Second edition

Achieving Zero Hunger

The critical role of investments in social protection and agriculture

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Contents

Foreword

The Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP) prepared new estimates on the additional investments required for sustainably ending hunger by 2030, in line with the highest aspirations of the post-2015 sustainable development agenda and the draft Addis Ababa Accord, which clearly states that "Our goal is to end poverty and hunger".

FAO, IFAD and WFP welcome this global commitment to end poverty, hunger and malnutrition by 2030. Our proposal on how to achieve zero hunger by 2030 is in the context of the proposed Sustainable Development Goal 2 to eliminate hunger and malnutrition by 2030, which, in turn, goes hand-in-hand with the proposed Sustainable Development Goal 1 to eliminate poverty at the same time. With almost 800 million people suffering from hunger and almost four-fifths of the extreme poor living in rural areas, it is necessary to raise agricultural and rural incomes to achieve those two priority Sustainable Development Goals.

The "dollar-a-day" extreme poverty line adopted for Millennium Development Goal (MDG) 1 monitoring purposes – was originally based on the estimated costs to meet basic needs, of which access to food was, by far, the most significant. Food expenditure generally ranges between 50 and 70 percent of the extreme poverty line income, depending on the country and context. The so-called dollar-a-day extreme poverty line was last adjusted by the World Bank in 2005 to US$1.25 a day in purchasing power parity terms.

Hence, the extreme poverty line is a reasonably good indicator of who goes hungry, although the poverty and hunger numbers differ due to the different data and methodological approaches used.

■ We can end poverty and hunger!

We can end poverty and hunger by 2030. But we will need a new approach that results in much higher level of resources mobilized towards hunger eradication than in a "business-as-usual" scenario. Such an approach combines public investment in social protection with public and private investment in productive sectors – especially in rural areas and, particularly, in agriculture.

More specifically, additional resources amounting to an annual average of US$265 billion per year during 2016–30, i.e. 0.3 percent of the average projected world income for that period, are required to fund both additional investment in social protection and additional targeted pro-poor investments in productive activities, of which rural areas would receive US$181 billion annually. This amount is well within the capacity of the international community to mobilize.

■ Agricultural investment and rural development

Increasing aggregate investment is expected to increase growth, employment and, thus, incomes. Well-designed and implemented investments for zero hunger will increase the productivity and incomes of small-scale producers by offering income-enhancing opportunities to the poor.

Of the US$265 billion additional average annual investment requirements, some US$198 billion will be for pro-poor investments in the productive sectors – US$140 billion for rural development and agriculture and US$58 billion for urban areas.

To eradicate extreme poverty and hunger sustainably, we need to boost both private and public investment, particularly in rural areas, to raise rural and agricultural productivity and incomes, and promote more productive, sustainable and inclusive food systems. Farmers themselves are the major source of investment in agriculture, but

policies and programmes, including credit and insurance, often discriminate against them, especially smallholder and other less well-endowed family farmers.

Most low- and middle-income countries are characterized by high unemployment and underemployment, with youth unemployment growing rapidly as economies adjust to new technologies and global market conditions while fiscal austerity poses constraints to the public sector and its role as potential employer.

■ Social protection

To break the vicious circle of poverty and hunger, people who are extremely poor and hungry have to be assisted – through well-designed social protection programmes that will enable them to quickly overcome extreme poverty and hunger.

From the total envelope of US$265 billion additional average annual investment requirements, some US$67 billion are needed for social protection programmes, of which US$41 billion will go to rural areas, where most of the poor live, and US$26 billion to urban areas.

Social protection is a powerful investment in human capacities and in the productive potential of the poor. Better nutrition raises productivity, and thus incomes, in both the short and long term. Social protection is not merely a handout resulting in increased consumption of goods and services. There is strong evidence that it also enhances productive capacities via increased investments in human and other forms of capital. It alleviates liquidity constraints and the resulting savings are deployed by the poor to strengthen their productive capacities and their incomes.

Thus, the combination of social protection and pro-poor investments will enable most of the poor to escape poverty and hunger sustainably. Other enabling factors (such as a conducive policy environment and political stability) are also needed, meaning that social protection and pro-poor investments are necessary, but not sufficient, to eradicate hunger.

As incomes increase due to targeted pro-poor investments in the productive sectors, there should be a corresponding decline in the amount of social protection needed.

■ Funding issues

The Third International Conference on Financing for Development, held in Addis Ababa in July 2015, aimed at ensuring that all countries, especially low-income countries, have the means to implement national policies and programmes to achieve their development objectives, including the post-2015 Sustainable Development Goals.

Currently, many low-income countries have limited possibilities to mobilize the substantial public resources needed to accelerate progress in hunger reduction towards hunger elimination. Therefore, their funding needs should be fulfilled through more generous international resource transfers than has been the case in the past quarter of a century, especially in the form of grants and low-interest instruments. International cooperation can also help to develop and share appropriate know-how on technologies and policies.

With the continued increase in greenhouse gas emissions, average temperatures and extreme weather events, efforts have to be made to address both adaptation to, and mitigation of, climate change. We intend to address these issues in the near future, especially in relation to agriculture and hunger reduction.

This technical report demonstrates that our proposal to end poverty, hunger and malnutrition is viable and affordable, provided that strong political will exists. This has been demonstrated in large and small countries, and also in middle income as well as poor countries.

We look forward to working with governments and the rest of the international community to ensure that hunger and poverty will be history by 2030.

José Graziano da Silva
FAO Director-General

Kanayo F. Nwanze
IFAD President

Ertharin Cousin
WFP Executive Director

Executive summary

Despite progress in recent decades, including the near achievement of the Millennium Development Goal (MDG) target of halving the proportion of hungry people in the world by the end of 2015, about 795 million people – or around one in nine – still suffer from chronic undernourishment (dietary energy deficiency), or hunger.

The eradication of hunger by 2030 is a target of Goal 2 of the new Sustainable Development Goals to be approved in September 2015 at the 70th Session of the United Nations (UN) General Assembly. Ending hunger is also in line with the Zero Hunger Campaign promoted by the UN Secretary-General, and closely linked to the Sustainable Development Goal 1 target to eliminate poverty by 2030. Governments in various regions have responded to the call of the UN Secretary-General and have committed to eradicating hunger and poverty.

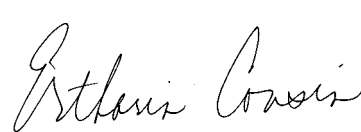To achieve zero hunger by 2030, the international community needs to build upon approaches and options that have proven effective, and that ensure continuous access to food for the undernourished and improve livelihood opportunities for the poor and hungry. This report presents new estimates on investments required to eradicate poverty and hunger sustainably by 2030.

To estimate the additional investment requirements, we begin with reference to a "business-as-usual" scenario. In this scenario, around 650 million people will still suffer from hunger in 2030. We then estimate the investment requirements to sustainably eliminate poverty and hunger by 2030.

The report specifically considers how poverty and hunger can be eliminated through a combination of investment in social protection and targeted pro-poor investments in productive activities.

Estimates of the additional annual investment requirements in this report were originally prepared for the Third International Conference on Financing for Development, which took place from 13 to 16 July 2015, in Addis Ababa, Ethiopia, and revised for the UN Summit for the adoption of the post-2015 development agenda and the UN General Assembly Debate in September 2015.

■ Social protection

Extreme poverty, hunger and some types of undernutrition can be rapidly eliminated with adequate social protection to close the poverty gap between earned incomes and the poverty line. The poverty line has been defined as the income necessary to meet all basic needs, including enough food to avoid hunger.

As there has been some discussion over the sufficiency of poverty line income, for the purposes of this work a 40 percent band above the extreme poverty line income of US$1.25/day, in purchasing power parity (PPP) terms, is used. Hence, the estimated additional income required to lift the poor out of poverty is calculated on the basis of US$1.75 rather than US$1.25 PPP per day.

■ Accelerating pro-poor growth

Additional investments in productive activities are required to catalyse and sustain higher pro-poor growth of incomes and employment than in the "business-as-usual" scenario. To be pro-poor, investments in urban and rural areas, including in agriculture, should be targeted so that the poor earn enough to overcome poverty by 2030. Progressively, as the incomes of the poor increase because of earlier pro-poor investments, the need for social protection to close the poverty gap declines.

Consequently, the cost of implementing such an approach involves the additional requirements of both social protection and productive investments while recognizing the implications of the higher incomes generated. First, the

average annual "gross poverty gap transfer (PGT)" from 2016 to 2030 – inclusive of a mark-up of 20 percent for administrative costs and leakages – is estimated. Second, the additional annual global investment requirements in productive activities are also estimated.

An average of US$265 billion per year during the period 2016–30 over and above the resources required for the "business-as-usual" scenario is estimated to be needed to fund the PGT for social protection and additional pro-poor investments to the raise earned incomes of the poor to the poverty line level by 2030. As the majority of the world's poor live in rural areas, they will benefit from the bulk of this amount, estimated at US$181 billion annually. Initially, the poor are expected to mainly earn incomes from wage work and their meagre productive assets (such as land), but are not expected to be able to invest much. To induce private investments, the additional investment required has to be adequately remunerated. Such remuneration is provided for in the calculations. However, as the poor save more, they are also able to invest more, and thus become more productive, and increase their earnings. Hence, public resource mobilization is key to both social protection and pro-poor investments in order to enable the poor to raise their earned incomes over the 15-year time period.

Both public and private investments can help to accelerate the poor's transition from reliance on social protection transfers through additional earned income from productive investments. While private investors, notably farmers themselves, are, by far, the largest source of investment in rural areas, investment in public goods – such as rural transport and other infrastructure as well as productivity-enhancing research, development and extension – will be necessary.

To summarize, hunger and extreme poverty can be eliminated quickly with adequate investments in social protection. However, sustained and sustainable poverty and hunger elimination requires a combination of social protection and pro-poor investments, which will quickly take people out of hunger and extreme poverty, and progressively raise the poor's earned incomes. Appropriate policies and coordinated programmes can ensure that the poor benefit from the growth and employment opportunities generated by the additional (public and private) investments.

However, low-income countries with higher incidences of poverty and hunger will find the resource requirements for such an approach beyond their means, and will need continuous external support until they can raise their domestic incomes and tax revenues sufficiently through growth and other policy reforms.

■ Appendices

Appendix 1 considers the additional investment requirements of an alternative economy-wide growth scenario above that of the "business-as-usual" scenario. This approach would require an additional US$1 470 billion per year, on average, between 2016 and 2030, of which about US$116 billion would go to agriculture. In this scenario, up to 5 percent of the population in countries requiring additional investments would still be unable to earn enough to overcome chronic hunger (or dietary energy deficiency or undernourishment) after 2030. The average annual costs of a "food deficit transfer" (FDT), i.e. the sum needed to meet the minimum dietary energy requirement (MDER), for the bottom 5 percent who are "left behind", are estimated at US$14 billion (including a 20 percent mark-up for administrative costs and leakages). A statistical table follows in Appendix 2.

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Acronyms and abbreviations

ADEC	average dietary energy consumption
BaU	"business-as-usual" [scenario]
CV	coefficient of variation
DEC	dietary energy consumption
FAO	Food and Agriculture Organization of the United Nations
FDT	food deficit transfer
GAPS	Global Agriculture Perspectives System [partial equilibrium model]
HLTF	High-Level Task Force on Global Food and Nutrition Security
ICOR	incremental capital output ratio
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
MDER	minimum dietary energy requirements
MDG	Millennium Development Goal
PGT	poverty gap transfer
PPP	purchasing power parity
SDG	Sustainable Development Goal
WFP	World Food Programme
ZHbotmea	zero hunger with social protection and pro-poor investments [scenario]
ZHtoinv	zero hunger with economy-wide investment [scenario]

Introduction

This report presents estimates of the additional investments required to eliminate world hunger, i.e. to achieve the objective of zero hunger worldwide by 2030, or eliminate the prevalence of undernourishment, defined as chronically inadequate dietary energy intake.

The report proposes a twin-track approach involving social protection transfers and targeted pro-poor investments in productive activities. On the one hand, investments in social protection programmes are expected to quickly lift people out of extreme poverty and hunger. Meeting the basic needs of the poor is presumed to include meeting their dietary energy needs. By also improving their nutrition, the poor's capacity to increase their productivity and incomes is also enhanced. This enables them to emerge from of a vicious circle of poverty, hunger and low productivity, to enter a virtuous circle of better nutrition, higher productivity and greater income generation. Such progress from "protection to production" will accelerate the reduction of poverty, hunger and malnutrition, contributing to realization of poverty and hunger elimination, the two most important Sustainable Development Goal (SDG) targets. At the same time, additional targeted pro-poor investments in productive activities are expected to enable higher income and employment growth for the poor. Thanks to these investments, the earned incomes of the poor will progressively rise, enabling them to permanently stay out of poverty by their own means.

This report is structured as follows: Section 2 frames the need for additional investments to eliminate poverty and hunger. Section 3 outlines the "business-as-usual" (*BaU*) scenario, to serve as the baseline reference for all estimates of additional resource requirements. Section 4 presents the main scenario, in which poverty and hunger elimination is achieved by investments in both social protection measures – to quickly take people out of poverty and hunger – and targeted pro-poor investments in productive activities (*ZHbotmea* scenario), to sustainably raise earned incomes in the longer term. Section 5 specifies the types of investments required and priority areas for resource mobilization focused on agriculture. Section 6 provides concluding remarks.

Appendix 1 considers an alternative scenario in which hunger elimination or zero hunger is achieved solely through investment in economy-wide growth (*ZHtotinv* scenario). This scenario is built using the same methodology employed by Schmidhuber and Bruinsma in 2011,[1] with food consumption projections obtained using the FAO global partial equilibrium GAPS model for country-based long-term projections of food demand and supply.[2] The FAO GAPS model is also used to estimate the food deficit transfer (FDT), i.e. the sum of transfers required to lift people "left behind" by the growth process (assumed to be the bottom 5 percent) out of undernourishment. Finally, a statistical table follows in Appendix 2.[3]

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[1] J. Schmidhuber and J. Bruinsma. 2011. Investing towards a world free of hunger: lowering vulnerability and enhancing resilience. *In* A. Prakash, ed. *Safeguarding food security in volatile global markets,* pp. 543–569. Rome, FAO.

[2] A. Kavallari, P. Conforti and D. van der Mensbrugghe. 2015 (forthcoming). *Global Agriculture Perspectives System (GAPS), Version 1.0*. ESA Working Report, Rome, FAO.

[3] This revised version responds to suggestions and comments on the original version of the report provided by colleagues. These comments underlined, *inter alia*, the need to: front-load and accelerate pro-poor productive investments; consider more plausible investment requirements per unit of additional income; better align assumptions about poverty incidence with the most recent figures provided by the *Global Monitoring Report 2014/2015* [World Bank and International Monetary Fund. 2015. *Global Monitoring Report 2014–2015. Ending poverty and sharing prosperity*. Washington, DC], while keeping in mind the undernourishment figures in *The State of World Food Insecurity 2015* [FAO, IFAD and WFP. 2015. *The State of Food Insecurity in the World 2015. Meeting the 2015 hunger targets: taking stock of uneven progress*. Rome, FAO]; and add an income buffer to ensure permanent exit from poverty in the face of temporary adverse conditions, to ensure better nutrition outcomes and to facilitate modest, but high-return investments.

Investing for development

■ Funding the post-2015 development agenda

The estimates of investments required to eliminate poverty and hunger support achievement of the Sustainable Development Goals (SDGs) to be adopted by the United Nations in September 2015. The Addis Ababa Action Agenda – the outcome document of the Third International Conference on Financing for Development, held in Addis Ababa from 13 to 16 July 2015 – identified, *inter alia*, the modalities for funding implementation of the post-2015 development agenda.[4]

■ Sustainably achieving zero hunger

The eradication of hunger and poverty are major targets of the SDGs. Eliminating hunger is a UN system-wide priority and the centrepiece of the Zero Hunger Challenge promoted by the UN Secretary General's High-Level Task Force on Global Food and Nutrition Security (HLTF). To achieve zero hunger by 2030, governments and the international community need to build on approaches that have already proved effective, which combine three important elements:

Ensuring food access. Promote immediate access to food and nutrition-related services to hungry people through social protection programmes, including transfers of food and/or cash to immediately relieve hunger and to increase human productive potential.

Increasing incomes. Create opportunities for the poor and hungry to improve their livelihoods with better labour conditions, and provide productivity-enhancing investments, e.g. in better infrastructure, market access, knowledge generation, and information and communications technologies.

Ensuring sustainability. Increase the sustainability of food systems by conserving natural resources and adopting sustainable agricultural practices. Reduce food waste and losses in production, storage and consumption; reduce greenhouse gas emissions in agriculture and other sectors, slow the pace of climate change and ensure the food security of future.[5]

■ Investing in agriculture

Investing in agriculture can effectively increase the productivity of agricultural labour and land. Productivity is a major determinant of farm incomes, thus contributing to

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[4] The world population, which was barely one billion at the beginning of the nineteenth century, is now more than seven billion two centuries later. While gross world product in 1800 was around US$175 billion, it is now almost US$76 000 billion [J.B. DeLong. 1998. *Estimating world GDP, one million B.C. – present*. Berkeley, USA, University of California at Berkeley; World Bank. 2014. Data Bank. Gross domestic product 2013]. Agriculture dramatically evolved during this period. For instance, wheat yields in Europe increased from around 1.2 tonnes per hectare in 1800 to around 7.0 tonnes per hectare today [D.B. Grigg. 1980. *Population growth and agrarian change: an historical perspective*. Cambridge, UK, Cambridge University Press]. Globally, in the last half century, cereal yields have more than tripled, helping to feed the fast-growing human and livestock populations.

However, this dramatic increase in the production of goods and services has progressively put under stress the capacity of the Earth to support human activities, hindering prospects for future development. "…Current policy, financing and investment patterns are not delivering the future we want … Some countries have fallen further behind, and inequalities have increased ... Shocks from economic crises, conflict, natural disasters, and disease outbreaks spread rapidly in our highly interconnected world. Environmental concerns, climate change and other global risks threaten to undermine past successes and future prospects" [United Nations. 2015. Zero draft of the outcome document of the third Financing for Development Conference, held in Addis Ababa, July 2015 (available at http://www.un.org/pga/wp-content/uploads/sites/3/2015/03/160315_ffd-zero-draft-outcome.pdf)].

Climate change is of particular concern for food security and nutrition, as it generally impacts already fragile ecosystems where most food-insecure people live.

[5] HLPE. 2012. *Food security and climate change.* A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome.

raising the living conditions of food insecure populations, e.g., by helping reduce pressure on scarce natural resources. Private agents, especially farmers, are, by far, the largest source of investment in rural areas. However, investment in

public goods – such as institution building, productivity-enhancing research, rural transport, health, education and social protection – is needed to ensure food security and nutrition as well as inclusive and sustainable development.[6]

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[6] FAO. 2012. *The State of Food and Agriculture 2012. Innovation in family farming.* Rome; FAO. 2015 (forthcoming). *The State of Food and Agriculture 2015. Social protection and agriculture: breaking the cycle of rural poverty.* Rome.

The baseline scenario to 2030: business as usual

To test the effectiveness of various measures envisaged to achieve zero hunger by 2030, we begin by building a scenario to reflect a "business-as-usual" (*BaU*) situation. This scenario provides projections of undernourishment to 2030 assuming that no significant changes in policies and actions to achieve zero hunger will be undertaken.

■ Measuring undernourishment

Dietary energy consumption (DEC) measures the dietary energy nourishment of people. The prevalence of undernourishment is the proportion of a population with a DEC below the minimum caloric intake required, known as the minimum dietary energy requirement (MDER).[7] An increase of the DEC of undernourished people that brings them above the MDER reduces the prevalence of undernourishment. The prevalence of undernourishment is calculated on the basis of three parameters: the average (per capita) dietary energy consumption (ADEC), the MDER, and an estimate of the coefficient of variation (CV).

■ The base year

To build the *BaU* scenario, we use the average for the 2005–07 period as the base year, the same base year used to anchor FAO projections on agriculture and undernourishment in the future.[8] In the base period, around 949 million people were undernourished,[9] the large majority of whom (828 million) were in 60 countries. These countries are expected to have missed the zero hunger target in 2030 if no effective interventions are taken, including substantial additional investments to those projected in the baseline scenario. The remaining undernourished people (120 million) were in 50 countries, which are expected to be on target to achieve zero hunger by 2030 (Table 1, first panel). Most undernourished people (920 million) were in low- and middle-income countries across five geographical regions, notably East Asia, Latin America and the Caribbean, the Near East and North Africa, South Asia and sub-Saharan Africa. The incidence of undernourishment was particularly high in sub-Saharan Africa (29 percent) and in South Asia (20.5 percent).[10]

■ "Business-as-usual" scenario to 2030

Food consumption projections suggest that by 2030, 653 million people will still be undernourished.

In the *BaU* scenario, the global world product is expected to grow at 2.4 percent per year to 2030. In the various regions, gross domestic product (GDP) is projected to increase at rates between 2.0 percent (in Latin America and the Caribbean) and 4.5 percent in East Asia (Table 2). The population in the five regions is expected to grow by an annual average of 1.1 percent between the baseline period and 2030.

The shift in GDP is expected to raise the ADEC from 2 619 to 2 857 kcal/person/day (+9.0 percent) in low- and middle-income countries (Table 1, second panel).[11] This should result in a decline in the prevalence of undernourishment to

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[7] FAO. 2015. *The State of World Food Insecurity in the World 2015. Meeting the 2015 international hunger targets: taking stock of uneven progress*, Annex 2. Rome. Referred to hereafter as *SOFI 2015*.

[8] N. Alexandratos and J. Bruinsma. 2012. *World agriculture towards 2030/2050: the 2012 revision*. ESA Working Report No. 12-03. Rome, FAO.

[9] Food consumption is distributed across the population according to calorie distribution functions calibrated on the prevalence of undernourishment reported in *SOFI 2015*. Due to calibration procedures to match the FAO GAPS model, which is calibrated on food consumption as in Alexandratos and Bruinsma, 2012 (see note 8), and the *SOFI* dataset, the undernourishment indicators obtained for the base year are only slightly different from the those reported in *SOFI 2015*.

[10] These figures are substantially aligned with the statistics reported in *SOFI 2015*. Some discrepancies are due to calibration procedures.

[11] The ADEC is not merely net caloric intake, but is a gross figure that includes a proportion allowing for food loss and waste.

TABLE **1**

Undernourishment in the base year and projections to 2030 in the *BaU* scenario

	Population	Minimum daily energy requirements	Average dietary energy consumption	Coefficient of variation of food distribution	Chronically undernourished people	
	(millions)	*(kcal/person/day)*			*(percent)*	*(millions)*
2005–07 (base year)						
WORLD	**6 568**	**1 846**	**2 769**	**0.297**	**14.45**	**949**
High-income countries	1 351	1 949	3 348	0.223	2.17	29
Low- and middle-income countries	5 216	1 819	2 619	0.317	17.63	920
East Asia	1 957	1 875	2 850	0.362	15.91	311
Latin America and the Caribbean	556	1 838	2 898	0.278	8.38	47
Near East and North Africa	432	1 832	3 007	0.285	8.34	36
South Asia	1 520	1 769	2 292	0.276	20.47	311
Sub-Saharan Africa	730	1 747	2 238	0.327	29.05	212
50 countries on target in 2030	2 626	1 886	3 122	0.243	4.59	120
60 countries not on target in 2030	3 941	1 819	2 534	0.333	21.02	828
25 worst-off countries*	492	1 752	2 062	0.373	39.81	196
2030 *BaU* scenario						
WORLD	**8 274**	**1 865**	**2 955**	**0.272**	**7.89**	**653**
High-income countries	1 437	1 941	3 425	0.217	1.12	16
Low- and middle-income countries	6 838	1 849	2 857	0.283	9.31	637
East Asia	2 247	1 878	3 133	0.327	7.79	175
Latin America and the Caribbean	682	1 872	3 091	0.258	3.96	27
Near East and North Africa	615	1 865	3 133	0.266	4.72	29
South Asia	2 016	1 825	2 587	0.245	9.31	188
Sub-Saharan Africa	1 245	1 812	2 528	0.288	17.36	216
50 countries on target in 2030	3 113	1 895	3 243	0.233	2.01	63
60 countries not on target in 2030	5 161	1 846	2 782	0.295	11.44	590
25 worst-off countries*	833	1 812	2 363	0.320	25.17	210

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.

Note: Numbers in the tables may not add up due to rounding.

Source: Calculations based on *SOFI 2015* and N. Alexandratos and J. Bruinsma. 2012. *World agriculture towards 2030/2050: the 2012 revision.* ESA Working Report No. 12-03. Rome, FAO.

TABLE **2**

GDP and investment in the "business-as-usual" scenario				
	GDP		**Annual GDP growth, 2016–30**	**Average annual investment, 2016–30**
	2005–07	**2030**		
	(US$ billions, constant 2013 prices)		*(percent)*	*(US$ billions, constant 2013 prices)*
WORLD	**56 263**	**101 131**	**2.41**	**15 989**
High-income countries	42 388	61 530	1.65	9 899
Low- and middle- income countries	13 875	39 601	3.80	6 090
East Asia	6 037	21 859	4.53	4 069
Latin America and the Caribbean	3 588	6 413	2.02	561
Near East and North Africa	1 881	4 334	3.34	549
South Asia	1 393	4 391	3.82	425
Sub-Saharan Africa	548	1 629	4.02	175
50 countries on target in 2030	49 820	76 654	1.83	12 045
60 countries not on target in 2030	6 443	24 476	4.63	3 944
25 worst-off countries*	273	793	4.03	75

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.

Source: Calculations based on N. Alexandratos and J. Bruinsma. 2012. *World agriculture towards 2030/2050: the 2012 revision.*
ESA Working Report No. 12-03. Rome, FAO.

9.3 percent.[12] However, this percentage remains high in sub-Saharan Africa and South Asia (at 17.4 percent and 9.3 percent respectively), and above the zero hunger target in four of the five regions.

The projections of undernourishment to 2030 in the *BaU* scenario clearly indicate that efforts are needed to increase food consumption for more than 650 million people who would otherwise remain undernourished.

In the following sections, this report explores a scenario (*ZHbotmea*) in which zero hunger can be achieved through a mix of investments in social protection and additional targeted "pro-poor" investments in productive activities, specifically in rural areas, where the great majority of the poor live.

An alternative scenario (*ZHtotinv*) is also explored for comparative purposes, notably the achievement of zero hunger through additional investment for economy-wide growth, complemented by financing to cover the remaining dietary energy gap for the bottom 5 percent presumed to be "left behind". The findings for this scenario are reported in Appendix 1.[13]

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[12] The drop of the coefficient of variation (CV) for the DEC distribution is obtained by keeping the standard deviation (SD) of the DEC distribution constant over time at its base year (2005–07) level for every country. As CV = SD / ADEC, the CV declines when the ADEC increases with a constant SD.

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[13] The three main approaches adopted so far to estimate the cost and related funding requirements for development goals are based on: 1) unit-cost-based analyses; 2) growth; and 3) computable general equilibrium (CGE) models (*European Report on Development 2015. Combining finance and policies to implement a transformative post-2015 development agenda*, pp. 68–69. Brussels, Overseas Development Institute [ODI], in partnership with the European Centre for Development Policy Management (ECDPM), the German Development Institute [Deutsches Institut für Entwicklungspolitik] [GDI/DIE], the University of Athens [Department of Economics, Division of International Economics and Development] and the Southern Voice Network). The approaches adopted here for the estimation of social protection fit in the first group while those for the estimation of additional investment requirements belong to the second.

A twin track approach for zero hunger: investing in social protection and in pro-poor development

This report assumes that hunger is essentially caused by a lack of entitlements or purchasing power, which, in turn, does not allow people to have access to sufficient and nutritious food. Therefore, hunger can be reduced or eradicated by enhancing the access of people to the means to buy and/or produce the food they need.

■ How much income is needed to exit hunger?

The basic premise is that people who are out of extreme poverty are also free from hunger. Therefore, assuming that the US$1.25/day PPP poverty line is a threshold for extreme poverty, each person who has an income of at least US$1.25/day is also free from hunger.

Based on this assumption, the additional per capita income needed to exit poverty is the additional amount of income required by the poor to overcome the US$1.25/day PPP poverty line, i.e. the so called "poverty gap". However, to ensure that people who exit poverty stay permanently out of poverty, some additional income is required as a buffer to deal with real income shocks, unforeseen expenditure needs and/or price spikes. Therefore, for the purposes of this report, the total amount of income required each year to keep everybody out of poverty is calculated on the basis of the absolute poverty line of US$1.25/day PPP plus a buffer of 40 per cent, i.e. US$1.75/day PPP.[14]

In the *BaU* scenario, both the poverty gap and the number of poor are projected to vary due to changes in national income as well as population and income distribution from 2016 to 2030.[15] Therefore, the additional income needed to take people out of poverty will also change. Table 3 presents the additional income required to take people out of poverty with respect to the *BaU* scenario by region, both in US$ terms (in constant 2013 prices) and as percentages of GDP for 2016, 2030 and, on average, from 2016 to 2030.

Figure 1 shows the required additional income needed to take people out of poverty worldwide for every year between 2016 and 2030. While per capita income growth reduces the proportion of the poor as well as the poverty gap, population growth will increase the additional income needed to exit poverty. The average income requirements from 2016 to 2030 are estimated at around US$145 billion (in constant 2013 prices).

FIGURE **1**

Additional average annual income required to keep people out of poverty

US$ billion, constant 2013 prices

Additional pro-poor income requirements

Annual 2016–30 average
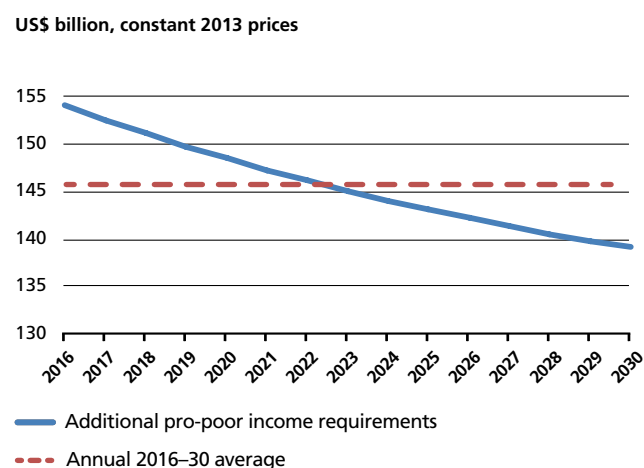
Source: Calculated based on *SOFI 2015* and the World Bank's PovcalNet.

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[14] This is much less than the US$2.00/day PPP poverty line, which would be adjusted to around US$2.50/day PPP following the last World Bank poverty line income adjustment. For a discussion on updating the international poverty line, see M. Ravallion, S. Chen and P. Sangraula. 2009. Dollar a day revisited. *The World Bank Economic Review,* 23(2): 163–184.

[15] The poverty gap and the number of the poor, calculated as total population times the percentage of the poor (prevalence of poverty), are estimated on the basis of country-wise log-normal distribution functions with reference to the poverty indicators in the World Bank's PovcalNet database and the undernourishment estimates in *SOFI 2015*. The annual income required at country level to keep people out of poverty is calculated as the poverty gap (as a percentage of the poverty line) times the poverty line plus the "buffer" times the number of poor people times 365.

TABLE **3**

Additional income required to keep people out of poverty						
	2016	**2030**	**Average, 2016–30**	**2016**	**2030**	**Average, 2016–30**
	(US$ billions, constant 2013 prices)			*(Percentage of GDP)*		
WORLD	**154**	**139**	**145**	**0.21**	**0.14**	**0.17**
High-income countries	3	2	2	0.01	0.00	0.00
Low- and middle-income countries	151	137	143	0.64	0.35	0.46
East Asia	16	6	10	0.13	0.03	0.06
Latin America and the Caribbean	8	7	7	0.16	0.11	0.13
Near East and North Africa	2	2	2	0.07	0.04	0.06
South Asia	47	35	41	1.81	0.81	1.20
Sub-Saharan Africa	78	86	82	8.30	5.29	6.56
50 countries on target in 2030	32	32	32	0.05	0.04	0.05
60 countries not on target in 2030	122	107	113	0.94	0.44	0.62
25 worst-off countries*	50	55	53	11.00	6.95	8.64

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.
Source: Calculated based on *SOFI 2015* and the World Bank's PovcalNet data.

■ Increasing incomes of the poor

In this scenario (*ZHbotmea*), two mutually reinforcing instruments are considered to provide the poor with additional income to take and keep them out of poverty, namely investments in 1) social protection, and 2) agriculture and rural development. The two instruments are combined so that:

a. universal exit out of poverty and hunger is achieved as soon as possible;

b. productive capacities and earned incomes of the poor due to investments progressively increase, particularly in rural areas; and

c. reliance on incomes received through social protection programmes progressively declines.

■ The role of investment in social protection

Achieving zero hunger as soon as possible requires quickly providing the poor with additional incomes so that they can achieve sufficient nourishment. At the beginning, a large proportion of the additional income needed to lift the poor out of poverty is provided through social protection to close the poverty gap (known as the poverty gap transfer or PGT). The estimated PGT enables the currently estimated number of extreme poor plus those barely above the extreme poverty line of $1.25/day PPP to avoid extreme poverty.

As there has been some discussion over the sufficiency of the poverty line income and the adjustments made over time to the original dollar a day line, we use a 40 percent band above the last individual extreme poverty line income of US$1.25/day PPP. This higher income of US$1.75/day PPP should also enable more diversified diets that should address at least some human nutrition needs besides dietary energy adequacy. Incomes above the bare minimum for human survival should also enable the poor to begin saving and investing modestly.

Evidence from income surveys used to estimate poverty incidence suggests that large numbers of people no longer deemed poor receive incomes barely above the US$1.25/day poverty line. Such people are especially vulnerable to falling below the poverty line. Additionally, concerns have been raised about the changing definitions and measures of the extreme poverty line, with frequent claims that price adjustments for basic needs items as well as the producer price index for petty producers in most economies are generally higher than adjustments of the overall consumer price index from which PPP price adjustments are derived.

For these reasons, the estimated PGT is calculated for the higher poverty line of US$1.75 /day PPP described above. The poor can be quickly brought to the US$1.75/day poverty line through the PGT, thus eliminating poverty and hunger fairly quickly.

TABLE **4**

Average annual poverty gap transfer and economy-wide investments in the *ZHbotmea* scenario, 2016–30					
	Poverty gap transfer		Additional investments		Poverty gap transfer	Additional investments
	Total	Rural	Total	Rural	Total	Total
	(US$ billions, constant 2013 prices)				(% GDP)	
WORLD	**67**	**41**	**198**	**140**	**0.08**	**0.23**
High-income countries	2	1	2	1	0.00	0.00
Low- and middle-income countries	65	40	195	138	0.21	0.63
East Asia	10	2	1	1	0.06	0.01
Latin America and the Caribbean	6	1	2	0	0.11	0.03
Near East and North Africa	2	1	0	0	0.05	0.01
South Asia	20	16	24	19	0.59	0.71
Sub-Saharan Africa	27	19	168	118	2.14	13.42
50 countries on target in 2030	16	8	41	30	0.02	0.06
60 countries not on target in 2030	51	33	157	110	0.28	0.86
25 worst-off countries*	17	12	109	73	2.82	17.82

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.
Note: Country-wise details are reported in Table A2 in Appendix 2.
Source: Calculated based on *SOFI 2015* and the World Bank's PovcalNet data.

Achieving this higher poverty line will permanently ensure access to basic food and other needs and enable more diverse and thus healthier diets that provide better access to micronutrients, trace elements, vitamins and minerals. Improving nutrition in the short and long term should enable poor people to engage more productively in economic activities, which will further improve their incomes. It has been shown that social protection increases investments by the poor. Therefore, more generous transfers would also enable the poor to save and invest parts of their income to improve their productivity. Savings and investment will allow poor people to transition from a vicious circle of poverty, hunger, and low productivity to a virtuous circle of income growth, better nutrition, higher productivity, greater resilience and lives of dignity.

The PGT, as designed in this scenario, is expected to shrink in subsequent years, due to the economic growth projected in the *BaU*, increased productivity and incomes due to better nourishment and the additional "pro-poor" investments in productive activities. However, in this scenario, it is assumed that 5 percent of the population will not benefit for various reasons, such as personal disability, health and socio-economic conditions, and will continue to need to meet their basic needs with social protection transfers.

The cost of the PGT includes the income to be transferred and a 20 percent mark-up for administrative costs and leakages (gross PGT). This amounts to US$67 billion per year, on average during the period 2016–30, with the bulk needed in low- and middle-income countries (Table 4).

Expenditure on social protection programmes typically invests in enhancing human capacities, with important positive effects on the productive potential of beneficiaries, including through improving the food and nutrition status of recipients. Social protection also helps overcome household liquidity constraints, enabling individuals and communities to engage in more profitable, but riskier, income- and employment-generating activities. The absence of social protection or other risk-sharing arrangements often forces poor rural households to cope in ways that increase their vulnerability further and undermines their future income generation capacity, e.g. by inadvertently encouraging short-term overexploitation of the natural resources they depend on.

■ **The role of investment in productive activities**

While additional income is to be provided quickly through social protection to overcome extreme poverty and

FIGURE **2**

Poverty gap transfer and pro-poor investments in the *ZHbotmea* scenario

US$ billion, constant 2013 prices

Total

US$ billion, constant 2013 prices

Rural

Additional earned income

Net PGT

PGT + Additional earned income

Required additional investment
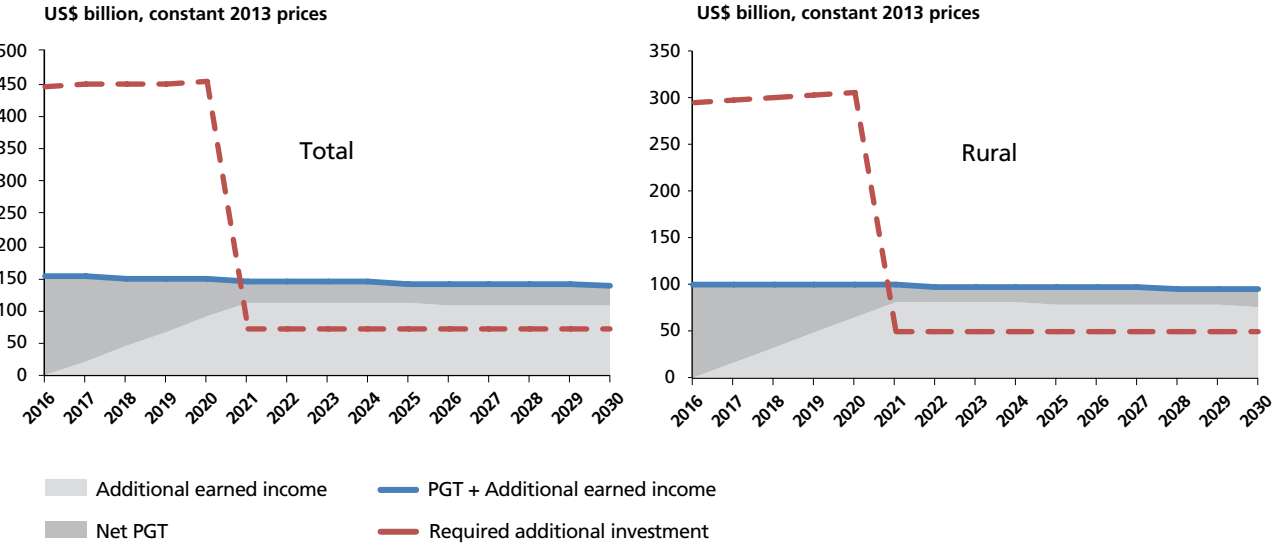
Source: Calculated based on from *SOFI 2015* and the World Bank's PovcalNet.

hunger, progressively higher earned incomes for the poor will come from additional investments in productive activities. Increasing earned incomes will enhance resilience and gradually reduce dependence on social protection transfers.

Additional annual investment requirements are calculated so as to generate the additional income that people have to progressively earn in order to stay permanently out of poverty, and so that social protection will no longer be needed after 2030, apart from transfers for the indigent population unable to earn their own incomes.[16] Globally, the average additional annual investments required between 2016 and 2030 amount to US$198 billion (Table 4, third column).

At the beginning, the bulk of additional investments, particularly the private component, will have to be provided by non-poor investors. Non-poor investors expect returns to their investments.[17] This implies that only a portion of the

income generated by additional investment will go to the poor. The remainder will remunerate other non-poor investors who would not invest otherwise.

Meanwhile, the extreme poor are initially expected to mostly earn incomes from labour remuneration with much less coming from returns to their modest productive assets (such as land). This implies that, at least in the initial stages, most of the share of income to remunerate capital will go to non-poor investors. However, as poor people themselves acquire the means to save and invest, they should progressively increase their earnings, not only from labour, but also from remuneration to the capital they manage to acquire.

[16] The investment requirements are calculated on an annual basis with reference to an incremental capital output ratio (ICOR), explained in more detail later, for the economy-wide investments in Appendix 1.

[17] Provision for the remuneration of capital provided by non-poor investors is derived from data based on historical country-specific capital-labour ratios. Phasing out the PGT and phasing in additional earned income »»

»» in this report are based on the assumption that the additional investments required would begin early, i.e. with a "big push" to pro-poor activities. However, the transition from transfer to earned income depends on country-specific capacities and possibilities to invest in pro-poor productive activities. Therefore, the amount of investment required and the corresponding average annual PGT reported in this report are merely indicative.

■ Investments in rural and urban areas

To the extent possible, income transfers and income-earning opportunities have to be provided to poor persons wherever they are. Currently, the majority of the extreme poor are in rural areas. This implies that a larger share of the total additional investments in productive activities should take place in rural areas.[18]

Therefore, of the total PGT of US$67 billion, US$41 billion will be for the rural poor. Also, of the total US$198 billion of additional investments, US$140 billion will be for rural areas. Table 4 provides annual averages for both the PGT and targeted pro-poor investments in productive activities, economy-wide and in rural areas, for the period 2016–30. The results for every year are shown in Figure 2.

■ Funding issues

Funding the PGT and pro-poor investments in productive activities may not be problematic for countries where the overall annual amount of these investments is a relatively small proportion of GDP and public expenditure, such as for selected countries in the Near East and North Africa, Latin America or East Asia. However, such investments may be not be affordable for some low-income countries, especially in sub-Saharan Africa and South Asia. A careful assessment of countries' "fiscal space" may be needed to explore the possibilities for domestic funding of these investments and other complementary social protection schemes.[19]

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[18] This scenario raises some questions: first, how will the investment rate be effectively and sustainably raised; second, how will the tendency for the agriculture sector investment rate to be lower than the overall investment rate be reversed; third, how will the tendency for the agriculture sector wage rate to be lower than the overall wage rate be reversed so as to exceed the poverty line income. Here, the role of the public sector and other institutions in creating opportunities for and protecting the poor becomes very important.

[19] ILO. 2014. *World Social Protection Report 2014/15. Building economic recovery, inclusive development and social justice*, pp. 149–153, Geneva, Switzerland.

Targeted pro-poor investment in rural areas: possible domains

■ **Pro-poor investment in productive activities**

In this scenario, if a progressive reduction of the PGT has to be realized, investment has to generate enough income to keep people out of poverty. Economic growth generated by pro-poor investment has to be inclusive, so as to provide opportunities for improving the livelihoods of the poor. Indeed, if hunger is to be overcome, additional investment in rural development and agriculture has to be geared to achieve economically, environmentally and socially sustainable development in domains that may be overlooked in a *BaU* scenario, but are crucial for hunger reduction and poverty alleviation.

A broad categorization of how agricultural capital stock is currently allocated among investment categories is reported in Table 5. The relative importance of each category varies across regions and countries.[20]

■ **Possible domains for additional investment in rural areas**

Part of the additional pro-poor investments required to generate income for the poor may fit within the broad categories of Table 5. However, as the basic objective of additional investments is to eliminate poverty and hunger, they have to offer opportunities for the poorer

TABLE **5**

Categories of capital stock in agriculture					
	Land development	**Machinery and equipment**	**Plantation crops**	**Livestock-related assets**	**Total**
	(percent)				
WORLD	**35.10**	**16.59**	**9.56**	**38.75**	**100.00**
High-income countries	31.10	36.82	4.47	27.61	100.00
Low- and middle-income countries	36.45	9.77	11.28	42.50	100.00
East Asia	33.33	10.51	13.63	42.53	100.00
Latin America and the Caribbean	27.73	7.99	7.80	56.48	100.00
Near East and North Africa	62.69	13.53	3.84	19.95	100.00
South Asia	44.35	9.22	7.41	39.02	100.00
Sub-Saharan Africa	26.88	3.56	9.47	60.10	100.00
50 countries on target in 2030	33.20	26.58	7.50	32.71	100.00
60 countries not on target in 2030	36.44	9.53	11.02	43.01	100.00
25 worst-off countries*	24.06	3.42	7.06	65.46	100.00

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.
Source: FAOSTAT 2015.

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[20] Allocation of investment for different purposes could be the subject of additional work.

and more vulnerable segments of the population to increase their incomes.

Table 6 allocates the average annual investment envelope for rural areas of low- and middle-income countries to possible investment domains, following Schmidhuber, Bruinsma and Boedeker (2011), Schmidhuber and Bruinsma (2011) and FAO (2010).[21]

This can consist of investment enabling and incentivizing sustainable smallholder activities, such as investment in agricultural research and development, vocational education and extension services, land and water management, and conservation.

Also, investment for rural development is crucial for creating additional rural income opportunities. Transport infrastructure, electricity and communication are key rural assets needed worldwide. Rural financial services facilitate access to credit and better management of rural household savings.

In rural areas, the development of off-farm employment opportunities will have synergies with agricultural development. On the one hand, additional agricultural investment could increase the capital stock available for sustainable agricultural production, increase the capital-labour ratio and ease structural changes.[22] On the other hand, investment in other rural sectors would develop employment opportunities likely to absorb the excess labour released by agriculture, should the structural transformation of the sector continue due, for example, to mechanization.

Investment in agriculture should enhance sustainable agricultural practices, including soil and water conservation, improved irrigation systems, greater water efficiency and preservation of biodiversity, as well as genetic improvements in agriculture, fisheries and forestry. Mechanization may also be required to increase agricultural productivity. At the same time, programmes with quick results, such as better access to inputs through a voucher scheme or other means for enhancing access, will be necessary.

Investments in agro-processing operations, such as milling cereals, extracting oil, ginning cotton, and storage and marketing facilities, should help reduce food losses and waste and, in turn, increase quality and food safety. This would also require food inspection services with trained staff, upgraded laboratories and expertise to design and monitor food safety standards.

Institution building, such as those for securing tenure rights, is also important for protecting the assets of the poor to encourage productivity increases. Research and development useful to improving the productivity of the poor are also essential.

■ Public and private investment

While the bulk of investment in agriculture in the *BaU* scenario is, and will be, carried out by private agents, especially by the farmers themselves, provision of certain goods and services requires public investment. There are several reasons why public investments are needed: 1) most needed goods and services are public goods in which private investors would not invest (e.g. rural roads); 2) the scale of investment is beyond the reach of private investors; 3) there are natural monopolies, such as irrigation systems, where only one network is desirable for efficiency reasons; and 4) returns may only materialize in a time frame unattractive to private investors. This additional public investment is expected to complement private investment, mostly provided by farmers and other entrepreneurs in the *BaU* scenario. Additional public investment is also expected to accompany diversification of income sources with the expansion of goods and services provided by agriculture.

As shown in Table 6, around 60 percent of the additional investment needed to enhance the incomes of the poor in rural areas are public investments. These include public facilities, such as transport infrastructure; services with economies of scale, such as research and development; or services normally provided by public authorities, such as land titling and tenure security.[23]

The self-reliance of countries in funding the additional investment required depends on their capacity to save part of their income and to allocate it to cover additional investment needs.[24] Public expenditures will require adequate revenue.

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[21] J. Schmidhuber, J. Bruinsma, and G. Boedeker. 2011. Capital requirements for agriculture in developing countries to 2050, pp. 317–343. *In* P. Conforti, ed. *Looking ahead in world food and agriculture: perspectives to 2050*. Rome, FAO; J. Schmidhuber and J. Bruinsma. 2011. Investing towards a world free of hunger: lowering vulnerability and enhancing resilience. *In* A. Prakash, ed. *Safeguarding food security in volatile global markets,* pp. 543–569. Rome, FAO; FAO. 2010. *Investing in food security* (available at https://www.responsibleagroinvestment.org/sites/responsibleagroinvestment.org/files/FAO_Investing%20in%20FS_2009.pdf).

[22] FAO. 2012. *The State of Food and Agriculture 2012. Innovation in family farming*. Rome.

[23] The shares of public investment reported in Table 6, given the limited information available, are based on expert judgement.

[24] Preliminary estimates of the capacity of countries to fund additional investments, by looking at their national gross savings rate as a percentage of GDP, are available.

TABLE **6**

Additional rural investment per investment domain and region (US$ millions, constant 2013 prices)

	East Asia	Latin America and the Caribbean	Near East and North Africa	South Asia	Sub-Saharan Africa	Total	Share	of which public	Share of public over total
	(US$ millions, constant 2013 prices)						(percent)	(US$ millions, constant 2013 prices)	(percent)
Improving primary agriculture and natural resources						**25 149**	**18.11**	**6 918**	**27.51**
Soil conservation	58	24	13	417	3 912	4 424	3.19	1 327	30.00
Water conservation/ improved irrigation	29	23	58	1 855	3 177	5 141	3.70	1 542	30.00
Preservation/improvement of crop genetic resources	31	25	19	154	692	921	0.66	276	30.00
Preservation/improvement of animal genetic resources	24	26	17	117	319	502	0.36	151	30.00
Preservation/improvement of fish genetic resources	129	38	20	288	1 428	1 903	1.37	571	30.00
Preservation/improvement of forest genetic resources	45	73	21	125	8 857	9 122	6.57	2 737	30.00
Mechanization	18	28	16	1 005	2 067	3 135	2.26	313	10.00
Improving agroprocessing operations						**19 494**	**14.04**	**4 984**	**25.57**
Cold and dry storage	16	25	17	695	2 721	3 474	2.50	695	20.00
Rural and wholesale market facilities	15	23	24	1 114	5 542	6 718	4.84	3 359	50.00
First-stage processing	36	37	33	1 982	7 213	9 302	6.70	930	10.00
Improving infrastructure:						**49 624**	**35.73**	**43 006**	**86.66**
Rural roads	73	115	55	3 768	29 057	33 067	23.81	29 760	90.00
Rural electrification	36	67	32	1 884	14 537	16 557	11.92	13 246	80.00
Improving institutional framework						**20 277**	**14.60**	**12 471**	**61.50**
Land titling, tenure security	8	28	14	321	3 490	3 861	2.78	3 475	90.00
Rural finance	36	50	32	1 877	12 451	14 446	10.40	7 223	50.00
Food safety related regulations (including veterinary and pest controls, crop inspections)	7	23	14	378	1 549	1 971	1.42	1 773	90.00
Improving research, development and extension						**24 350**	**17.53**	**21 915**	**90.00**
Research and development	30	38	24	1 254	5 251	6 597	4.75	5 937	90.00
Extension	45	56	38	1 882	15 731	17 753	12.78	15 977	90.00
Total	**637**	**699**	**449**	**19 116**	**117 993**	**138 894**	**100.00**	**89 294**	**64.29**

Source: Calculations based on J. Schmidhuber, J. Bruinsma, and G. Boedeker. 2011. Capital requirements for agriculture in developing countries to 2050, pp. 317–343. *In* P. Conforti, ed. *Looking ahead in world food and agriculture: perspectives to 2050.* Rome, FAO; J. Schmidhuber and J. Bruinsma. 2011. Investing towards a world free of hunger: lowering vulnerability and enhancing resilience. *In* A. Prakash, ed. *Safeguarding food security in volatile global markets* pp. 543–569. Rome, FAO; FAO. 2010. *Investing in food security.* Rome.

■ **Investment for zero hunger in a policy and governance context**

To produce maximum results, investment has to take place in a context where policies are conducive and stable. In addition to public goods, the public sector should ensure clear regulatory frameworks and stable institutions that reward entrepreneurship, mitigate risks, prevent and solve conflicts, create market opportunities and address market asymmetries and failures. For instance, the adoption of principles highlighted in the *Voluntary Guidelines on the responsible governance of tenure of land, fisheries and forests*[25] in national legislation can contribute to shaping a sustainable pro-poor investment climate. Also, adoption of Responsible Agricultural Investment (RAI)[26] principles and, more generally, the adoption of measures that maximize the domestic multiplier effects of investment and its benefits for the weaker members of society are most likely to speed up achievement of the zero hunger target. This has to be accompanied by stricter regulations and monitoring of child labour in agriculture,[27] as well as investment aimed at closing the gender gap in agriculture.[28]

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[25] FAO-CFS. 2012. *Voluntary Guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security.* Rome. FAO.

[26] FAO-CFS. 2014. *Principles for responsible investment in agriculture and food systems*. Rome, FAO.

[27] FAO. 2015. *Handbook for monitoring and evaluation of child labour in agriculture*. Rome.

[28] FAO. 2011. *The State of Food and Agriculture 2010–11. Women in agriculture: closing the gender gap for development*. Rome; A. Quisumbing, R. Meinzen-Dick, T.L. Raney, A. Croppenstedt, J.A. Behrman and A. Peterman, eds. 2014. *Gender in agriculture: closing the knowledge gap*. Rome, Springer for FAO and Washington, DC, IFPRI.

Further considerations and concluding remarks

"Hunger in a world of plenty is not just a moral outrage; it is also short-sighted from the economic point of view".[29]

This report presents new estimates for resources required to eradicate extreme poverty and hunger quickly, but also in a sustainable manner by 2030, consistent with the aspirations of the post-2015 sustainable development agenda. In the UN system, the Secretary General's High-level Task Force on Global Food and Nutrition Security (HLTF) has also focused on the Zero Hunger Challenge which, *inter alia*, seeks to eliminate poverty, hunger and malnutrition.

The SDG 2 to eliminate hunger by 2030 is paralleled by SDG 1 to eliminate poverty at the same time. The hunger estimates for MDG monitoring purposes involved chronic undernourishment defined in terms of dietary energy, i.e. carbohydrates, calories or joules. For MDG monitoring purposes, the dollar-a-day poverty line was adopted, which has most recently been adjusted to US$1.25/day PPP. For the purposes of this report, a 40 percent "buffer" has been added to ensure that people stay out of poverty and hunger.

Hence, ending poverty and hunger requires sustainably and permanently closing the "poverty gap". This will be done by providing the poor with additional transfer income and income-earning opportunities to stay above the extreme poverty line. Social assistance,[30] including transfers, should therefore ensure that basic consumption needs are met, as also implied by the UN General Assembly endorsement of the concept of a "social protection floor".

Since the UN General Assembly's commitment to establish a social protection floor for all, there have been important efforts to cost the creation of such a floor throughout the world, most notably by the ILO. The ILO estimates use national poverty lines, which are often lower for many low-income countries, but higher for some middle-income countries, as well as for all high-income countries.

This report addresses the challenge of achieving zero hunger by presenting an alternative scenario.[31]

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[29] FAO. 2002. *Anti-Hunger Programme. A twin-track approach to hunger reduction: priorities for national and international action*. Rome.

[30] Social protection, social assistance and other such terms have different meanings in different historical and cultural contexts. Use of the term in this report is consistent with ILO terminological usage.

[31] The scope of the present report can be further extended. This will include, for instance, the development of other scenarios, to take into account inequality in income distribution and other factors likely to affect agricultural productivity, such as climate change.

Climate change scenarios could be built, for instance, by assuming shifts in yields due to climate change. In the FAO GAPS model, yields are explicitly modelled as crop/livestock "own-price" functions, shifted by country and time-dependent coefficients. Downward shifts in yields through alternative vectors of yield shifters can be used to obtain alternative zero hunger climate change scenarios. Reduced yields are likely to be reflected in higher food prices and, consequently, in reduced purchasing power. This, in turn, is expected to lead to further investment requirements to achieve the zero hunger objective.

Scenarios reflecting greater (or lower) inequality in food distribution could also be simulated through alternative hypotheses regarding the CV for DEC. Last, but not least, the methodology described above only implicitly takes into consideration the multiplier effects that selected investments may have on domestic activities. This also applies to employment generation and related impacts on income distribution that specific investments may generate, and the impacts of growth on natural resource and environmental sustainability. Enlarging the scope of analysis to take into consideration these aspects requires: 1) applying a dynamic global economy-wide model that captures the relationships among investment, GDP, employment, income distribution and natural resources; and 2) exploring investment priorities needed to achieve specific economic, social and environmental sustainability objectives. All such extensions of the report would provide additional insights on investments required to eliminate poverty, hunger and undernutrition to 2030 and beyond. However, the work required is time and resource-consuming, and can only be completed over a much longer period.

While appreciative of the pioneering ILO work in this regard,[32] it departs from the ILO methodology by taking, as reference, the MDGs' US$1.25/day PPP poverty line for all countries, which may well exceed national poverty lines in low-income, some lower-middle income and other countries.

If effectively and efficiently delivered, social protection coverage can eliminate poverty and hunger quickly. Complementary investments in productive activities, for example in agriculture, will substantially reduce reliance on such income transfers with the acquisition of greater earned incomes, whether from wages, net production income or returns to other productive assets. However, this requires appropriate policies and institutions to ensure that the poor actually benefit from additional investment.

While investments can indeed increase growth, employment and incomes, including in agriculture, such gains are unlikely to be equally shared. Most agricultural investments are made by farmers, but rarely by the landless poor. Hence, public investments and policies must be clearly pro-poor and inclusive to decrease inequality and to eliminate poverty and hunger.

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[32] ILO has estimated the cost of a social protection floor (SPF) benefit package, i.e. the amount of money to be spent annually to ensure universal minimums for selected disadvantaged categories [ILO. 2015. *A global fund for social protection floors in least developed countrie*s. Informal note prepared by the ILO Social Protection Department as a technical input for preparations for the Addis Ababa Conference on Financing for Development, 13–16 July 2015].

This global estimate is based on the cost of: (i) a universal child benefit of 12 percent of a country's national poverty line; (ii) a benefit of 100 percent of a country's national poverty line to all orphans; (iii) a maternity benefit for four months, of 100 percent of a country's national poverty line to all mothers with new-borns; (iv) unemployment support of 100 percent of a country's minimum wage to one person per vulnerable household for 90 days; (v) a benefit of 100 percent of a country's national poverty line to all persons with severe disabilities; and (vi) a universal pension of 100 percent of a country's national poverty line. All these include administrative costs. »»

»» These costs, as average shares of GDP, range between 1.9 percent for East Asia to 7.6 percent for the poorest countries, with an average of 3.1 percent of GDP for all low- and middle-income countries. (The aggregate percentages are own calculations. For countries without data, shares of similar countries or regional averages were assumed. ILO does not report data for the high-income countries.)

The costs and benefits of the PGT are different from the ILO SPF, as the targeted people and measures are different. While our PGT uses a US$1.75/day PPP poverty line buffer, the SPF has several "universal" components with the costs of transfers calculated on the basis of national poverty lines. However, significant complementarities exist between the PGT and the SPFs. On the one hand, full implementation and realization of the SPFs will leave less room for addressing poverty and hunger. On the other hand, if implementation and realization of nationally defined social protection floors is to be achieved progressively, "temporary interventions could still be required" [from comment on the zero draft of this report by ILO]. While investment in agriculture and rural development will reduce the need for the PGT to 2030, effective SPFs can replace it.

Appendix 1. **Achieving zero hunger by investing in economy-wide growth**

I n the *ZHtotinv* scenario presented in this appendix, zero hunger is to be achieved through an economy-wide increase of GDP generated by investment.

■ Investment to reduce undernourishment

The methodology to calculate the investment required to achieve zero hunger by 2030 hinges on the relationships between investment, output or GDP and the level of dietary energy consumption (DEC), on the assumption that hunger is mainly caused by poverty (lack of purchasing power). Additional investment, in agriculture and all other sectors of the economy, is expected to raise GDP. The GDP's upward shift increases per capita income, which should lead to an upward shift in per capita food consumption and, consequently, in average dietary energy consumption (ADEC), measured in kilocalories/person/day.[33] It is also assumed that DEC is distributed across the population so that an increase in ADEC benefits all strata of the population. We assume that variability in the distribution of DEC across the national population is captured by an estimate of the coefficient of variation (CV) of the distribution.[34]

Figure A1 sketches the causal relationships implied by the proposed methodology to estimate the investments in agriculture required to achieve the zero hunger target by 2030.

An appropriate upward shift of investment in the whole economic system is expected to lead, through the above-mentioned causal relationships, to the elimination of the prevalence of undernourishment. The objective of this methodology is to determine the appropriate additional investment in agriculture (and the rest of the economic system) required to achieve "zero" prevalence of hunger in each country where undernourishment is projected to prevail until 2030. However, we also assume a minimum threshold of undernourishment, below which it is not possible to go simply by means of growth or GDP expansion. Here, we adopt a prudent threshold of 5 percent of the population, compared with the 3 percent used by Schmidhuber and Bruinsma.[35]

■ Scenario "zero hunger with economy-wide investment" (*ZHtotinv*)

To determine the additional investment required above the expected investment in the *BaU* scenario, the investment required to achieve the zero hunger target in 2030 in the so-called zero hunger (*ZHtotinv*) scenario is compared with the *BaU* scenario.

The *BaU* scenario offers projections up to 2030, reported in the last FAO long-term projections for world agriculture to 2030 and 2050. The *ZHtotinv* scenario is instead built by using, in reverse, the causal relationships described in Figure A1 (with the backward arrow ← referring to requirements):

> *Change in prevalence of undernourishment (targeted to be zero) ← change in food intake of undernourished people ← change in average (per capita) dietary energy consumption (ADEC) ← change in per capita food expenditure ← change in expendable per capita income ← change in per capita GDP ← change in GDP ← change in investment.*

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[33] Higher demand for agricultural and food products will imply, *inter alia*, increasing levels of agricultural value added, rising with agricultural investment. This entails multiplier effects, which are implicitly accounted for using the incremental capital-output ratios in this methodology.

[34] This approach essentially relies on the "trickle-down" of growth, i.e., it is assumed that the growth of per capita GDP will also benefit the poor and undernourished. See N. Kakwani, S. Khandker, and H.H. Son. 2004. *Pro-poor growth: concepts and measurement with country case studies.* International Poverty Centre Working Report No. 1. Brasilia, UNDP.

[35] J. Schmidhuber and J. Bruinsma. 2011. Investing towards a world free of hunger: lowering vulnerability and enhancing resilience. *In* A. Prakash, ed. *Safeguarding food security in volatile global markets*, pp. 543-569. Rome, FAO.

FIGURE **A1**

Causal relationships linking investment with the prevalence of undernourishment
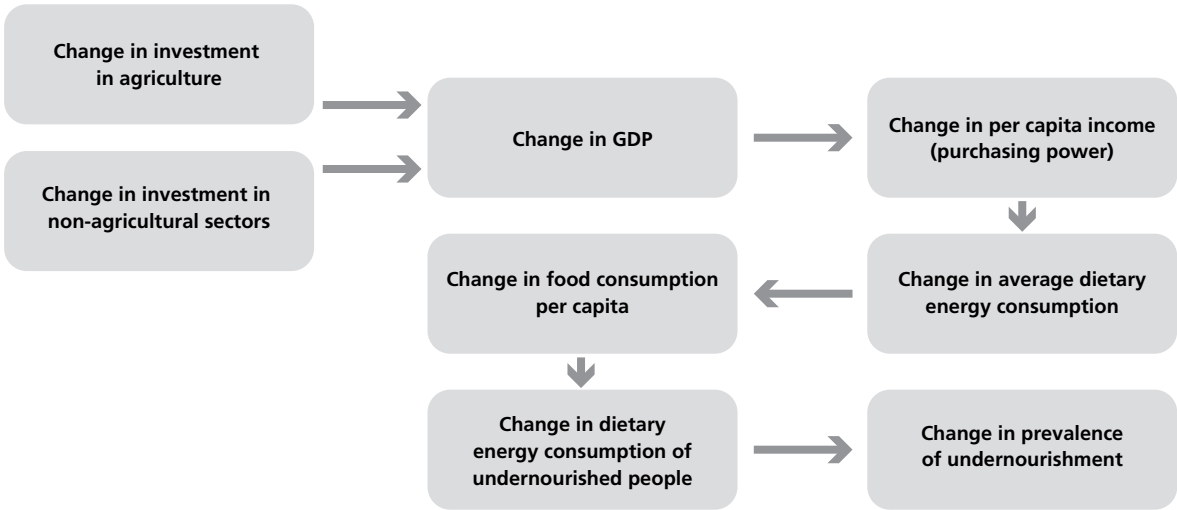
Source: FAO.

Following the above requirement chain, reversing the causal chain, the methodology is developed as follows:

The starting point is to estimate by how much the ADEC would need to be raised by 2030, given the way DEC is distributed across the population, to bring all people above the MDER.

As food consumption generally depends on income, in the next step, how much per capita income (approximated by GDP per capita) economy-wide should increase in order to increase ADEC to its desired level is calculated. Additional GDP is then calculated by multiplying additional per capita GDP by the population size.

The additional investment required to achieve the additional GDP is then calculated assuming a plausible set of gross incremental capital output ratios (ICORs).

The additional investment required in agriculture is then calculated as a share of total investment, assuming that the agricultural investment share is equivalent to the share of agricultural value-added in GDP.

While per capita GDP is projected to increase due to technical progress and other factors in the *BaU* scenario, GDP has to increase more in order to reduce the prevalence of undernourishment in all countries to 5 percent or less. The *ZHtotinv* scenario is built step-wise, and then compared with the *BaU* scenario, to work out the additional investment required to achieve the zero hunger target.

The findings of this step-wise methodology are reported below.

■ **Step 1:** *ZHtotinv* **average dietary energy consumption**

First, we estimate how much the ADEC would need to be raised by 2030, so that fewer than 5 percent of the population would be undernourished (i.e. with a caloric intake below the MDER), assuming that the MDER and the DEC distribution across the population is as in the *BaU* scenario. In low- and middle-income countries, the ADEC has to increase by more than 5 percent, from 2 857 to 3 019 kcal/person/day (Table A1.1). For sub-Saharan Africa and the 25 "worst-off" countries, the ADEC has to increase by 13.7 percent and 17.9 percent, respectively.

■ **Step 2:** *ZHtotinv* **GDP (and new prices of agricultural goods)**

Subsequently, we calculate the per capita income (approximated by per capita GDP) required to achieve the desired ADEC. This calculation is carried out using the FAO GAPS partial equilibrium model.

For countries that need to increase their ADECs, we fix the ADEC at the desired level, and compute the per capita GDP target sufficiently high in order to increase demand for food to meet the ADEC target.[36] Food consumption in

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[36] Only countries that have not reduced their prevalence of undernourishment to 5 percent or less by 2030 will have to increase their ADEC. Countries already on target will not require additional investment.

TABLE **A1.1**

Undernourishment in the *BaU* and *ZHtotinv* scenarios					
	Population	**Minimum daily energy requirements**	**Average dietary energy consumption**	**Coefficient of variation of food distribution**	**Chronically undernourished people**	
	(millions)	*(kcal/person/day)*			*(percent)*	*(millions)*
2030 *BaU* scenario						
WORLD	**8 274**	**1 865**	**2 955**	**0.272**	**7.9**	**653**
High-income countries	1 437	1 941	3 425	0.217	1.1	16
Low- and middle-income countries	6 838	1 849	2 857	0.283	9.3	637
East Asia	2 247	1 878	3 133	0.327	7.8	175
Latin America and the Caribbean	682	1 872	3 091	0.258	4.0	27
Near East and North Africa	615	1 865	3 133	0.266	4.7	29
South Asia	2 016	1 825	2 587	0.245	9.3	188
Sub-Saharan Africa	1 245	1 812	2 528	0.288	17.4	216
50 countries on target in 2030	3 113	1 895	3 243	0.233	2.0	63
60 countries not on target in 2030	5 161	1 846	2 782	0.295	11.4	590
25 worst-off countries*	833	1 812	2 363	0.320	25.2	210
2030 *ZHtotinv* scenario						
WORLD	**8 274**	**1 865**	**3 088**	**0.266**	**4.1**	**338**
High-income countries	1 437	1 941	3 415	0.248	1.8	26
Low- and middle-income countries	6 838	1 849	3 019	0.270	4.6	312
East Asia	2 247	1 878	3 294	0.313	4.7	106
Latin America and the Caribbean	682	1 872	3 099	0.266	3.8	26
Near East and North Africa	615	1 865	3 171	0.275	3.7	23
South Asia	2 016	1 825	2 734	0.232	4.9	99
Sub-Saharan Africa	1 245	1 812	2 868	0.252	4.6	57
50 countries on target in 2030	3 113	1 895	3 245	0.254	2.6	80
60 countries not on target in 2030	5 161	1 846	2 993	0.273	5.0	258
25 worst-off countries*	833	1 812	2 881	0.259	5.0	42

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.
Source: Simulations using the GAPS model and based on *SOFI 2015*.

the GAPS model is a function of per capita income and prices. Hence, to target a higher level of food intake, per capita income needs to increase.[37] Increased demand also stimulates domestic supply and trade, leading to new equilibrium prices.

In the GAPS model, the new ADEC target requires additional physical consumption of food. However, on the assumption that additional output is only available at higher marginal cost, the additional demand also leads to price increases.[38] Thus, the required per capita GDP is simultaneously determined with new prices that equilibrate demand and supply. GDP is then calculated by multiplying per capita GDP with the population size. The first three columns in Table A1.2 report GDP in the *BaU* and *ZHtotinv* scenarios. The subsequent columns in Table A1.2 report the average annual GDP growth rates required for those two scenarios. In the *ZHtotinv* scenario, GDP growth in low- and middle-income countries ranges from 2.1 percent in Latin America and the Caribbean to 5.9 percent in SAS. In the 25 "worst-off" countries, the average annual GDP growth rate required to achieve zero hunger is even larger (8.1 percent). The 60 countries not on target in 2030 would require almost 1.4 percent additional annual GDP growth to achieve the zero hunger target. Sub-Saharan Africa and South Asia would require 1.9 percent and 1.6 percent more annual growth respectively.

■ **Step 3: Investment for *ZHtotinv* (and *BaU*) GDP**

We then calculate the investment required to achieve the incremental GDP with respect to the base year, in both *ZHtotinv* and *BaU* scenarios. To this end, we make use of the concept of a gross ICOR,[39] which gives the amount of investment required to generate one additional unit of net output (GDP). Table A1.2 reports the economy-wide annual average gross investment necessary to achieve GDP growth under both the *BaU* and *ZHtotinv* scenarios and highlights the additional investment required by the zero hunger scenarios in the third panel, as compared with the *BaU* scenario.

Additional gross economy-wide investments in the *ZHtotinv* scenario amount to US$1.5 trillion, all in low- and middle-income countries, as all high-income countries are already on target. In low- and middle-income countries, it implies a 24.1 percent increase with respect to the *BaU* scenario. This percentage change is different across regions, ranging from 3.2 percent in Latin America and the Caribbean to 57.0 percent in South Asia. The 25 worst-off countries require much more than doubling their investment (+159.7 percent).

■ ***Step 4: ZHtotinv* (and *BaU*) share of agricultural value added in GDP**

To work out the required additional investment in agriculture to achieve the zero hunger target, the share of total investment in agriculture is assumed to be broadly proportional to the share of agricultural value added in GDP. Using cross-sectional GDP shares in the base year, we estimate a relationship between agricultural value added and GDP. The share of the first decreases as the second increases. We assume that this inverse relationship will also hold in the future. This allows us to calculate the share of agricultural value added in GDP for both the *ZHtotinv* and *BaU* scenarios. As GDP is larger in the *ZHtotinv* scenario (Table A1.3), the share of agricultural value added is lower, compared to the *BaU* scenario.

■ **Step 5: *ZHtotinv* (and *BaU*) annual investment in agriculture**

We then calculate the investment in agriculture as a proportion of the total investment required to achieve the incremental GDP in both scenarios. To this end, we use the share of agricultural value added in GDP, with the assumptions above. Cumulative investment, calculated on an annual basis from 2016 to 2030 in both scenarios, is then averaged per year, as shown in Table A1.3.

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[37] In the GAPS model, physical demand is linked to income via "income elasticities of demand". For the purpose of this exercise, we keep income elasticities constant across periods.

[38] In the GAPS model, this is reflected by upward sloping supply curves. A scenario where the expansion of demand occurs in a "fixed price" context is also explored. In this scenario, additional agricultural output is available at no additional production cost, due, for instance, to increased agricultural productivity.

[39] ICOR values for low- and middle-income countries were set for the base year at three for countries with per capita incomes up to US$2 000, at four for countries with per capita GDP up to US$4 000, and at five for countries with per capita GDP over US$4 000. For each year from 2005–07 to 2030, annual investments were calculated as INVTt = ICORt * ΔGDPt. »»

»» Annual investment is considered to be cumulative. The ICOR was assumed to be country-specific and to increase with GDP. A similar ICOR-based approach has been used to estimate the investment required to achieve selected MDGs, see S. Devarajan, M.J. Miller, and E.V. Swanson. 2002. *Goals for development: history, prospects, and costs.* Policy Research Working Report No. 2819. Washington, DC, World Bank. Recent estimates of ICORs, in the range of those we have adopted, can be found in H. Taguchi and S. Lowhachai. 2014. A revisit to the incremental capital-output ratio: the case of Asian economies and Thailand. *International Journal of Economic Policy in Emerging Economies*, 7(1): 35–54; S. Kuznets. 1960. Quantitative aspects of the economic growth of nations: V. Capital formation proportions: international comparisons for recent years. *Economic Development and Cultural Change*, 8(4, Part 2): 1–96; K. Sato1971. International variations in the incremental capital-output ratio. *Economic Development and Cultural Change*, 19(4): pp. 621–640.

TABLE **A1.2**

Additional economy-wide investment required in the *ZHtotinv* scenario									

	GDP (US$ billions, constant 2013 prices)			Average annual GDP growth (%)		Average gross annual investment (US$ billions, constant 2013 prices)		Additional gross investment	
								(US$ billions, constant 2013 prices)	(% change)
	2005–7	**2030**	**2030**				**2016–30**		
		BaU	*ZH*	*BaU*	*ZH*	*BaU*	*ZH*	*Diff. ZH-BaU*	*ZH/BaU*
WORLD	**56 263**	**101 131**	**106 160**	**2.41**	**2.77**	**15 989**	**17 460**	**1 470**	**9.19**
High-income countries	42 388	61 530	61 530	1.65	1.65	9 899	9 899	0	0.00
Low- and middle-income countries	13 875	39 601	44 631	3.80	4.69	6 090	7 560	1 470	24.14
East Asia	6 037	21 859	25 137	4.53	5.57	4 069	5 115	1 047	25.73
Latin America and the Caribbean	3 588	6 413	6 477	2.02	2.10	561	579	18	3.21
Near East and North Africa	1 881	4 334	4 417	3.34	3.48	549	565	17	3.01
South Asia	1 393	4 391	5 465	3.82	5.45	425	667	242	57.01
Sub-Saharan Africa	548	1 629	2 099	4.02	5.92	175	273	98	55.87
50 countries on target in 2030	49 820	76 654	76 654	1.83	1.83	12 045	12 045	0	0.00
60 countries not on target in 2030	6 443	24 476	29 506	4.63	6.04	3 944	5 415	1 470	37.27
25 worst-off countries*	273	793	1 363	4.03	8.13	75	195	120	159.71

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.
Note: ZH refers to the *ZHtotinv* scenario.
Source: Simulations using the GAPS model and based on *SOFI 2015*.

■ **Step 6: Comparing the *ZHtotinv* and the *BaU* scenarios**

In the last step, we compare the annual investment in the *ZHtotinv* scenario with annual investment in the *BaU* scenario. The figures for additional investment are provided in the fourth panel of Table A1.3. The additional average annual gross investment for the period 2016–30 to achieve the zero hunger target is US$116 billion (in constant 2013 prices). Looking at the regional allocations of this amount, more than half (US$65 billion) is for East Asia.[40] In some areas, such as sub-Saharan Africa and South Asia, where the *ZHtotinv* scenario requires additional investments of 66 percent and 49 percent more than in the *BaU*,

respectively (Table A1.3, last column), implementing such an additional investment programme may be challenging, not only for funding reasons, but also for institutional, managerial and logistical reasons. These difficulties could be more formidable in the worst-off countries, where the *ZHtotinv* scenario requires additional annual investment of around 130 percent.

■ **Gross and net investment**

The figures provided here refer to additional "gross" investment, i.e. investment required both to increase the capital asset-base of the countries and to replace fixed capital consumption (depreciation). To provide a rough order of magnitude, 20–40 percent of this additional investment would replace fixed capital depreciation,

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[40] As the *ZHtotinv* scenario to 2030 is built with the GAPS partial equilibrium model, where food prices respond to interactions between supply and demand, the increased demand for agriculture and food items generated by the per capita GDP increase is satisfied by an expansion of supply associated with increased prices. However, this price increase, slightly below 10 percent on average, only partially offsets the increase in per capita income.

TABLE **A1.3**

Additional investment in agriculture in the *BaU* and *ZHtotinv* scenarios						
	Share of agriculture value added in GDP *(%)*			Average gross annual investment in agriculture *(US$ billions, constant 2013 prices)*		Additional gross investment in agriculture
						(US$ billions, constant 2013 prices) / *(% change)*
	2016	**2030**	**2030**		2016-2030	
		BaU	*ZH*	*BaU*	*ZH*	*Diff. ZH-BaU* / *ZH/BaU*
WORLD	**4.52**	**4.11**	**4.51**	**654**	**770**	**116** / **17.67**
High-income countries	2.75	2.50	2.75	256	256	0 / 0.00
Low- and middle-income countries	8.21	6.63	8.17	398	513	116 / 29.05
East Asia	7.20	5.39	7.17	240	304	65 / 27.00
Latin America and the Caribbean	6.23	5.66	6.23	33	35	2 / 4.93
Near East and North Africa	7.11	5.97	7.10	31	34	2 / 7.40
South Asia	15.28	12.43	15.17	57	86	28 / 49.45
Sub-Saharan Africa	17.58	15.21	17.41	26	43	17 / 65.94
50 countries on target in 2030	3.31	3.02	3.31	355	355	0 / 0.00
60 countries not on target in 2030	10.05	7.52	9.98	299	415	116 / 38.66
25 worst-off countries*	21.14	18.52	20.74	15	35	20 / 129.80

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.
Note: ZH refers to the *ZHtotinv* scenario.
Source: Simulations using the GAPS model and based on *SOFI 2015*.

depending on the countries and the specific period.[41] Only the remaining share would actually be available to expand the capital base of the countries.

■ **Complementing additional investment with a transfer to cover the food deficit**

In the *ZHtotinv* scenario, we assume that the indigent 5 percent of the population is not going to benefit from the additional investment for various reasons, e.g. personal disability, health and socio-economic conditions. Therefore, their food deficit has to be filled by a food deficit transfer (FDT), i.e. the annual transfer income needed to lift them out of hunger or undernourishment.[42] The calculations are based on the estimated average food deficit expressed in kilocalories and an estimated unit cost of a kilocalorie country-wise.[43] For the total annual cost of the food deficit, a mark-up of 20 percent, assuming

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[41] Preliminary estimates. The share of fixed capital depreciation in gross investment depends on the composition of the capital stock. Countries with a large share of plant and machinery have lower depreciation rates than countries with higher shares of transport and information technologies. Higher-income countries tend to have larger depreciation rates; for example, in 2011, the depreciation rate for the United States of America was 4.1 percent, while for China, it was 3.1 percent. See R. Inklaar and P.M. Timmer. 2013. *Capital labor and TFP in PWT 8.0.* Groningen, Netherlands, University of Groningen.

[42] The annual expenditure needed to free people from undernourishment in region *r* for period *t*, net of implementation costs, can be calculated as the average share (across all the population) of the MDER the undernourished lack times the total population, times the MDER, times the average (economy-wide) consumer price of one kilocalorie times the number of days in a year.

[43] Economic Research Service, United States Department of Agriculture. Calculations are based on annual household expenditure data from Euromonitor International (available at http://www.euromonitor.com/).

TABLE **A1.4**

Summary findings of the *ZHtotinv* scenario							
	FDT	Additional gross investment	FDT + additional gross investment	FDT + additional gross investment	Additional gross investment in agriculture	FDT + additional gross investment in agriculture	FDT + additional gross investment in agriculture
		(US$ billions, constant 2013 prices)		*(% GDP)*	*(US$ billions, constant 2013 prices)*		*(% GDP)*
WORLD	**14**	**1470**	**1484**	**1.7**	**116**	**130**	**0.15**
High-income countries	3	0	3	0.0	0	3	0.01
Low- and middle-income countries	11	1 470	1 481	4.8	116	127	0.41
East Asia	4	1 047	1 051	6.4	65	69	0.42
Latin America and the Caribbean	2	18	20	0.4	2	4	0.07
Near East and North Africa	1	17	18	0.5	2	3	0.10
South Asia	2	242	244	7.1	28	30	0.88
Sub-Saharan Africa	2	98	100	8.0	17	19	1.52
50 countries on target in 2030	6	0	6	0.0	0	6	0.01
60 countries not on target in 2030	8	1 470	1 478	8.1	116	123	0.68
25 worst-off countries*	1	120	121	19.9	20	21	3.45

* The worst-off countries are defined as countries that would have to raise their average DEC in 2030 by more than 10 percent to eliminate hunger.
Source: Simulations using the GAPS model and based on *SOFI 2015*.

10 percent for administrative costs and 10 percent for leakages, is added.[44]

The cost of this transfer, reported in the first column of Table A1.4 for low- and middle-income countries, is US$11.2 billion, and amounts to US$14.1 billion if high-income countries are included. The FDT as a share of GDP varies across regions, as expected. In the *ZHtotinv* scenario, it ranges from a minimum of 0.1 percent for high-income to a maximum of 0.3 percent for the worst-off countries.

Table A1.4 reports the summary findings for the *ZHtotinv* scenario. The average additional annual economy-wide investment required from 2016 to 2030 for zero hunger by 2030 is US$1 484 billion (in constant 2013 prices). This includes an FDT of US$14.1 billion.

Globally, this amounts to 1.7 percent of average annual GDP from 2016 to 2030. However, this percentage rises to 8.0 percent for sub-Saharan Africa, and to 19.9 percent for the worst-off countries.

Of the total additional investment, US$115.6 billion is for agriculture. The annual additional investment in agriculture and the FDT amount to US$129.7 billion. Globally, this amount is 0.15 percent of average aggregate GDP from 2016 to 2030. At the country and regional level, however, this is 1.5 percent of GDP in sub-Saharan Africa, or 3.5 percent of GDP for the worst-off countries.

[44] Varying estimates of mark-ups for administrative costs of cash transfer programmes exist, from the 5 percent for universal cash transfer programmes adopted by the International Labour Office in the above-mentioned exercise, to the 100 percent of the Cash Transfers for Orphans and Vulnerable Children (CT-OVC) programme in Kenya. For a review of the administrative costs of social protection programmes, see, for example »»

»» N. Caldés, D. Coady and J. Maluccio. 2004. *The cost of poverty alleviation transfer programs: a comparative analysis of three programs in Latin America*. FCND Discussion Report Brief No. 174. Washington, DC, IFPRI; M. Samson, I. van Niekerk and K. Mac Quene 2006. *Designing and implementing social transfer programmes*. Cape Town, South Africa, Economic Policy Research Institute.

Appendix 2. **Statistical table**

Average annual poverty gap transfers and economy wide investments per country in the *ZHbotmea* scenario, 2016–30

		Poverty gap transfers		Additional investments		Poverty gap transfers	Additional investments
		Total	Rural	Total	Rural	Total	Total
		(US$ billions, constant 2013 prices)				(% GDP)	
High-income countries	Australia	13	0	0	0	0.00	0.00
	Canada	21	0	0	0	0.00	0.00
	Central Asian Republics	713	452	149	94	0.12	0.02
	European Union 27	175	0	0	0	0.00	0.00
	Israel	4	0	0	0	0.00	0.00
	Japan	60	0	0	0	0.00	0.00
	New Zealand	2	0	0	0	0.00	0.00
	Rest of Eastern Europe	2	1	0	0	0.00	0.00
	Rest of Western Europe	7	0	0	0	0.00	0.00
	Russian Federation	3	0	0	0	0.00	0.00
	United States of America	128	0	0	0	0.00	0.00
	South Africa	828	466	2 196	1 237	0.21	0.55
	Total	**1 955**	**920**	**2 345**	**1 332**	**0.00**	**0.00**
Low- and middle-income countries	Angola	827	810	3 176	3 111	0.44	1.70
	Burundi	414	385	2 198	2 046	24.66	130.98
	Benin	397	251	2 411	1 527	3.82	23.25
	Burkina Faso	508	477	2 674	2 513	3.06	16.10
	Botswana	31	19	74	45	0.14	0.33
	Central African Republic	202	139	938	646	7.19	33.47
	Côte d'Ivoire	586	374	3 107	1 981	1.76	9.33
	Cameroon	443	308	2 505	1 742	1.10	6.21
	Democratic Republic of the Congo	6 052	4 017	49 718	33 003	27.49	225.84

Sub-Saharan Africa

TABLE **A2**

(Continued)

		Poverty gap transfers		Additional investments		Poverty gap transfers	Additional investments
		Total	Rural	Total	Rural	Total	
		(US$ billions, constant 2013 prices)				(% GDP)	
	Congo	147	80	507	275	0.69	2.39
	Eritrea	165	140	788	669	8.13	38.86
	Ethiopia	1 278	1 085	4 355	3 699	2.03	6.94
	Gabon	23	5	17	4	0.14	0.10
	Ghana	424	302	1 594	1 136	0.98	3.66
	Guinea	259	210	1 318	1 069	2.96	15.04
	Gambia	34	22	163	109	2.35	11.42
	Kenya	979	820	7 369	6 175	2.09	15.76
	Liberia	178	101	2 590	1 463	11.21	163.18
	Lesotho	78	65	259	214	3.16	10.44
	Madagascar	807	620	7 952	6 106	6.44	63.40
	Mali	515	408	6 400	5 067	3.04	37.73
	Mozambique	1 101	793	4 523	3 256	3.77	15.49
	Mauritania	63	39	204	126	1.17	3.78
	Mauritius	1	0	0	0	0.01	0.00
Low- and middle-income countries	Malawi	838	776	5 495	5 083	8.64	56.61
	Namibia	67	54	266	214	0.48	1.89
	Niger	489	435	2 270	2 023	4.99	23.16
	Nigeria	4 011	2 750	24 914	17 083	1.28	7.93
	Rwanda	485	408	2 896	2 441	4.28	25.56
	Sudan	697	579	2 210	1 835	0.74	2.34
	Senegal	390	276	1 416	1 002	1.69	6.14
	Sierra Leone	195	148	929	707	6.35	30.28
	Somalia	359	283	1 738	1 371	7.06	34.17
	Swaziland	46	42	336	303	0.92	6.68
	Chad	364	311	1 279	1 094	2.16	7.58
	Togo	255	199	1 185	924	6.07	28.23
	Uganda	761	729	2 922	2 800	2.22	8.51
	United Republic of Tanzania	1 164	0	8 758	0	2.50	18.79
	Zambia	806	636	5 286	4 170	2.81	18.46
	Zimbabwe	304	238	1 127	880	3.13	11.60
	Total	**26 742**	**19 334**	**167 866**	**117 908**	**2.14**	**13.42**

Note: "Sub-Saharan Africa" appears rotated along the left side of the data rows.

TABLE **A2**

(Continued)

		Poverty gap transfers		Additional investments		Poverty gap transfers	Additional investments
		Total	Rural	Total	Rural	Total	Total
		(US$ billions, constant 2013 prices)				(% GDP)	
Low- and middle-income countries	**Near East and North Africa**						
	Afghanistan	254	203	237	190	1.45	1.36
	Algeria	92	44	0	0	0.04	0.00
	Egypt	202	153	0	0	0.08	0.00
	Iran (Islamic Republic of)	131	0	0	0	0.03	0.00
	Iraq	278	151	46	25	0.31	0.05
	Jordan	1	0	0	0	0.00	0.00
	Lebanon	48	23	5	2	0.10	0.01
	Libya	74	36	6	3	0.07	0.01
	Morocco	257	189	31	23	0.22	0.03
	Saudi Arabia	154	0	0	0	0.02	0.00
	Syrian Arab Republic	16	8	0	0	0.02	0.00
	Tunisia	14	0	0	0	0.02	0.00
	Turkey	6	4	0	0	0.00	0.00
	Yemen	182	149	45	37	0.44	0.11
	Total	**1 707**	**960**	**369**	**279**	**0.05**	**0.01**
	Latin America and the Caribbean						
	Argentina	125	0	0	0	0.03	0.00
	Bolivia (Plurinational State of)	90	41	37	17	0.42	0.17
	Brazil	2 841	0	277	0	0.14	0.01
	Chile	38	4	0	0	0.01	0.00
	Colombia	576	192	104	35	0.19	0.03
	Costa Rica	21	7	0	0	0.05	0.00
	Cuba	79	51	18	12	0.08	0.02
	Dominican Republic	51	20	0	0	0.06	0.00
	Ecuador	115	69	5	3	0.14	0.01
	El Salvador	95	42	61	27	0.35	0.22
	Guatemala	245	171	199	138	0.42	0.34
	Guyana	10	0	5	0	0.38	0.18
	Haiti	420	0	595	0	5.32	7.55
	Honduras	146	81	146	82	0.68	0.68
	Jamaica	40	26	18	12	0.25	0.12
	Mexico	340	100	0	0	0.02	0.00

TABLE **A2**

(Continued)

			Poverty gap transfers		Additional investments		Poverty gap transfers	Additional investments
			Total	Rural	Total	Rural	Total	Total
			(US$ billions, constant 2013 prices)				(% GDP)	
Low- and middle-income countries	Latin America and the Caribbean	Nicaragua	45	29	16	10	0.46	0.17
		Panama	37	23	2	1	0.11	0.00
		Paraguay	59	32	12	6	0.33	0.06
		Peru	186	76	0	0	0.08	0.00
		Suriname	8	6	5	4	0.21	0.12
		Trinidad and Tobago	21	17	15	12	0.06	0.04
		Uruguay	2	0	0	0	0.00	0.00
		Venezuela (Bolivarian Republic of)	415	0	93	0	0.15	0.03
		Total	**6 002**	**987**	**1 608**	**359**	**0.11**	**0.03**
	South Asia	Bangladesh	2 644	2 086	3 333	2 628	1.99	2.50
		India	15 482	12 220	19 518	15 405	0.53	0.67
		Nepal	348	315	256	231	1.30	0.96
		Pakistan	1 454	1 119	975	750	0.55	0.37
		Sri Lanka	192	166	116	100	0.29	0.17
		Total	**20 121**	**15 905**	**24 198**	**19 116**	**0.59**	**0.71**
	East Asia	Cambodia	102	93	37	34	0.58	0.21
		China	5 809	0	0	0	0.05	0.00
		Hong Kong, China Special Administrative Region	2	0	0	0	0.00	0.00
		Indonesia	2 077	1 337	455	293	0.23	0.05
		Korea, Democratic People's Republic of	180	142	56	44	0.36	0.11
		Korea, Republic of	10	0	0	0	0.00	0.00
		Lao People's Democratic Republic	65	54	41	34	0.71	0.45
		Malaysia	87	61	0	0	0.02	0.00
		Mongolia	31	13	14	6	0.38	0.17
		Myanmar	361	285	91	72	0.58	0.15
		Philippines	958	0	326	0	0.33	0.11
		Taiwan	6	0	0	0	0.00	0.00
		Thailand	9	7	0	0	0.00	0.00
		Viet Nam	531	480	94	85	0.33	0.06
		Total	**10 226**	**2 470**	**1 114**	**567**	**0.06**	**0.01**
	Other		376	249	208	138	0.05	0.03
		WORLD (GRAND TOTAL)	**67 131**	**40 825**	**197 708**	**139 699**	**0.08**	**0.23**

Source: Calculated based on *SOFI 2015* and the World Bank's PovcalNet data

Achieving Zero Hunger

The critical role of investments in social protection and agriculture

This report provides estimates of investment costs, both public and private, required to eliminate chronic dietary energy deficits, or to achieve zero hunger by 2030. This target is consistent with achieving both the Sustainable Development Goal 2, to eliminate hunger by 2030, and the Sustainable Development Goal 1, to eradicate poverty.

The report adopts a reference "baseline" scenario, reflecting a "business-as-usual" situation, to estimate the additional investment requirements. In this scenario, around 650 million people will still suffer from hunger in 2030. The investment requirements to eliminate hunger by 2030 are then estimated.

Hunger is eliminated through a combination of social protection and targeted "pro-poor " investments. The first component aims to bring the poor immediately above the extreme poverty line through social protection by a "transfer to cover the poverty gap" (PGT)

The second component involves additional investment required to stimulate and to sustain higher pro-poor growth of incomes and employment than in the business-as-usual scenario. This would, in turn, reduce the need for social protection to cover the PGT.

The analysis is complemented by looking at alternative ways to achieve zero hunger by 2030.