the average number of days for the LBW was assumed to be similar for all the pathologies.

## 7. Average waiting time spent at primary care

- **Methods/Assumptions:** Average waiting time to receive the OPD service/ diagnosis and treatment for all pathologies is two hours.

## 8. Daily Hours lost due to hospitalization

- **Methods/Assumptions:** When a child admitted in the hospital (IPD), at least one parent will spent the full day with that child.

### Costing Data

#### 1. Primary Care: Unit Cost per attention

- **Methods/Assumptions:** Labour costs/ Human resource costs of health care professionals at OPD and registration fees of patients were considered.

#### 2. Primary Care: Cost of medical inputs per event

Pathology	Methods	Data source	Assumptions
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LBW, Anaemia, ADS, ARI, Malaria	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	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 <sub>2</sub> was analysed considering the rate of utilization by the unit cost of the item
Underweight	Review of secondary data	CMAM	

### Costing Data – Assumptions

#### 3. Hospitalization: Daily cost of hospital bed (l)

- **Methods/Assumptions:** 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.

#### 4. Hospitalization: Cost of medical inputs per event (m)

- **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.

#### 5. ICU: Daily cost of hospital bed (n)

- **Methods/Assumptions:** 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.

#### 6. ICU: Cost of medical inputs per event (o)

- **Methods/Assumptions:** 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.

#### 7. Costs not covered by the health system (p)

- **Methods/Assumptions:** This includes all out of pocket expenses like registration card, lab tests, medicines, etc.

#### 8. % of Cases that Attend Health Services (q)

- **Methods/Assumptions:** This data was estimated based on data presented in the DHS Report for ‘seeking professional medical assistance’ or proxies.

### Variables for Education Section

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

Initial enrolment	Count of students/pupils as per admission forms	Annual Abstract 2001 E.C. /2008-09 G.C./ EMIS, Planning and Resource Mobilization
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	
<b>Education costs</b>		
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

#### **Variables for Productivity costing**

<b>Variable</b>	<b>Method</b>	<b>Data source</b>	<b>Assumptions</b>
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 each of the working-age individuals in the household	Central Statistical Agency. Ethiopia Household Income Consumption & Expenditure Survey (EHICE) 2010/11. Federal Democratic Republic Government of Ethiopia. 2012	Data on consumption will be a proxy for income productivity; 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		
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	Due to lack of specific data it is taken as a proxy of all activities

### **Annex 3. Brief Description of COHA 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.

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