ReSAKSS
Regional Strategic Analysis and Knowledge Support System
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Annual Trends and Outlook Report 2015

ACHIEVING A NUTRITION REVOLUTION FOR AFRICA:

The Road to Healthier Diets and Optimal Nutrition

Edited by
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ReSAKSS is funded by the United States Agency for International Development (USAID), the Bill & Melinda Gates Foundation, the International Fund for Agricultural Development (IFAD), and the Ministry of Foreign Affairs of Netherlands (MFAN). Earlier, ReSAKSS also received funding from the UK Department for International Development (DFID) and the Swedish International Development Cooperation Agency (SIDA).

DOI: http://dx.doi.org/10.2499/9780896295933

ISBN: 978-0-89629-593-3

Citation
Covic, N. and S. L. Hendriks (Eds). 2016. *Achieving a Nutrition Revolution for Africa: The Road to Healthier Diets and Optimal Nutrition*. ReSAKSS Annual Trends and Outlook Report 2015. International Food Policy Research Institute (IFPRI).

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Cover design: Shirong Gao/IFPRI

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2015

Contents

Contents *Continued*

Contents *Continued*

Contents *Continued*

List of Tables

Tables *Continued*

CASE STUDY TABLE

List of Figures

Figures *Continued*

CASE STUDY FIGURES

List of Boxes

Boxes *Continued*

Abbreviations

A4NH	CGIAR Research Program on Agriculture for Nutrition and Health
AAPPI	average annual percentage-point increase
AARR	average annual rate of reduction
ABC-I	activity-based costing ingredients
AEZ	agroecological zone
AFB1	aflatoxin B1
AFM1	aflatoxin M1
AfricaAIMS	Africa Aflatoxin Information Management System
ANLP	African Nutrition Leadership Programme
ANSP	Africa Nutrition Security Partnership
APRG	Association d'Appui et de Promotion Rurale du Gulmu (Burkina Faso)
APTECA	Aflatoxin Proficiency Testing and Control in Africa
ARNS	African Regional Nutrition Strategy
ATFFND	African Task Force for Food and Nutrition Development
ATOR	Annual Trends and Outlook Report
AU	African Union
AUC	African Union Commission
BCC	behavior change communication
BCURE	Building Capacity to Use Research Evidence
BMI	body mass index
BPI	Biofortification Priority Index
CAADP	Comprehensive Africa Agriculture Development Programme
CAEWR	Commission of Agriculture, Environment, and Water Resources
CHANGE	Creating Homestead Agriculture for Nutrition and Gender Equity
CHW	community health worker
CIP	International Potato Center
CRF	common results framework
DHS	Demographic and Health Survey
EBF	exclusive breastfeeding
ECOWAP	ECOWAS Agricultural Policy
ECOWAS	Economic Community of West African States
EDHS	Ethiopia DHS
EHFP	Enhanced Homestead Food Production
EIDM	evidence-informed decision making
EIPM	evidence-informed policy making
ENAs	essential nutrition actions
EthioSIS	Ethiopian Soil Information System
FAFS	Framework for African Food Security
FAO	Food and Agriculture Organization of the United Nations
FBS	Food Balance Sheets
FNC	Food and Nutrition Council (Zimbabwe)
FNSC	food and nutrition security committee (Zimbabwe)
FNSIS	Food and Nutrition Security Information System (Zimbabwe)
FSN	food security and nutrition
FtF	Feed the Future
GDP	gross domestic product
GLSS	Ghana Living Standards Survey
GNR	Global Nutrition Report
HAZ	height-for-age z-score
Hb	hemoglobin
HBV	hepatitis B virus

Abbreviations *Continued*

HC	health committee
HCC	hepatocellular carcinoma
HFP	Homestead Food Production
HHN	health, hygiene, and nutrition
HINI	high-impact nutrition interventions
HKI	Helen Keller International
ICN2	Second International Conference on Nutrition
IFPRI	International Food Policy Research Institute
IMAM	integrated management of acute malnutrition
IYCF	infant and young child feeding
LAC	Latin America and the Caribbean
LANEA	Leveraging Agriculture for Nutrition in East Africa
LANSA	Leveraging Agriculture for Nutrition in South Asia
LMIC	low- to middle-income country
LNS	lipid-based nutrient supplement
MCM	multicriteria mapping
MDD-W	minimum dietary diversity of women
MDG	Millennium Development Goal
MIYCN	maternal, infant, and young child nutrition
MOOC	massive open online community
MP	malaria prevention
MSN	multisectoral nutrition
NAFSIP	National Agriculture and Food Security Investment Plan
NAIP	National Agriculture Investment Plan
NARS	national agricultural research system
NCD	noncommunicable disease
NEPAD	New Partnership for Africa's Development
NNAP	National Nutrition Action Plan (Kenya)
OSP	orange sweet potatoes
OWL	older women leader
PACA	Partnership for Aflatoxin Control in Africa
PLAN	Le Programme de Leadership Africain en Nutrition
ppb	parts per billion
RAIP	regional agriculture investment program
REC	Regional Economic Community
REU	Reaching End Users
SAA	strategic action area (Malabo Declaration)
SD	standard deviation
SDG	Sustainable Development Goal
SMART	specific, measurable, achievable, relevant, and time bound
SNNP	Southern Nations, Nationalities, and Peoples' Region
SSI	semi-structured interview
SUN	Scaling Up Nutrition
SUNLEAD	Scaling Up Nutrition Leadership in Africa
SUNRAY	Sustainable Nutrition Research for Africa in the Years to Come
SURE	Supporting the Use of Research Evidence
U5	children younger than five years
UN	United Nations
VFL	village farm leader
WASH	water, sanitation, and hygiene
WHA	World Health Assembly
WHO	World Health Organization
WHZ	weight-for-height z-score
WRA	women of reproductive age

Acknowledgments

The 2015 Annual Trends and Outlook Report (ATOR) has benefited from the research and efforts of the many authors and contributors whose work is presented here. We express our gratitude to all the authors and coauthors. ReSAKSS Coordinators and their teams collected, updated or compiled data on the various CAADP indicators tracked in chapter 12 of this report.

We are also grateful to the valuable and thorough reviews and feedback provided by several reviewers as part of our blind review process. We thank Samuel Benin who managed the peer-review process and the processing of data on CAADP indicators. We are also very grateful to Ousmane Badiane and Tsitsi Makombe for their guidance, feedback, and coordination of the production process. Excellent research assistance from Julia Collins and administrative support from Pamela Dogbe are gratefully acknowledged. Sincere thanks go to IFPRI's Communications and Knowledge Management Division, which provided thorough editorial support.

Finally, we would also like to acknowledge the organizations that provided financial support for the 2015 ATOR: the United States Agency for International Development (USAID) and the Bill & Melinda Gates Foundation.

Foreword

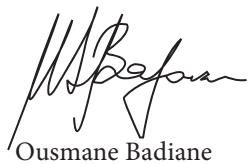
Africa's political commitment to nutrition is growing. Increasingly, African leaders recognize the critical role nutrition plays in fostering economic growth, food security, and poverty reduction. Because agriculture remains the main source of livelihood for the poor, agricultural policies and interventions need to be designed to maximize their nutrition and health benefits. The twenty-third assembly of African Union heads of state and government in Malabo, Equatorial Guinea, in 2014 passed three declarations with specific commitments on nutrition. The commitments include ending hunger by 2025, improving nutritional status, reducing child stunting to 10 percent and underweight to 5 percent by 2025, and accelerating progress on preventing child and maternal deaths. In recent years, the African Union Commission (AUC) and the NEPAD Planning and Coordinating Agency (NPCA) have spearheaded several initiatives to improve nutrition outcomes including the African Regional Nutrition Strategy for 2015–2025, the African Task Force on Food and Nutrition Development, and the Comprehensive Africa Agriculture Development Programme (CAADP) Agriculture Nutrition Capacity Development Initiative (2011–2013). The latter helped to strengthen countries' capacity for mainstreaming nutrition in their CAADP processes and national agriculture and food security investment plans (NAIPs). These initiatives complement country-led efforts to deal with malnutrition, such as those through the Scaling Up Nutrition Movement.

For Africa as a whole, levels of hunger and malnutrition have been on the decline. The chapter on tracking CAADP indicators shows that the prevalence of undernourishment in the entire population and the prevalence of underweight, stunting, and wasting in children under five years of age have all decreased since the launch of CAADP in 2003, although rather slowly. Thus millions remain malnourished and hungry. Drastically reducing hunger and malnutrition will require concerted efforts to make agriculture more nutrition sensitive.

Efforts are currently underway to do just that, especially in light of the Malabo Declaration and the CAADP Results Framework 2015–2025, by appraising existing NAIPs, and where needed, formulating second generation NAIPs, in a manner that ensures that nutrition issues are effectively addressed and mainstreamed. This will also help ensure that Malabo nutrition targets are met and that nutrition-sensitive agriculture interventions and best practices are in place.

The *2015 Annual Trends and Outlook Report* contributes to our understanding of the important role of nutrition in achieving sustainable development outcomes. The report examines the current status of nutrition in Africa, including progress in meeting Malabo nutrition targets, and highlights the importance of dietary quality and diversity, the need to increase the nutrition sensitivity of agriculture, and the importance of strengthening capacities for nutrition mainstreaming, monitoring, and evaluation.

We hope the report will highlight challenges and opportunities that need to be urgently addressed and stimulate action that leads to improved nutrition outcomes at the national, regional, and continental levels.



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Executive Summary

Never before has so much attention been paid to nutrition in development dialogues and planning. In the early design of the Comprehensive Africa Agriculture Development Programme (CAADP), the important role nutrition plays in achieving development goals was recognized, but little thought was given to how to integrate nutrition into agriculture and development investment plans. However, several key international events and commitments following the 2007–2008 food price crisis raised awareness of the need to improve nutrition in order to achieve international, regional, and national development and growth targets. This awareness is articulated in the Sustainable Development Goals and echoed in various strategic African Union policies, strategies, and plans, including the African Union (AU) Agenda 2063, the AU 2014–2017 Strategic Plan, and the three Malabo Declarations (2014) relating to nutrition. Other African Union Commission (AUC) initiatives support this commitment, including the CAADP Nutrition Initiative that commenced in 2011, and the African Regional Nutrition Strategy 2015–2025 (ARNS 2015–2025). In addition, 37 African countries are involved in the Scaling Up Nutrition (SUN) Movement.

While many first generation CAAPD programs included food security and nutrition (FSN) programs and activities, nutrition was not well integrated, and monitoring and evaluation systems for assessing the impact of these interventions on nutrition of vulnerable groups were not always included. Some nutrition indicators have now been incorporated in the CAADP Results Framework and can be monitored as part of CAADP implementation progress; CAADP indicators can also complement monitoring that countries are conducting in relation to SUN movement activities. Some countries have already developed common results frameworks for this purpose.

Focusing the 2015 Annual Trends and Outlook Report (ATOR) on nutrition will contribute to a broader understanding of the critical role of nutrition in achieving international, continental, and national economic growth targets through agriculture, food security, and nutrition. This report presents information and analysis in support of evidence-based policy making that should inform the second generation of CAADP national investment plans now being developed. This is an important moment for shaping the region's future and ensuring that the much-needed agriculture-led growth and development agenda can simultaneously deliver on improving nutrition, saving lives, improving productivity and health, and curbing nutrition-related diseases and the associated public health expenditures. These investment plans should address not only the usual elements of undernutrition but also widespread micronutrient deficiencies (termed "hidden hunger") and the growing problem of overweight and obesity that is associated with economic growth.

Key Findings

Agenda 2063 prioritizes healthy and well-nourished African citizens as an overarching goal for realizing a prosperous Africa that is based on inclusive growth and sustainable development, 2). In January 2014, African Leaders adopted the Common Africa Position (CAP) on the post-2015 development agenda with six priority areas for development and implementation of the Sustainable Development Goals (SDGs). These priority areas include striving for inclusive economic growth that reduces inequality and ensures sustainable agriculture, food self-sufficiency, and nutrition security for all. The Malabo Declaration on CAADP reaffirmed the commitment of African governments to allocate at least 10 percent of their national budgets to agriculture and seek to achieve an annual agricultural growth rate of at least 6 percent. The Declaration commits to using agriculture as a strategy to eradicate undernutrition (stunting and underweight), a goal which in the past was solely the responsibility of the health sector.

The post-Malabo Implementation Strategy and Roadmap (2014) emphasizes agriculture-sector activities that have direct links to nutrition, particularly stabilization of food availability and prices and diversification of available nutritious foods for local consumption to improve dietary diversity. This agriculture-based approach is reinforced by a broad range of nutrition policies and frameworks at continental, regional, and national levels, including the ARNS 2015–2025, which is aligned to World Health Assembly nutrition targets. The CAADP Results Framework integrates key nutrition targets, affording an opportunity to measure the impact of national agriculture and food security investment programs on nutrition.

Good nutrition provides a vital foundation for human development that is central to meeting our full potential. Improvements in nutrition status lead to a host of positive outcomes for individuals and families. Yet the current statistics and trends in nutritional status in Africa indicate a need for more concerted effort in tackling a triple burden of malnutrition that includes undernutrition, micronutrient deficiencies, and overweight and obesity. Far too many children in Africa are not growing and developing in ways that ensure the future productivity and health of the population. Fifty-eight million children below five years of age are too short for their age (described as stunted); 13.9 million weigh too little for their height (described as wasted); and 10.3 million are overweight. Over 220 million people do not consume enough calories. Moreover, 163.6 million children and women of reproductive age are anemic. Eight percent of adults over 20 years of age are obese. Adult obesity in all 54 African countries rose between 2010 and 2014. Malnutrition is a burden on national budgets and could cost countries between 3 percent (in Swaziland) and 16 percent (in Ethiopia) of national budgets in health costs and productivity losses.

However, the calamity of malnutrition is not inevitable. It results from choices we make or fail to make. As African countries review their past performance and draft investment plans for the next 5 to 10 years, they can make strategic policy choices that will improve the trajectory of development by ensuring that development programs lead to widespread and significant improvements for nutrition. The many links between agriculture and nutrition suggest that agricultural policies, interventions, and practices can be better designed to enhance nutrition and health benefits. We can turn agriculture into a powerful lever for raising people's health and nutritional status, while at the same time contributing to

other outcomes such as food security, income, equity, and sustainability. Efforts to scale up nutrition-specific interventions need to be paired with investments in nutrition-sensitive development programs and policies.

The most direct pathway for improving nutrition is through agricultural production—when production translates directly into consumption for households cultivating crops. However, we need to stimulate the demand for nutritious foods to ensure increased demand for, and consumption of, nutritious food, and reducing excessive demand for foods that lead to undesirable health consequences in order to curb the acceleration of rates of overweight, obesity, and noncommunicable diseases. Doing so will require the transformation of agriculture value chains to increase the nutritional value of foods. Improving the "basket" of food that households produce or can access economically can create multiple benefits for producers and consumers. The nutrient content and safety (lack of contamination risk) of foods should be enhanced. Like other productive sectors, agriculture is a source of household income (raised through wages earned by agricultural workers or through the sales of food produced) and expenditure on nutrition-enhancing goods and services (including health, education, and social services). Agriculture is known to be a more important source of income for the poor and undernourished in Africa than other economic sectors.

But as the continent and its countries develop, transformation from a rural and agriculture-based society can lead to problems associated with more developed food systems, including increasing levels of overweight and obesity. The potential nutritional impact of existing food policies (including agricultural subsidies) should be reviewed, and reforms should be initiated for those policies that are likely to have adverse effects on people's dietary quality and health. Increasing risks of overweight, obesity, and related noncommunicable diseases (NCDs) are normal symptoms of a progressing nutrition transition, but public policy can do a great deal in setting appropriate economic incentives to reduce these adverse impacts.

The food and agriculture sector is central to addressing not only undernutrition, but also to containing and preventing the spread of diet-related NCDs. Achieving these goals requires action throughout the food system, from sustainable natural resource management and input supply to enabling consumption of healthy diets and promoting gender equity. Delivering and promoting the consumption of safe food that is affordable and of good nutritional quality on a year-round basis requires working with a broad range of stakeholders—governments, farmers, agribusiness, retailers, and consumers.

Agricultural production needs to be diversified to include more nutrient-dense foods that can improve micronutrient intake. This would include fruits and vegetables as well as biofortified crops, which can make an important contribution in addition to animal source foods that remain too expensive for many. More attention to food value chains is needed to prevent postharvest losses; contamination and exposure to hazardous substances like mycotoxins due to mold growth across the value chain; and increases in consumption of high-energy foods that are contributing to the rise in obesity. Examples of ways scientific knowledge can be used to solve critical nutrition problems include biofortification and the use of zinc fertilizer in Ethiopia to improve dietary zinc intake. But more research and innovation is necessary to reduce losses of nutrients across the food system and to find ways of increasing the nutrient content of a variety of foods to improve nutrition.

Innovation is also needed in other areas to make CAADP investment plans deliver impact for nutrition more efficiently from production through processing and storage of food. But innovation in institutional design is also essential. The successes showcased in this report relate to institutional innovation in mainstreaming and integrating nutrition concerns into national policies, priorities, and coordination structures. Doing this requires building the necessary capacity for comprehensive, multisectoral approaches to coordination across sectors and stakeholders as well as vertical coordination within sector or stakeholder institutions. Both the human and financial resources as well as technical and managerial skills to support program planning, implementation, monitoring, and evaluation are critical.

Stronger national systems of policy mapping and analysis are essential to making the best choices in policy formulation and decision making. Supporting countries in developing the capacity to collect, analyze, and communicate this information to inform food system and agricultural policy and program design and monitor their impact is key. Comprehensive monitoring and evaluation systems, complete with key nutrition indicators and contextualized evidence, are needed to evaluate the impact of comprehensive investment plans on nutrition and attainment of the international, continental, and national commitments for growth, development, and nutrition. Building a strong body of evidence from rigorous, theory-based, comprehensive evaluations of different program models that bring together interventions from a variety of sectors (for example, health, education, agriculture, social protection, women's empowerment, water and sanitation) is essential to guiding future investments for better nutrition. Such evidence is necessary to assess what works and does not work in terms of strengthening the nutrition impact of agriculture and food security investment activities, the pathways to impact, and the cost-effectiveness of such programs. Championing the integration of such evidence will require well-developed leadership capabilities and a variety of leadership orientations. The multisectoral nature of such programs requires working with and interacting with multiple sectors and stakeholder actors, for which leadership is critical.

Notable improvement has been recorded in Africa on a number of indicators during the CAADP implementation period. Africa as a whole has experienced robust economic growth in GDP per capita and household consumption expenditure per capita during the last 20 years. Measures of hunger and malnutrition (overall undernourishment as well as underweight, stunting, and wasting in children) are improving across Africa, albeit slowly. The incidence of poverty has been declining in Africa as a whole, along with its depth. Agriculture value-added and public agriculture expenditures have increased, but not enough to meet the CAADP growth and expenditure targets for Africa as a whole. Overall, the analysis of CAADP indicators shows that countries that have been in the CAADP process the longest and those that have gone through most of the levels of the CAADP process have tended to register better outcomes in most of the indicators reviewed, thus highlighting the positive impact of CAADP.

Conclusion and Recommendations

Malnutrition in all its forms (undernourishment, micronutrient deficiencies, and overweight) is robbing Africa of much-needed productivity and growth potential. Addressing nutrition is an investment with high potential returns

in terms of reduced health costs, increased productivity, and improved human resource capacity and economic growth. Although nutrition interventions have been seen as belonging in the health sector, integrated programs that include agriculture and other sectors can create synergies and added value. The agriculture sector needs to become more nutrition sensitive so that it can work in tandem with other sectors to drive a much-desired nutrition revolution for Africa. Achieving the goals of the Malabo Declarations on (1) accelerated agricultural growth and transformation for shared prosperity and improved livelihoods and (2) nutrition security through inclusive economic growth and sustainable development will require efforts from agriculture, social agriculture, social protection, education, water and sanitation, and more to implement high-impact, integrated interventions at scale.

Achieving these goals requires a comprehensive food systems approach to agricultural development. Although the AU and CAADP have not deliberately adopted a food systems approach, the four pillars of CAADP cover key elements of the food system. Therefore, refinement of current CAADP frameworks to deliberately adopt a food systems approach offers tremendous opportunities to deliver more nutritious, healthier diets to the population at large, thus helping to overcome malnutrition in all its forms.

In this report we have dealt with opportunities for making Africa's food system deliver healthier and more nutritious foods, making these foods more available and affordable to all people, and promoting better food consumption patterns as African economies develop. Clearly, the choices we make for agriculture and other sectors now will shape the future food system and in turn, the health and productivity of the continent. To achieve a nutrition revolution for Africa, we recommend the following:

1. At all levels, make the political choice to position nutrition as a priority at the highest level of governance within an integral element of funded comprehensive growth and development strategies.

2. Make deliberate efforts to increase the nutrition sensitivity of current and future agriculture programs and projects by incorporating nutrition components, including, leveraging agricultural extension networks at the country level, and providing a nutrition workforce within the agriculture sector to support nutrition action. It will also be critical to integrate nutrition objectives and indicators into the design and monitoring mechanisms of all future programs seeking to achieve priority national development objectives, as well as the Malabo Declarations and Sustainable Development Goal targets.

3. Establish strong institutional structures to coordinate efforts and ensure that existing resources in agriculture, social protection, education, and water and sanitation are leveraged to scale up nutrition impact.

4. Create national growth and development strategies that include a blend of nutrition-specific and nutrition-sensitive programs that seek to increase the overall supply and distribution of healthy nutrient-dense foods at affordable prices through agricultural value chains that support sustainable livelihoods for rural households. This calls for a food systems approach.

5. Make agricultural policy and practice more nutrition-sensitive and, therefore, more effective in improving nutrition and agriculture. This can be achieved through review of agriculture, food, and trade policies to identify reforms necessary to stimulate the local supply and demand of healthy nutritious foods and discourage the consumption of unhealthy foods and food waste. This will also help ensure that unfavorable food policies do not aggravate nutritional challenges, especially in rapidly transforming food systems.

6. Create and strengthen institutional and policy environments that enable agriculture to support nutrition and health goals.

7. Harness the potential for science, technology, and innovation to reduce postharvest losses and food waste; promote product diversification with nutritious foods; improve processing to extend shelf life and make healthy foods easier to prepare; and improve storage and preservation to retain nutritional value, ensure food safety, and extend seasonal availability.

8. Accelerate efforts to reduce exposure to mycotoxins, such as aflatoxins, in the food value chain in support of nutrition, health, and economic objectives.

9. Develop capacity and leadership to use evidence-informed decision making to enhance the impact of agriculture on nutrition and health.

10. Accelerate current efforts to develop transformational leadership capabilities, which are needed to manage the change processes required to effectively coordinate and implement nutrition programs and interventions amid competing priorities and demands.

11. African academic institutions must work to develop the needed nutrition workforce to leverage current momentum on nutrition and sustain it into the future, including providing attention to frontline staff.

12. Make commitments that count—specific, measurable, achievable, relevant, and time bound (SMART), as well as ambitious and aligned to the efforts of others. More needs to be invested in more and better data. Inclusive annual national and subnational reporting mechanisms need to be developed and implemented to assess progress on commitments, nutrition outcomes, and actions in a timely way.

CHAPTER 1

Introduction

Namukolo Covic and Sheryl L. Hendriks

Never before has so much attention been paid to nutrition in development dialogues and planning. The early design of the Comprehensive Africa Agriculture Development Programme (CAADP) recognized the important role nutrition plays in achieving development goals, but little thought was given to how to integrate nutrition into agriculture and related development investment plans. Following the guidance of the Global Plan of Action (HLTF 2010) and drawing inspiration from Millennium Development Goal 1, the African Union/CAADP Framework for African Food Security (FAFS) (AU/NEPAD 2009) set out policy and program options for African governments to consider in the design of programs, including their comprehensive growth and development plans. The FAFS was launched at a meeting of 16 African governments at the height of the 2007–2008 world food crisis.

Following the first Nutrition for Growth Summit, held in London in 2013 (DFID 2013), signatories committed their political will and financial resources to work in partnership to accelerate progress toward achieving World Health Assembly targets by 2025 (WHO 2014). Other commitments have been made through the Scaling Up Nutrition (SUN) movement and the 2014 Rome Declaration on Nutrition from the Second International Conference on Nutrition (ICN2) (FAO and WHO 2014). These efforts contributed to informing the drafting of the Sustainable Development Goals (SDGs), especially SGD2 but, more broadly, at least 12 of the 17 SGDs contain indicators that track important nutrition elements (IFPRI 2016). The recent decision of the UN General Assembly to endorse the ICN2 Framework of Action and declare 2016–2025 the UN Decade of Action on Nutrition is a major step toward mobilizing action around reducing hunger and improving nutrition (IFPRI 2016).

The food price crisis of 2007–2008 and recent global attention to nutrition have demonstrated the need to focus more on nutrition—especially in the first 1000 days window of opportunity to reduce the long-term negative impacts of malnutrition. While the evidence in support of investment in nutrition has existed in health and nutrition circles for a long time, the need for integrating nutrition objectives and deliberately considering nutrition through the human life cycle in agriculture and development decisions has only recently become topical.

The importance of nutrition in the African economic and development agenda is articulated in the African Union's (AU's) Agenda 2063 (AUC 2015a), its First 10 Year Implementation Plan (AUC 2015b), and the three Malabo Declarations (2014) relating to nutrition. The latter are the Declaration on Nutrition Security through Inclusive Economic Growth and Sustainable Development, the Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods, and the Declaration on Ending Preventable Child and Maternal Deaths in Africa (Box 1.1) (AU 2014).

Other AUC initiatives support this commitment, including the CAADP Nutrition Initiative being implemented by the New Partnership for Africa's Development (NEPAD) (FAO 2016), and the African Regional Nutrition Strategy 2015–2025 (AUC undated), In addition, 37 African countries are involved in the Scaling Up Nutrition movement (SUN 2016).

While some first-generation CAADP programs included food security and nutrition (FSN) programs and activities, nutrition received little attention in programs and monitoring systems for assessing the impact of these interventions on the nutrition of specific vulnerable groups. Some nutrition indicators have now been incorporated in the CAADP Results

BOX 1.1—2014 MALABO DECLARATIONS: NUTRITION COMMITMENTS

Declaration on Nutrition Security through Inclusive Economic Growth and Sustainable Development in Africa

1. Ending hunger by 2025 through strengthening development policies
2. Ending child stunting and bringing down stunting to 10 percent and underweight to 5 percent by 2025
    a. Focusing on the first 1000 days of a child's life
    b. Prioritizing this goal in national development plans and strategies
    c. Establishing long-term targets that give all children an equal chance for success
3. Continuing dialogue and strengthening advocacy in support of improved nutrition

Declaration on Ending Preventable Child and Maternal Deaths in Africa

1. Ending preventable child and maternal deaths by the year 2035 in line with Post 2015 Sustainable Development Framework
2. Developing and implementing country-led roadmaps to accelerate ending preventable deaths among children and mothers

Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods

1. Ending hunger by 2025
2. Improving nutritional status and eliminating child undernutrition by bringing down stunting to 10 percent and underweight to 5 percent by 2025

Source: AU (2014).

Framework (NEPAD 2015) and can thus now be part of monitoring CAADP implementation progress, which can lend synergy to efforts being made by countries in tandem with SUN movement activities. Some countries have already developed common results frameworks for this purpose.

Focusing the 2015 Annual Trends and Outlook Report (ATOR) on nutrition will contribute to a broader understanding of the role and importance of nutrition in achieving international, continental, and national economic growth targets through agriculture, food security, and nutrition. This report presents information and analysis in support of evidence-based policy making at the moment when the second-generation CAADP national investment plans are being developed. This is an important moment for shaping the region's future and ensuring that the much-needed agriculture-led growth and development agenda can simultaneously deliver on improving nutrition and health, saving lives, improving the productivity of Africa's population, and curbing public health expenditure on nutrition-related diseases. This includes addressing not only the usual elements of undernutrition but also widespread micronutrient deficiencies (termed "hidden hunger") and the growing problem of overweight and obesity that is increasing across the African continent.

While nutrition has traditionally been the domain of the health sector, there are multiple ways of addressing malnutrition in all its forms (undernutrition, hidden hunger, and overweight and obesity) through smarter design of agriculture and food security–related programs. This report seeks to demonstrate different avenues for addressing malnutrition to unlock and multiply the efforts of countries in breaking the cycle of poverty, malnutrition, and inequality.

To this end, the report is organized around key focus areas relevant to current efforts on nutrition by the African Union. The AU policy context for nutrition is addressed in Chapter 2. The current status of malnutrition on the continent is addressed in Chapters 3 and 4. Chapter 3 sets out the current status of malnutrition on the continent and the costs associated with not acting, while Chapter 4 complements this by presenting insight into the impact of economic development in driving the nutrition transition across Africa, focusing on Ghana.The need to make agriculture more nutrition sensitive and some examples of what is being done to address different aspects of this on the continent are covered in Chapters 5 through 8. This includes an in-depth consideration of how agriculture can become more nutrition sensitive (Chapter 5); lessons that have been learned on using homestead food production to impact nutrition (Chapter 6); the role that biofortification can play to improve micronutrient intakes from staple foods, especially among the poor who may be hard to reach through other interventions (Chapter 7); and the importance of mitigating against exposure to mycotoxins like aflatoxins across the food value chain in support of improved nutrition, health, and economic outcomes (Chapter 8). Chapter 9 highlights the capacity needs, challenges and opportunities related to bringing about more effective evidence-informed policy and program processes at the national level. Important considerations toward monitoring and evaluation of nutrition sensitive programs are covered in Chapter 10 in support of the strong drive for multisectoral nutrition action to which agriculture needs to play its full potential. Chapter 11 focuses on capacity needs for multisectoral nutrition systems in addition to technical and managerial capacities for different types of program and research staff under different categories of the nutrition workforce. Leadership is highlighted as a cross-cutting capacity need that must also be addressed. The ATOR is the official monitoring and evaluation report for CAADP at the continental level and in this regard Chapter 12 tracks progress on CAADP indicators outlined in the CAADP Results Framework 2015–2025. The chapter also reviews progress in the CAADP implementation process in African countries.

To complement the information in the chapters, some case studies (CS) drawing attention to specific areas form part of the ATOR. CS-1 looks at how Kenya has made significant progress on nutrition policy and interventions toward achieving nutrition targets. CS-2 puts forward the use of zinc fertilizers as a potential intervention that can play a dual function of increasing productivity of cereals and increasing intake of zinc, a micronutrient of public health significance. And in light of the ongoing efforts to increase the nutrition sensitivity of agriculture by mainstreaming nutrition into National Agricultural Investment Plans, CS-3 examines how this process has unfolded for Mozambique and Nigeria.

The ATOR concludes with Chapter 13, which provides a summary and policy recommendations. The information included in this ATOR does not imply these are the only areas of nutrition focus on the continent. With 37 out of the 54 AU member states involved in the SUN movement, among many initiatives aiming to address nutrition, much is happening on nutrition in Africa. A strong multisectoral emphasis is increasingly evident in many countries. Agriculture needs to play its role, and this ATOR points to areas where this applies so that agriculture can contribute to bringing about a nutrition revolution toward "The Africa We Want" as indicated by Agenda 2063.

CHAPTER 2

The African Union Policy Environment toward Enabling Action for Nutrition in Africa

Laila Lokosang, Akoto Osei, and Namukolo Covic

The levels of undernourishment (underweight and stunting) in Africa have dropped in recent years, although progress across countries is uneven. African countries have demonstrated their commitment to improving nutrition in that at least 37 of 54 African countries (69 percent) are currently involved in the Scaling Up Nutrition (SUN) movement (SUN 2016). Both SUN and the Comprehensive Africa Agriculture Development Programme (CAADP) are primarily country led according to common principles of coordinated action and multisectorality, recognizing the need to include multiple stakeholders in order to achieve the desired food security and nutrition outcomes. There is also increasing socioeconomic integration with growing intra-Africa trade and investment, especially within African Union (AU) Regional Economic Communities (RECs) (AfDB, OECD, and UNDP 2015). Movement of labor, on the other hand, has remained more constrained, despite having AU and REC frameworks that should facilitate freer movement of labor in support of economic development (UNDP 2011). The RECs make efforts to promote trade relations among countries, and there is often overlap among countries belonging to different RECs. This arrangement calls for greater harmony of policy instruments, which would contribute to a supportive or enabling environment across the continent toward achieving shared goals of attaining sustained food and nutrition security over time.

The AU policy environment is an important part of the enabling environment for nutrition on the continent. AU policy direction and instruments are agreed upon by the heads of state and governments of member states and thus are useful rallying points for advocacy and action at the regional and national levels. This chapter provides an overview of the food security and nutrition–related policies at the level of the AU. It is by no means an exhaustive review but seeks to highlight key nutrition-related policies and show how they may contribute to creating an enabling environment for achieving nutrition targets.

Key African Union Policy Frameworks Related to Nutrition

The political will for nutrition has improved in many African countries, and the momentum among policy makers to tackle the nutrition problems on the continent has never been stronger. This is evident in numerous statements, decisions, and declarations that commit Africa's leaders to realizing the continent's aspiration for equitable growth and socioeconomic development through improving human nutrition. The African Regional Nutrition Strategy (ARNS) and the CAADP Pillar III Framework for African Food Security (FAFS) are strongly reinforced by the African Union's Agenda 2063 (AU 2015b), which is a blueprint for the continent's development over the next 50 years (2014–2063) and was reiterated in the three Malabo Declarations.

Agenda 2063 prioritizes healthy and well-nourished African citizens as an overarching goal for realizing a "prosperous Africa that is based on inclusive growth and sustainable development" (AU 2015b, 2). In January 2014, African leaders adopted the Common Africa Position on the post-2015 development agenda, which includes six priority areas for developing and implementing the Sustainable Development Goals (SDGs) in a manner that adequately supports the broader development of the continent (AU 2014b).

These priority areas include striving for inclusive economic growth that reduces inequality and ensures sustainable agriculture, food self-sufficiency, and nutrition security for all (AU 2014b). The Malabo Declaration on CAADP reaffirmed the commitment of African governments to allocate at least 10 percent of their national budgets to agriculture and seek to achieve an annual agricultural growth rate of at least 6 percent (AU 2014a). The declaration deliberately commits to using agricultural growth for eradicating undernutrition (stunting and underweight), rather than leaving achievement of this goal solely to the health sector as in the past.

The Malabo Declarations also recognize and call for investment in social protection (with a special focus on women and youth) and agribusiness programs as integral elements of national investment plans. The post-Malabo Implementation Strategy and Roadmap (2014) emphasizes implementing agriculture-based activities that have direct links to nutrition, particularly through stabilization of food availability and prices, as well as diversification of available nutritious foods for local consumption to improve dietary diversity.

The above strategies are reinforced by a broad range of nutrition policies and frameworks at the continental, regional, and national levels. This includes ARNS 2015–2016 (AU 2015a), mentioned above, which includes specific nutrition targets (Box 2.1) that are aligned to World Health Assembly nutrition targets. ARNS 2015–2025 advocates concrete, evidence-based interventions consistent with the globally agreed-upon Comprehensive Implementation Plan for Maternal, Infant and Young Child Nutrition that was adopted at the 2012 World Health Assembly (WHO 2014) and by the 23rd AU ordinary session through the Malabo Declaration on Ending Preventable Child and Maternal Deaths in Africa (Doc. Assembly/AU/18(XXIII)Add.3). ARNS 2015–2025 spells out four strategic areas to guide the AU Commission and member states in the governance of nutrition:

- Definition of standards, norms, policies, and frameworks for AU member state adoption and ratification
- Convening and facilitation of consensus on matters regarding nutrition security in Africa
- Nutrition security policy and program advocacy and promotion
- Establishment of decision-making architecture for the implementation of the strategy

BOX 2.1—2025 NUTRITION TARGETS OF THE AFRICA REGION NUTRITION STRATEGY 2015–2025

- A 40% reduction in the number of children younger than five who are stunted
- A 50% reduction in anemia in women of child-bearing age
- A 30% reduction in low birth weight
- No increase in overweight for children younger than five
- An increase in exclusive breastfeeding rates during the first six months of life to at least 50%
- A reduction in childhood wasting, maintaining it at less than 5%

Source: African Union (2015a).

Over the years, the AU has advocated for African countries to develop national nutrition policies through the Africa Task Force for Nutrition and Development. Almost all the RECs, other regional institutions, and

countries in Africa have nutrition policies. The majority of these policies lean toward the global call for multisectoral nutrition action in implementing both nutrition-specific and nutrition-sensitive interventions across sectors. Examples of these interventions are given in Table 2.1.

TABLE 2.1—EXAMPLES OF NUTRITION-SENSITIVE AND NUTRITION-SPECIFIC INTERVENTIONS

Nutrition-specific interventions	Nutrition-sensitive interventions
Adolescent health and pre-conception nutrition	Agriculture and food security
Micronutrient supplementation or fortification	Social safety nets
Breastfeeding and complementary feeding	Early childhood development
Dietary supplementation	Maternal mental health
Feeding behaviors and stimulation	Women's empowerment
Treatment of severe acute malnutrition	Child protection
Treatment of moderate acute malnutrition	Classroom education
Disease prevention and management	Water and sanitation
Nutrition interventions in emergencies	Health and family planning services

Source: Black et al. (2013).

Most nutrition policies in Africa focus on addressing undernutrition (stunting, wasting, and underweight, as well as deficiencies in key micronutrients such as iron, zinc, iodine, and vitamin A). However, few pay attention to the growing problem of overweight and obesity now associated with developing economies (Steyn and Mchiza 2014; IFPRI 2016a). ARNS 2015–2025 includes a target to arrest or reduce overweight in children younger than five to less than 5 percent (AU 2015a).

CAADP is the overarching policy framework for attaining food security and nutrition and sustainable development through agriculture-led investment at the national and regional levels within Africa. CAADP actions are structured under four interrelated pillars (FARA et al. 2009):

- Pillar I: Extending the area under sustainable land management and reliable water control systems
- Pillar II: Improving rural infrastructure and trade-related capacities for market access
- Pillar III: Increasing food supply, reducing hunger, and improving responses to food emergency crises
- Pillar IV: Improving agriculture research and technology dissemination and adoption

CAADP sought to achieve Millennium Development Goal 1 (MDG 1), to reduce by half the levels of extreme poverty and hunger by 2015 (UN 2015), but also took into account the importance of responding to emergencies and disasters with food and agricultural responses involving safety nets and resilience building for the long term. The CAADP-FAFS provides a framework for the implementation of CAADP Pillar III. The framework was developed as a deliberate attempt to ensure that the CAADP agricultural growth agenda targeted the chronically poor and vulnerable directly, instead of hoping for a trickle-down effect (NEPAD and AU 2009). The framework sought to provide guidance to countries on the design of their national plans to address structural, systemic, and long-term aspects of chronic food insecurity challenges on the continent. It set out four specific strategic intervention areas for improving Africa's food security and nutrition status:

- Improving risk management and resilience
- Increasing the supply of affordable food
- Increasing the incomes of the vulnerable
- Improving the quality of diets through diversification of food among target groups

CAADP-FAFS also underscores that failure to address food insecurity, including undernutrition, while large sections of the African population face severe poverty, hunger, and marginalization from gainful employment and markets, could put countries at risk for social instability and conflict (NEPAD and AU 2009). Table 2.2 presents the 11 principles of Pillar III as given in the CAADP-FAFS document. The given principles include attention to the right to food for all Africa's citizens, specifically focusing on the more vulnerable groups of society, those chronically affected by hunger and malnourishment, with particular attention to women and children in addressing both long- and short-term effects.

TABLE 2.2—THE 11 PRINCIPLES OF THE COMPREHENSIVE AFRICA AGRICULTURE DEVELOPMENT PROGRAMME PILLAR III FRAMEWORK FOR AFRICAN FOOD SECURITY

1.	Protect the right to food for all citizens of Africa.
2.	Focus on the chronically hungry and malnourished, particularly women and children, in order to address short-term crises and, in the long term, integrate this population into broad agricultural development.
3.	Ensure that all parties and players automatically seek to understand and address hunger and malnutrition.
4.	Mainstream considerations of human diseases such as HIV/AIDS, malaria, and TB.
5.	Ensure that emergency responses promote growth and reduce chronic hunger (that is, do no harm to the overall CAADP agenda).
6.	Protect and promote the resilience of the livelihoods of the vulnerable.
7.	Ensure that gender dimensions of hunger and malnutrition are addressed.
8.	Promote intraregional trade, particularly in food staples, to raise food supply and quality, and to moderate price volatility.
9.	Integrate regular review and broad-based dialogue to ensure successful implementation of this pillar.
10.	Be in coherence with the MDGs, especially MDG 1, to cut extreme poverty and hunger.
11.	Integrate lessons from success stories in cutting hunger and malnutrition.

Source: NEPAD and AU (2009).

The CAADP-FAFS further articulates a number of options for improving food access, principally including investment to provide incentives for local processing and marketing of nutrient-rich foods, as well as public procurement programs to enhance market demand for nutritious foods. It also advocates rationalization of food price policies to improve incentives for production, processing, and marketing of food favored by vulnerable populations. Other equally important options the framework gives include development of community or homestead vegetable and fruit gardens; production of fish, poultry, and small animals (rabbits, goats, and guinea pigs); reduction of postharvest losses and loss of the nutritional value of micronutrient-rich foods, such as fruits and vegetables; improvement of food storage and preservation; implementation of school-based gardening programs; and improvement of food safety. These aspects of the framework point to the need for a more deliberate food-systems approach to addressing

BOX 2.2—NUTRITION-RELATED INDICATORS INCLUDED IN THE COMPREHENSIVE AFRICA AGRICULTURE DEVELOPMENT PROGRAMME RESULTS FRAMEWORK

- Prevalence of national undernourishment
- Prevalence of underweight for children under five
- Prevalence of stunting for children under five
- Prevalence of wasting for children under five
- Minimum dietary diversity among women
- Minimum acceptable diet for children 6–23 months old

Source: NEPAD (2015).

food security and nutrition on the continent in order to bring on board the additional dimensions needed. CAADP has been instrumental in bringing about increased food production on the continent. However, it is also widely accepted that this increased food production has not equitably resulted in the levels of reduction in undernutrition that would be expected. Effective implementation of the CAADP Pillar III principles with adequate nutrition sensitivity would contribute to attaining better nutrition outcomes. These outcomes, however, would further depend on how effectively other issues that impact nutrition are addressed, including the nutrition-specific interventions required and the nutrition sensitivity of social protection, health, water and sanitation, and so on.

Mainstreaming Nutrition into the Comprehensive Africa Agriculture Development Programme

Being a key strategy for attaining food and nutrition security for Africa, CAADP now includes the CAADP Nutrition Initiative, which aims at mainstreaming nutrition into national agriculture investment plans (NAIPs). Inclusion of nutrition indicators (Box 2.2) in NAIPs introduces a requirement to monitor nutrition progress on the continent as an integral part of monitoring progress in the agriculture sector. Besides the accountability and governance aspects this inclusion provides for nutrition on the continent, it is expected to create an opportunity to measure and improve the nutrition sensitivity of agricultural development programs implemented as part of CAADP.

Monitoring and Evaluation of Progress toward Commitments and Targets

Agenda 2063, the Malabo Declarations, the CAADP Results Framework, and the ARNS 2015–2025 all make reference to accountability and governance mechanisms as a necessary aspect of transforming the agriculture-led economic development and nutrition progress that the AU is promoting.

As the continent sets out to implement Agenda 2063, the Malabo Declaration intentions, and the ARNS 2015–2015 strategy aligned to global commitments and continental goals (those set by the UN's Sustainable Development Goals and the World Health Assembly), deliberate action will be required to make sure that the second generation of CAADP NAIPs and regional strategies recognize and integrate actions to improve the impact of various agriculture, social protection, and health strategies on nutrition across the human life cycle. The future potential of Africa is dependent on the nutrition, health, and productivity of its people. Addressing nutrition is a vital element to ensure Africa's economic development. For agriculture to reach its full potential role in the development agenda, nutrition needs to improve and the scourge of overweight and obesity that are possible outcomes of such development need to be curbed through careful policy planning and implementation.

Conclusion

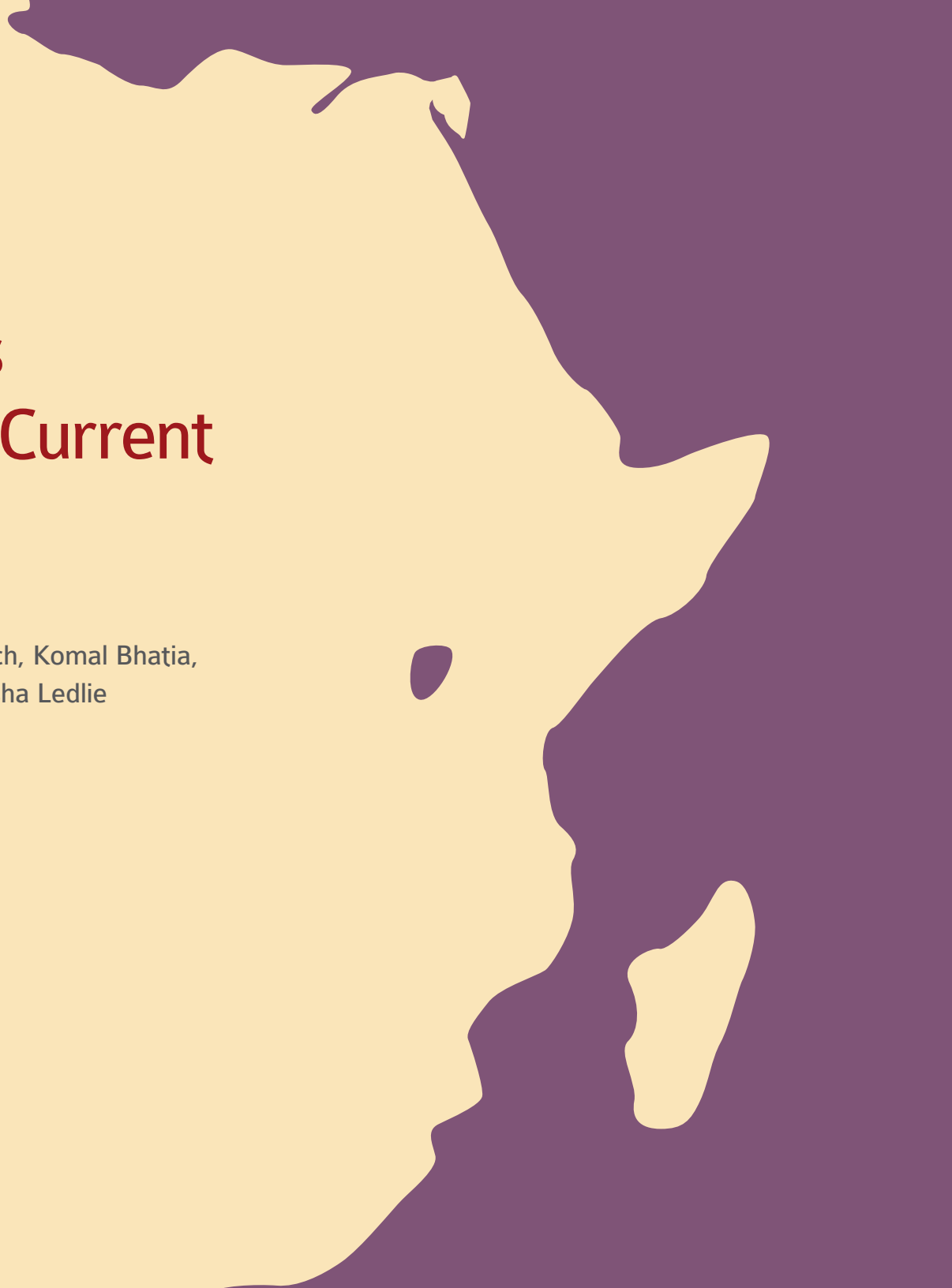
The current AU policy environment supports efforts by African countries to address malnutrition and can be a rallying point for different interventions at the continental, REC, and country levels. In addition, the accountability processes incorporated into the various declarations create opportunities for monitoring nutrition progress across the continent.

The chapters in this report reflect on the current status of nutrition in Africa and offer insight into some of the different approaches being used to improve nutrition outcomes as part of agriculture interventions. The ATOR also always includes a chapter (Chapter 12) that reports current progress on CAADP indicators.

CHAPTER 3

Africa's Progress toward Meeting Current Nutrition Targets

Lawrence Haddad, Mohamed Ag Bendech, Komal Bhatia, Kamilla Eriksen, Isatou Jallow, and Natasha Ledlie



In the era of the Sustainable Development Goals, the world faces many seemingly intractable problems. Malnutrition should not be one of them. The incentives to improve nutrition are strong, and determined countries can make rapid advances in malnutrition reduction.

Good nutrition provides a vital foundation for human development that is central to meeting our full potential. When nutrition status improves, a host of positive outcomes can follow for individuals and families. Improved nutrition in Africa means many more children will live past the age of five, their growth will be less disrupted, and they will gain in height and weight. Their cognitive abilities will develop more fully, allowing them to learn more both in and outside of school. As a result of sufficient nourishment and a positive early environment, children are more likely to get better jobs and suffer fewer illnesses as adults—aging healthily and living longer to support the African Union Agenda 2063 vision of a prosperous and united Africa (AU 2015b).

The Scale and Nature of Malnutrition in Africa

The extent of malnutrition in Africa is large. Box 3.1 summarizes the current state of malnutrition on the continent.

As in many other regions, the nutrition problems Africa is facing are multiple and overlapping. Figure 3.1 shows that 8 of the 54 African countries (Botswana, Egypt, Equatorial Guinea, Lesotho, Libya, Namibia, South Africa, and Swaziland) are facing serious public health issues on three key dimensions: stunting, women's anemia, and overweight/obesity—a triple burden.[1] Thirteen countries are facing a double burden of undernutrition and overweight/obesity. Only 4 countries are facing serious single burdens of stunting (Ethiopia and Rwanda) and women's anemia (Ghana and Senegal).

BOX 3.1—THE SCALE OF MALNUTRITION IN AFRICA

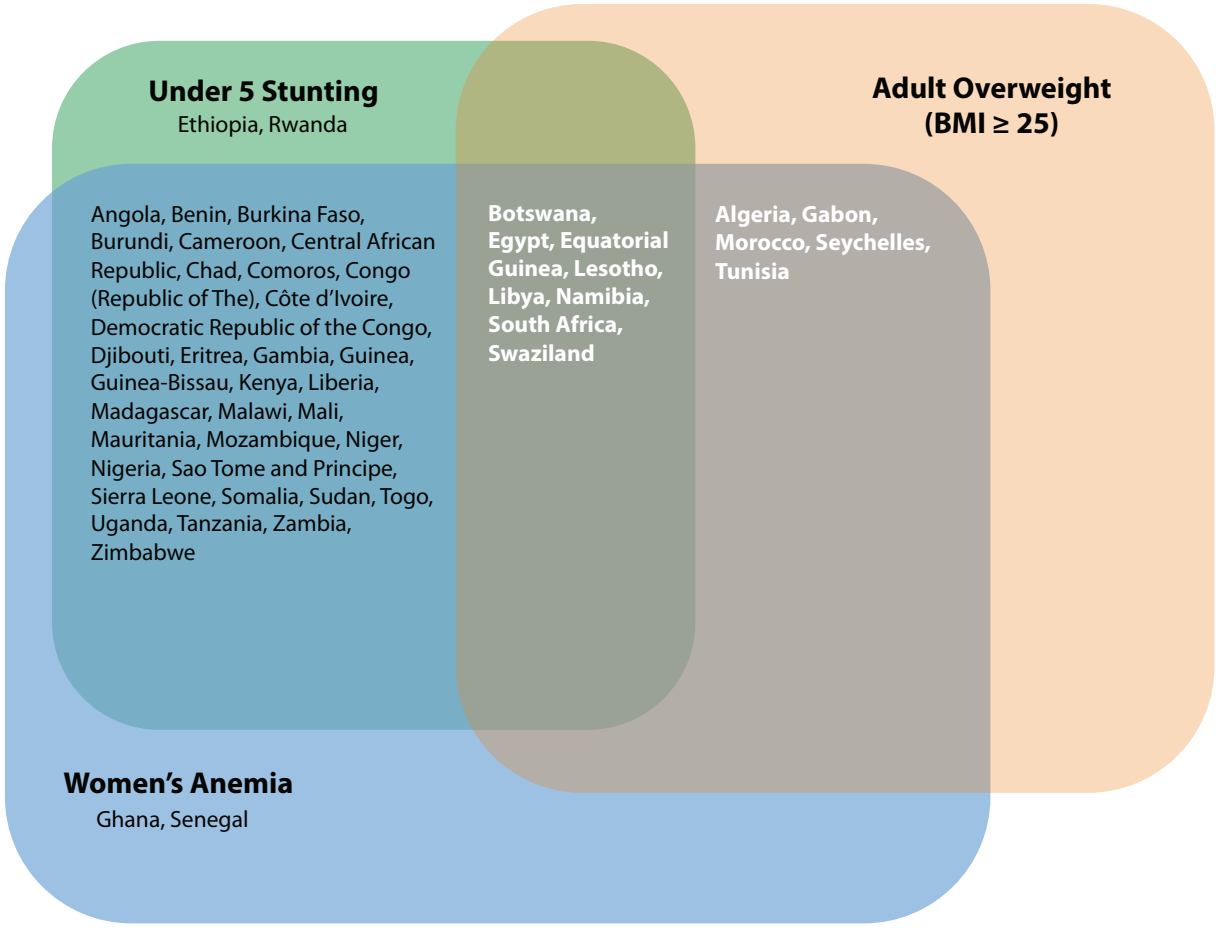
While the number of people affected by malnutrition is difficult to calculate—because a person can suffer from more than one type of malnutrition simultaneously—the scale of malnutrition in Africa is staggering:

- 58 million children younger than five are too short for their age (stunted), 13.9 million weigh too little for their height (wasted), and 10.3 million are overweight. None of these children are growing healthily.
- 163.6 million children and women of reproductive age are anemic.
- 220 million people are estimated to be calorie deficient.
- 8 percent of adults older than 20 are obese.
- Adult obesity is on the rise in all 54 African countries (2010–2014).
- 13 countries in Africa have to manage serious levels of stunting in children younger than five or anemia in women of reproductive age and adult overweight (Figure 3.1).
- In eight African countries, only a minority of children are growing healthily. In Burundi, Chad, Democratic Republic of the Congo, Djibouti, Ethiopia, Guinea-Bissau, Niger, and Somalia, the percentage of children younger than five who are not stunted or wasted ranges between 43 and 48 percent.

Source: UNICEF, WHO, and World Bank (2015); WHO (2015a, 2015b, 2015c); FAO (2015); IFPRI (2016).

1 These indicators are chosen, first, because they are a subset of the eight global goals that the World Health Assembly has set and, second, because they represent undernutrition, micronutrient deficiency, and a diet-related risk factor for noncommunicable disease.

FIGURE 3.1—THE MULTIPLE BURDENS OF MALNUTRITION IN AFRICAN COUNTRIES



Source: IFPRI (2016); data on stunting and overweight based on Joint Malnutrition Estimates of UNICEF, WHO, and World Bank (2015); data on anemia in women of reproductive age from Stevens et al. (2013).

Note: Analysis includes 54 African countries, listed according to the United Nations' naming and regional classification. BMI = body mass index.

The burdens in terms of human suffering, mortality, and disease are large (IFPRI 2016), but so too are the economic burdens. As the presidents of the African Development Bank and the World Bank have recently stated, early child malnutrition undermines "grey matter infrastructure" (cited in Rice 2016, p 59).The data bear them out. The African Union and World Food Programme estimates of the monetary cost of hunger for seven countries are summarized in Figure 3.2.

Recognizing the extent and consequences of these burdens, African leaders made a bold commitment within the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods: "to improve nutritional status, and in particular, [to eliminate] child undernutrition in Africa with a view to bringing down stunting to 10 percent and underweight to 5 percent by 2025" (African Union 2014, 4). In addition, African leaders have signed on to the

World Health Assembly's key targets for six nutrition outcomes by 2025, and the Africa Regional Nutrition Strategy has adopted them as well (African Union 2015a, 20). Leaders have also signed on to the Sustainable Development Goals, the second of which is to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture" (UN 2016). And as part of the United Nations General Assembly Decade of Action on Nutrition 2016–2025, African governments endorsed the Rome Declaration on Nutrition and the Framework for Action adopted by the Second International Conference on Nutrition in November 2014.

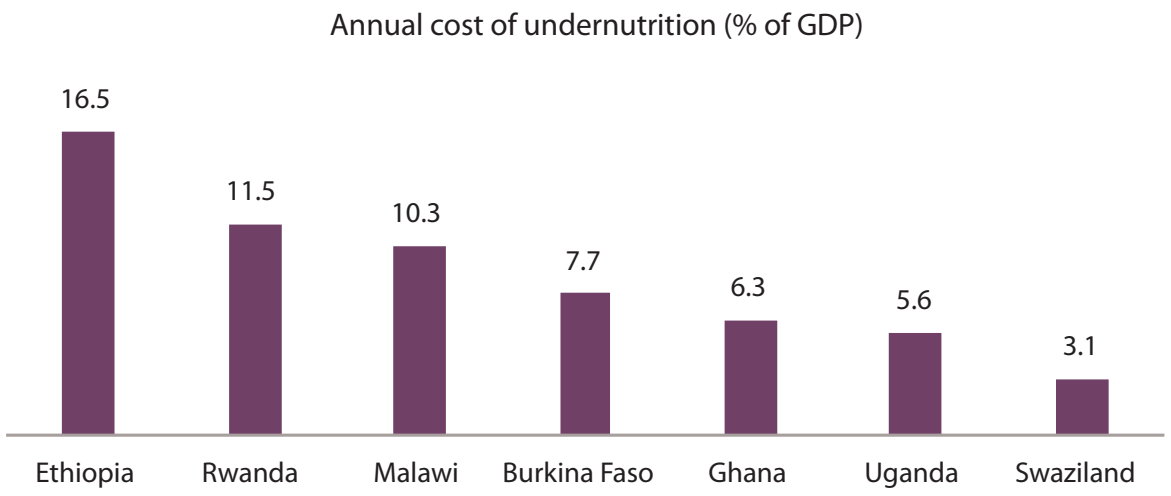
African Progress in Meeting Nutrition Targets

This section assesses the progress of African countries in meeting the Malabo 2025 targets for stunting among children younger than five and the World Health Assembly (WHA) 2025 targets for under-five stunting, wasting and overweight, exclusive breastfeeding rates (for infants younger than six months), anemia in women, adult overweight and obesity, and adult diabetes (Box 3.2).

The Malabo 2025 Target for Stunting

To assess whether a country will attain the Malabo stunting target[2] by 2025, we calculate the average annual rate of reduction (AARR) required for a country to get to 10 percent stunting from where it currently stands. We then compare the required AARR with the country's recent performance in reducing rates (the current AARR as determined by the Joint Child Malnutrition Estimates from UNICEF, WHO, and World Bank 2015). If the current AARR ≥ the required AARR, then the country is "on course." If the current AARR is > 0 but < the required AARR, then the country is designated as "off course but making progress," and if the current AARR is ≤ 0 (that is, stunting rates are static or increasing), then the country is designated as "off course, no progress."

FIGURE 3.2—THE ANNUAL COST OF UNDERNUTRITION, SEVEN AFRICAN COUNTRIES



Source: African Union Commission et al. (2014).
Note: GDP = gross domestic product.

2 The World Health Organization does not assess the rate of progress on underweight because it is not a WHA indicator; hence we are unable to comment on it here.

Table 3.1 lists countries by their latest stunting estimate, with colors that designate whether they are on or off course. Of the 54 countries, 49 have sufficient data to make the comparison while 5 do not. Of the 49 with data, only 4 are on course to meet the Malabo Declaration target, 39 are off course but making some progress, and only 6 are making no progress.

BOX 3.2—WORLD HEALTH ASSEMBLY INDICATORS AND 2025 TARGETS

STUNTING: Reduce by 40 percent the number of children younger than five who are stunted[a]

WASTING: Reduce and maintain childhood wasting at less than 5 percent

UNDER-FIVE OVERWEIGHT: Halt the increase in childhood overweight

ANEMIA: Reduce anemia in women of reproductive age by 50 percent

LOW BIRTH WEIGHT: Reduce by 30 percent

EXCLUSIVE BREASTFEEDING: Increase rate of exclusive breastfeeding in first six months of life to at least 50 percent

ADULT OVERWEIGHT: Halt the rise in prevalence

ADULT OBESITY: Halt the rise in prevalence

ADULT DIABETES *(raised blood glucose)*: Halt the rise in prevalence

Source: WHO (2016a, 2016b).

Note: a For more on the methods behind the World Health Assembly stunting target, see de Onis et al. (2013).

TABLE 3.1—COUNTRIES RANKED ACCORDING TO STUNTING PERCENTAGE, LOWEST TO HIGHEST PREVALENCE, WITH ASSESSMENT OF PROGRESS TOWARD MALABO TARGET

Rank	Country	Stunting percentage	Rank	Country	Stunting percentage
1	Seychelles	7.9	28	Comoros	32.1
2	Tunisia	10.1	29	Liberia	32.1
3	Algeria	11.7	30	Cameroon	32.6
4	Morocco	14.9	31	Burkina Faso	32.9
5	Gabon	17.5	32	Nigeria	32.9
5	Ghana	18.8	33	Lesotho	33.2
7	Senegal	19.4	34	Djibouti	33.5
8	Libya	21.0	35	Benin	34.0
9	Mauritania	22.0	36	Uganda	34.2
10	Egypt	22.3	37	Tanzania	34.7
11	Namibia	23.1	38	Rwanda	37.9
12	South Africa	23.9	39	Sierra Leone	37.9
13	Gambia	24.5	40	Sudan	38.2
14	Congo	25.0	41	Mali	38.5
15	Swaziland	25.5	42	Chad	38.7
16	Somalia	25.9	43	Zambia	40.0
17	Kenya	26.0	44	Ethiopia	40.4
18	Equatorial Guinea	26.2	45	Central African Republic	40.7
19	Togo	27.5	46	Malawi	42.4
20	Guinea-Bissau	27.6	47	DRC	42.6
21	Zimbabwe	27.6	48	Niger	43.0
22	Angola	29.2	49	Mozambique	43.1
23	Côte d'Ivoire	29.6	50	Madagascar	49.2
24	South Sudan	31.1	51	Eritrea	50.3
25	Guinea	31.3	52	Burundi	57.5
26	Botswana	31.4		Cape Verde	No data
27	Sao Tome and Principe	31.6		Mauritius	No data

Source: Based on IFPRI (2016). Stunting percentage is the most recent estimate from UNICEF, WHO, and World Bank (2015), September 2015 update.

Note: Analysis includes 54 African countries, listed according to the United Nations' naming and regional classification. Congo = Republic of the Congo; DRC = Democratic Republic of the Congo; Tanzania = United Republic of Tanzania. For details on the criteria for rating countries, see IFPRI (2016).

On course, good progress | Off course, some progress | Off course, no progress | Insufficient data to make assessment

The World Health Assembly 2025 Targets

Table 3.2 undertakes the same exercise as Table 3.1, but this time in relation to meeting the more modest WHA target[3] of a 40 percent reduction in the number of stunted children by 2025. The results show that 9 countries are on course, the same 6 are making no progress, and 34 are off course but making some progress.

TABLE 3.2—COUNTRIES RANKED ACCORDING TO STUNTING PERCENTAGE, LOWEST TO HIGHEST PREVALENCE, WITH ASSESSMENT OF PROGRESS TOWARD WORLD HEALTH ASSEMBLY 2025 TARGET

Rank	Country	Stunting percentage	Rank	Country	Stunting percentage	Rank	Country	Stunting percentage
1	Seychelles	7.9	19	Togo	27.5	37	Tanzania	34.7
2	Tunisia	10.1	20	Zimbabwe	27.6	38	Sierra Leone	37.9
3	Algeria	11.7	21	Guinea-Bissau	27.6	39	Rwanda	37.9
4	Morocco	14.9	22	Angola	29.2	40	Sudan	38.2
5	Gabon	17.5	23	Côte d'Ivoire	29.6	41	Mali	38.5
6	Ghana	18.8	24	South Sudan	31.1	42	Chad	38.7
7	Senegal	19.4	25	Guinea	31.3	43	Zambia	40.0
8	Libya	21.0	26	Botswana	31.4	44	Ethiopia	40.4
9	Mauritania	22.0	27	Sao Tome and Principe	31.6	45	Central African Republic	40.7
10	Egypt	22.3	28	Comoros	32.1	46	Malawi	42.4
11	Namibia	23.1	29	Liberia	32.1	47	DRC	42.6
12	South Africa	23.9	30	Cameroon	32.6	48	Niger	43.0
13	Gambia	24.5	31	Burkina Faso	32.9	49	Mozambique	43.1
14	Congo	25.0	32	Nigeria	32.9	50	Madagascar	49.2
15	Swaziland	25.5	33	Lesotho	33.2	51	Eritrea	50.3
16	Somalia	25.9	34	Djibouti	33.5	52	Burundi	57.5
17	Kenya	26.0	35	Benin	34.0		Cape Verde	No data
18	Equatorial Guinea	26.2	36	Uganda	34.2		Mauritius	No data

Source: Based on IFPRI (2016). Stunting percentage is the most recent estimate from UNICEF, WHO, and World Bank (2015), September 2015 update.

Note: Analysis includes 54 African countries, listed according to the United Nations' naming and regional classification. Congo = Republic of the Congo; DRC = Democratic Republic of the Congo; Tanzania = United Republic of Tanzania.

On course, good progress | Off course,some progress | Off course, no progress | Insufficient data to make assessment

3 The WHA nutrition targets tracked by the *Global Nutrition Report* are listed in Table 3A.1 and the on/off course rules are specified in Table 3A.2. The Africa Regional Nutrition Strategy 2016–2025 targets are aligned with the WHA targets. The strategy was adopted by the AU in 2015 and can be found here: http://sa.au.int/en/sites/default/files/Africa%20Regional%20Nutrition%20Strategy%202015-2025%2013.3.2015%20-%20English_0.pdf.

Table 3.3 summarizes the country rankings and progress status for wasting. Here the WHA 2025 target is less than 5 percent. As the table shows, of 51 countries with data, 17 are on course and 34 are off course.

Table 3.4 summarizes the rankings and progress for anemia in women of reproductive age (15–49 years old). Only one country, Burundi, is on track to meet this WHA target.

Finally, for exclusive breastfeeding of infants younger than six months, so important for getting infants off to the best possible start in life, Table 3.5 shows that 23 countries are on course, 3 are off course but making some progress, and 12 are off course and making no progress (one of these 12, Egypt, is actually showing a worsening rate of exclusive breastfeeding). Sixteen countries do not have sufficient data on exclusive breastfeeding to make an assessment.

TABLE 3.3—COUNTRIES RANKED ACCORDING TO WASTING PERCENTAGE, LOWEST TO HIGHEST PREVALENCE, WITH ASSESSMENT OF PROGRESS TOWARD WORLD HEALTH ASSEMBLY TARGET

Rank	Country	Wasting percentage	Rank	Country	Wasting percentage	Rank	Country	Wasting percentage
1	Swaziland	2.0	19	Senegal	5.8	37	Egypt	9.5
2	Rwanda	2.2	20	Cameroon	5.8	38	Guinea	9.9
3	Morocco	2.3	21	Congo	5.9	39	Burkina Faso	10.9
4	Tunisia	2.8	22	Guinea-Bissau	6.0	40	Comoros	11.1
5	Lesotho	2.8	23	Mozambique	6.1	41	Sao Tome and Principe	11.2
6	Equatorial Guinea	3.1	24	Burundi	6.1	42	Gambia	11.5
7	Zimbabwe	3.3	25	Zambia	6.3	43	Mauritania	11.6
8	Gabon	3.4	26	Libya	6.5	44	Somalia	14.9
9	Tanzania	3.8	27	Togo	6.7	45	Eritrea	15.3
10	Malawi	3.8	28	Namibia	7.1	46	Mali	15.3
11	Kenya	4.0	29	Botswana	7.2	47	Chad	15.7
12	Algeria	4.1	30	Central African Republic	7.4	48	Sudan	16.3
13	Seychelles	4.3	31	Côte d'Ivoire	7.6	49	Niger	18.7
14	Uganda	4.3	32	Nigeria	7.9	50	Djibouti	21.5
15	Benin	4.5	33	DRC	8.1	51	South Sudan	22.7
16	Ghana	4.7	34	Angola	8.2		Cape Verde	No data
17	South Africa	4.7	35	Ethiopia	8.7		Madagascar	No data
18	Liberia	5.6	36	Sierra Leone	9.4		Mauritius	No data

Source: Based on IFPRI (2016). Wasting percentage is most recent estimate from UNICEF, WHO, and World Bank (2015), September 2015 update.

Note: Analysis includes 54 African countries, listed according to the United Nations' naming and regional classification. Congo = Republic of the Congo; DRC = Democratic Republic of the Congo; Tanzania = United Republic of Tanzania.

On course, good progress Off course, no progress Insufficient data to make assessment

TABLE 3.4—COUNTRIES RANKED ACCORDING TO ANEMIA PERCENTAGE, LOWEST TO HIGHEST PREVALENCE, WITH ASSESSMENT OF PROGRESS TOWARD WORLD HEALTH ASSEMBLY TARGET

Rank	Country	Anemia percentage	Rank	Country	Anemia percentage
1	Rwanda	17.4	27	Tanzania	39.6
2	Ethiopia	19.2	28	Cameroon	41.5
3	Burundi	20.9	29	Somalia	42.6
4	Seychelles	21.2	30	Sao Tome and Principe	42.7
5	Mauritius	23.4	31	Mozambique	44.2
5	Kenya	25.0	32	Guinea-Bissau	44.6
7	Uganda	26.7	33	Angola	44.8
8	Lesotho	26.8	34	Sierra Leone	45.2
9	Djibouti	27.1	35	Gambia	45.3
10	South Africa	27.6	36	Equatorial Guinea	45.4
11	Swaziland	27.8	37	Central African Republic	46.0
12	Libya	27.9	38	Chad	46.6
13	Tunisia	28.0	39	Niger	46.7
14	Zimbabwe	28.4	40	Guinea	48.4
15	Botswana	28.5	41	Nigeria	48.5
16	Malawi	28.8	42	Côte d'Ivoire	48.8
17	Zambia	29.2	43	DRC	49.0
18	Comoros	30.8	44	Liberia	49.3
19	Sudan	31.5	45	Burkina Faso	49.5
20	Madagascar	31.8	46	Benin	49.6
21	Algeria	32.7	47	Congo	50.7
21	Namibia	32.7	48	Gabon	50.8
22	Eritrea	32.8	49	Togo	52.7
23	Morocco	33.1	50	Mali	56.2
24	Egypt	34.5	51	Ghana	56.4
25	Cape Verde	37.9	52	Senegal	57.5
26	Mauritania	39.0		South Sudan	No data

Source: IFPRI (2016). Anemia percentage is most recent estimate (2011) from Stevens et al. (2013).

Note: Analysis includes 54 African countries, listed according to the United Nations' naming and regional classification. Congo = Republic of the Congo; DRC = Democratic Republic of the Congo; Tanzania = United Republic of Tanzania.

On course, good progress | Off course, no progress | Insufficient data to make assessment

TABLE 3.5—COUNTRIES RANKED ACCORDING TO PERCENTAGE OF INFANTS YOUNGER THAN SIX MONTHS EXCLUSIVELY BREASTFED, HIGHEST TO LOWEST PREVALENCE, WITH ASSESSMENT OF PROGRESS TOWARD WORLD HEALTH ASSEMBLY TARGET

Rank	Country	EBF percentage	Rank	Country	EBF percentage
1	Rwanda	87.0	27	Egypt	39.7
2	Sao Tome and Principe	73.8	28	Mali	37.8
3	Zambia	72.5	29	Central African Republic	34.0
4	Malawi	70.2	30	Senegal	33.0
5	Burundi	69.3	31	Congo	32.9
6	Eritrea	68.7	32	Sierra Leone	32.0
7	Lesotho	66.9	33	Cameroon	28.2
8	Uganda	63.2	34	Morocco	27.8
9	Kenya	61.4	35	Mauritania	26.9
10	Cape Verde	59.6	36	Algeria	25.7
11	Togo	57.5	37	Niger	23.3
12	Sudan	55.4	38	Mauritius	21.0
13	Liberia	55.2	39	Guinea	20.5
14	Guinea-Bissau	52.5	40	Botswana	20.3
15	Ghana	52.3	41	Nigeria	17.4
16	Ethiopia	52.0	42	Comoros	12.1
17	Burkina Faso	50.1	42	Côte d'Ivoire	12.1
18	Namibia	48.5	43	Tunisia	8.5
19	DRC	47.6	44	South Africa	8.3
20	Gambia	46.8	45	Equatorial Guinea	7.4
21	South Sudan	45.1	46	Gabon	6.0
22	Swaziland	44.1	47	Somalia	5.3
23	Madagascar	41.9	48	Djibouti	1.3
24	Benin	41.4	49	Chad	0.3
25	Tanzania	41.1		Angola	No data
26	Mozambique	41.0		Libya	No data
26	Zimbabwe	41.0		Seychelles	No data

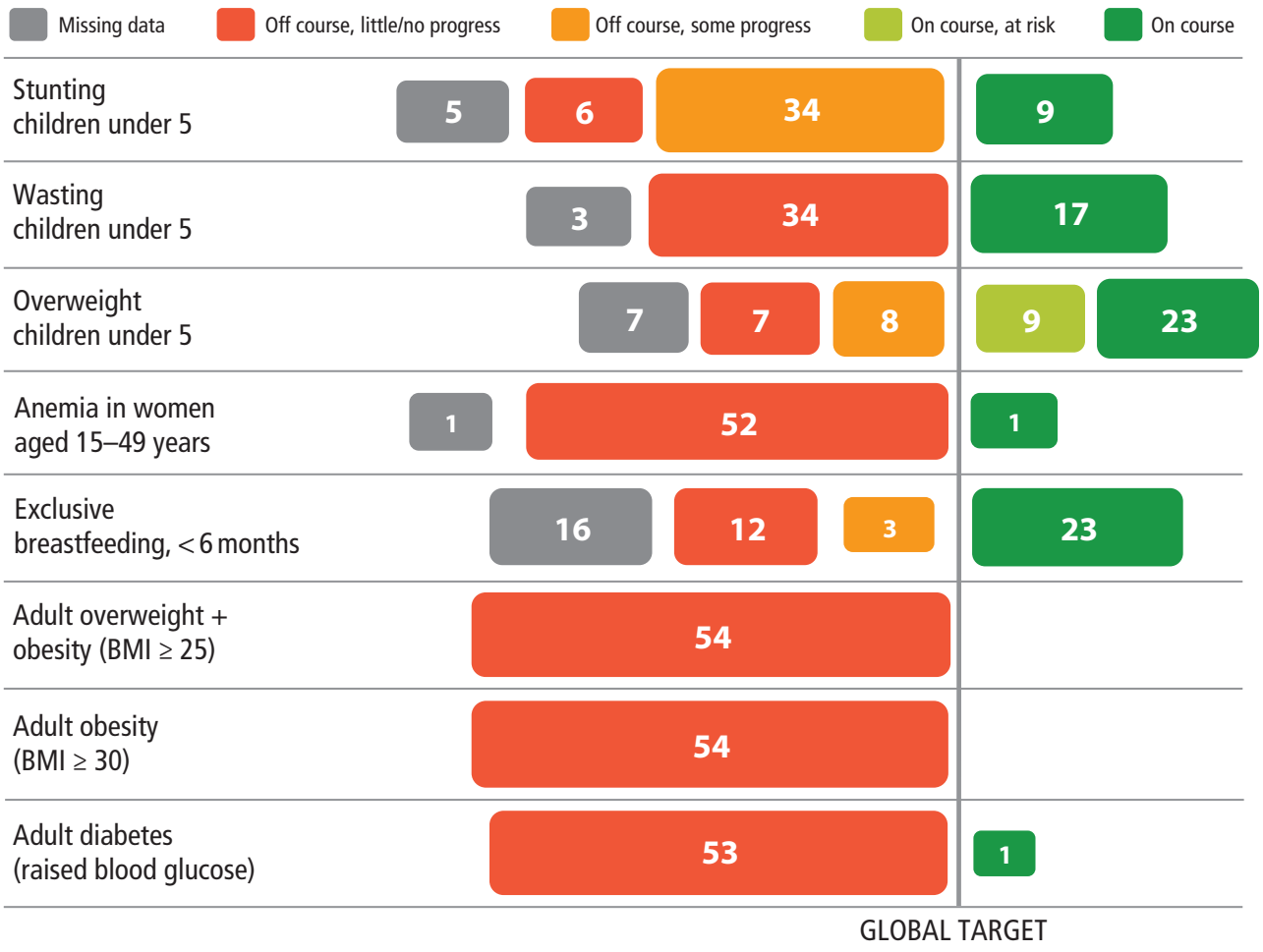
Source: Based on IFPRI (2016). Exclusive breastfeeding percentage is most recent estimate from UNICEF (2016), March 2016 update.

Note: Analysis includes 54 African countries, listed according to the United Nations' naming and regional classification. Congo = Republic of the Congo; DRC = Democratic Republic of the Congo; Tanzania = United Republic of Tanzania. EBF = exclusive breastfeeding.

On course, good progress | Off course, some progress | Off course, no progress | Insufficient data to make assessment

Figure 3.3 provides a summary of the eight indicators tracked by the *Global Nutrition Report*. Overall global progress on the eight WHA nutrition indicators is mixed. The data on overweight, obesity, and diabetes remind us of the size of the challenge faced, but the data on growth in children under age five and improvements in exclusive breastfeeding rates remind us of what can be achieved with the right focus, interventions, policies, sustained commitment, and stakeholder accountability mechanisms.

FIGURE 3.3—NUMBER OF AFRICAN COUNTRIES AT VARIOUS STAGES OF PROGRESS AGAINST GLOBAL TARGETS ON NUTRITION



Source: IFPRI (2016); data on stunting, wasting, and overweight based on Joint Malnutrition Estimates of UNICEF, WHO, and World Bank (2015); data on exclusive breastfeeding from UNICEF (2016); data on anemia in women of reproductive age from Stevens et al. (2013).

Note: Analysis includes 54 African countries, listed according to the United Nations' naming and regional classification. The *Global Nutrition Report 2016* (IFPRI 2016) provides data for all 54 African countries on levels and rates of progress for these indicators.

What Needs to Happen to End Malnutrition in Africa by 2030?

The calamity of malnutrition is not inevitable. It results from choices we make or fail to make. The *Global Nutrition Report 2016* (GNR 2016) outlines five sets of choices that policy makers—and all stakeholders—need to make (IFPRI 2016).

First, it is vital to make the right political choices. As highlighted in previous *GNR*s and in *Nourishing Millions* (Gillespie et al. 2016), governments and civil society in Brazil, Peru, Viet Nam, Kenya, Ghana, and the Indian states of Odisha and Maharashtra have pursued determined and sustained efforts to improve nutrition outcomes. And their efforts have paid off. These countries have made political choices to allocate scarce resources to nutrition. Political commitment to do something about malnutrition creates the space for dialogue about what needs to happen. But malnourished people need more than talk—they need action. Strong executive leadership from high-level government officials is vital to set the tone for all other stakeholders.

Second, we know a lot about which actions to take. The evidence is strong. Increasingly we know how to do it. We know we have to work at multiple levels across multiple sectors—whether the problem is stunting or anemia. We know we need a blend of nutrition-specific and nutrition-sensitive actions, supported by an enabling environment that makes it easier to make commitments that count.

Third, predictable and dedicated nutrition financing is essential if action is to be implemented in a sustained and widespread manner. This means making existing resources in agriculture, social protection, health, education, and water and sanitation work harder for nutrition, but it also means finding extra resources—from governments, local authorities, communities, external donors, households, and businesses—for the scale-up of already high-impact interventions.

Fourth, we need to reject business as usual. Business as usual will result in the persistence of this suffering all over the world, the depletion of human potential, and the squandering of economic growth. For example, as the *GNR 2016* shows, simple extrapolations of the rate of change of anemia prevalence in women suggest it would take until 2124 to attain a 5 percent prevalence rate (IFPRI 2016). Malnourished people cannot wait that long for their rights to be respected, protected, and promoted.

Finally, leaders throughout Africa need to make commitments that count. Commitments need to be specific, measurable, achievable, relevant, and time-bound (SMART), and they also need to be ambitious and aligned to the efforts of others. Therefore, more needs to be invested in more and better data, and inclusive annual national and subnational reporting mechanisms need to be developed and implemented to assess progress on commitments and nutrition outcomes and actions in a timely way.

Here is one final thought. Imagine if a new disease emerged that threatened the potential of one in three humans and affected all countries and all age groups. Imagine also that we already knew a lot about how to prevent and address it. Finally, imagine a world in which many leaders—at all levels—turned a blind eye to this new disease. The world would be outraged. This is the scenario that must be avoided for malnutrition. Ending malnutrition by 2030 is not a dream. It is a choice. We look to leaders throughout Africa to make that choice. The rest of us need to make it easier for them to do so—and harder not to.

CASE STUDY 1

Kenya's Status on Meeting World Health Assembly Child Nutrition Targets by 2025

Elizabeth Kimani-Murage, Teresia Macharia, Peninah Masibo, Dickson Amugsi, Marjorie Volege, and Betty Samburu

Malnutrition is a critical risk factor in most African countries and remains a fundamental challenge to child survival. It is a major public health concern in Africa south of the Sahara, associated with more than one-third of the global disease burden for children younger than five (Black et al. 2013; WHO 2015a). In East Africa, 50 percent of young children are stunted (UNSCN 2010). Recognizing that accelerated global action is needed to address the growing problem of the double burden of malnutrition, in 2012, World Health Assembly (WHA) Resolution 65.6 endorsed a comprehensive implementation plan on maternal, infant, and young child nutrition, which specified a set of six global nutrition targets to be met by 2025 (IFPRI 2015), indicated in Figure C1.1.

In reporting the nutritional profile of countries across the world, the *Global Nutrition Report 2015* (IFPRI 2015) singled out Kenya as the only country in the world on course to meet all the five WHA maternal and child nutrition health targets. However, in the 2016 report, based on some updates in the WHO database, Kenya is no longer on course to meet the target for anemia in women of reproductive age (IFPRI 2016). Figure C1.2 shows the progress Kenya has made so far vis-à-vis the WHA targets. Data spanning 16 years clearly show that the country has made good progress (Kenya NBS and ICF Macro 2010; Kenya NBS and ICF International 2015; NCPD et al. 1994, 1999).

What Did Kenya Do Right?

Kenya has put in place a number of interventions toward improving child nutrition. These include a supportive legal and policy environment, strong leadership and coordination in the nutrition sector, donor support, and improvement in underlying determinants of malnutrition, among others. The progress made in nutrition indicators could be attributed to concerted efforts toward ending malnutrition in Kenya, but there has not been systematic research to validate this perception.

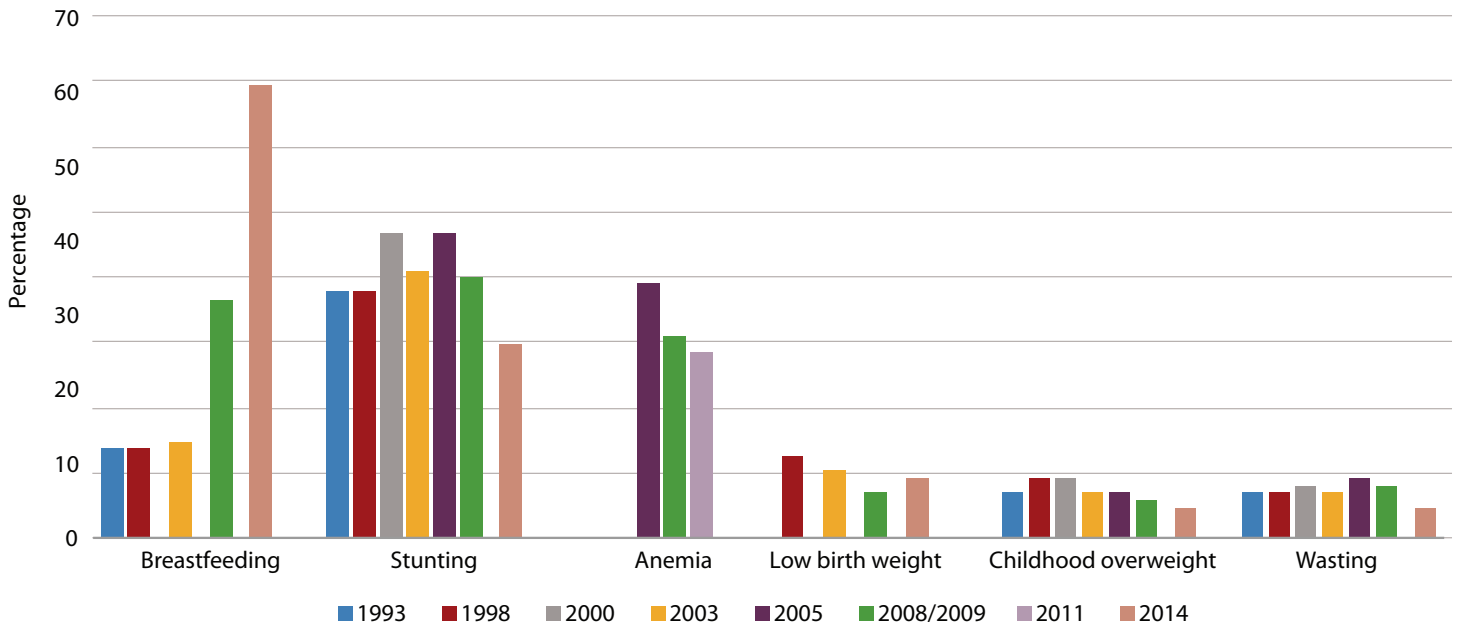
Supportive Legal and Policy Environment

Kenya has adopted several policies and regulations that support optimization of nutrition, as illustrated in Table C1.1.

Strong Government Leadership, Framework, and Coordination

Kenya has well-coordinated structures for implementation of nutrition actions, with clear roles and responsibilities for all stakeholders both in and out of government. All actions, including maternal, infant, and young child nutrition (MIYCN) actions, are coordinated by the Nutrition Inter-agency Coordinating Committee, which is chaired by the head of the

FIGURE C1.1—PROGRESS TOWARD WORLD HEALTH ASSEMBLY NUTRITION INDICATORS, KENYA, 1998–2014



Source: Kenya NBS and ICF Macro (2010); Kenya NBS and ICF International (2015); NCPD et al. (1994, 1999); WHO (2015b).
Note: Low birth weight was not included in *Global Nutrition Report 2015* (IFPRI 2015) due to lack of data in some countries.

Nutrition and Dietetics Unit in the Ministry of Health. The government and other implementing partners have increasingly enhanced the capacity of healthcare staff to support nutrition counseling through training on high-impact nutrition interventions (HINI), including those for MIYCN. This coordination is strengthened by the Scaling up Nutrition (SUN) movement, for which the head of the Nutrition and Dietetics Unit is the focal person. Kenya was an early-riser SUN country, joining in 2012 (SUN 2015), an action that has resulted in significant positive implications on nutrition leadership and coordination in the country. The SUN movement has enhanced the collaboration of other stakeholders Civil Society Alliance, academia and researchers, government ministries, the private sector, donors, and the UN) and encouraged a multisectoral approach to implementation of nutrition-specific and -sensitive interventions and strategies (SUN 2015).

TABLE C1.1—KENYA'S SUPPORTIVE LEGAL AND POLICY ENVIRONMENT

Policy and legislative provisions	How nutrition is addressed	Year of enactmentor inception
Kenya Vision 2030 (http://www.vision2030.go.ke/)	A development blueprint with a strong focus on nutrition. The nutrition section is aligned to World Health Assembly (WHA) targets.	2008
Constitution of Kenya[a]	Recognizes food and nutrition as a human right	2010
Food and nutrition security policy[b]	A key public policy endorsed by nine ministries to address nutrition security in the country through multisector action	2012
Kenya National Nutrition Action Plan (NNAP)[c]	A framework for coordinated implementation of high-impact nutrition interventions by the government and other nutrition stakeholders for maximum impacts at all levels. The NNAP is aligned to WHA targets. For example, Kenya aims to reach a target of 80 percent exclusive breastfeeding. At the moment it is at 61 percent, having increased from 32 percent in 2008.	2012
Mandatory fortification[d]	Dry milled products fortified in line with nutrient and regulatory requirements. Vegetable oils and fats fortified with vitamin A, wheat and maize flour with zinc and iron, and salt with iodine. The target is to reach 27 million individuals in Kenya with fortified foods.	2012
Adoption of the International Code of Marketing of Breastmilk Substitutes into national legislation: The Breast Milk Substitute (Regulation and Control) Act of 2012[e]	Protects, promotes, and supports breastfeeding through regulating and controlling marketing of breast milk substitutes	2012
National Nutrition Monitoring and Evaluation Framework[f]	Guides the monitoring and evaluation of activities of the nutrition sector in the country. This framework aims at consolidating nutrition data and information from various sources.	2013
National Guideline for Integrated Management of Acute Malnutrition (IMAM)[g]	Provides an opportunity for healthcare providers to realize the importance of proper management of acute malnutrition at health facility and community levels, ensure successful diagnosis and treatment, and consequently reduce child mortality due to malnutrition. Review of the IMAM guidelines is almost finalized.	2009
Policy on free maternal healthcare services in public health facilities[h]	Abolishes maternity charges in public health facilities to help all expectant mothers access maternal care	2013
Workplace Support Bill	Mandates that employers provide supportive structures for breastfeeding women, including breastfeeding stations and breaks. The guidelines are currently in the process of being developed by the Ministry of Health.	2016
Baby-Friendly Hospital Initiative	Promotes optimal breastfeeding around the time of delivery in maternity wards	Revitalized through the Infant and Young Child Feeding Strategy 2007–2010
Baby-Friendly Community Initiative	Promotes optimal breastfeeding and other maternal, infant, and young child nutrition (MIYCN) practices at the community level. The guidelines were developed and launched in 2016.	Adopted in MIYCN strategy 2012–2017

Source: [a] Constitution of Kenya (2010); [b] Kenya, Agricultural Sector Coordination Unit (2011); [c] Kenya, Ministry of Public Health and Sanitation (2012); [d] Kenya Food, Drugs and Chemical Substances Act (2012); [e] The Breast Milk Substitutes (Regulation and Control) Bill (2012); [f] National Nutrition Monitoring and Evaluation Framework (2013); [g] Kenya, Ministry of Public Health and Sanitation (2009); [h] "Ministry of Health Implements Free Maternity Services Nationwide" (2013).

Strong Donor Support

Kenya developed a budget of US$824 million to achieve the objectives underpinning the National Nutrition Action Plan 2012–2017 (NNAP), for which public funds in the amount of approximately US$70 million have been committed over the five-year plan (SUN 2013). The network of development partners supporting the initiative includes UN agencies and bilateral donors such as the European Union, the United States (through the United States Agency for International Development), Japan, the United Kingdom (through the Department for International Development), and the World Bank. There is an increase in support for nutrition at the county level, as evidenced by increased human resource capacity for nutrition as well as budgeting for nutrition in some of the counties, as part of decentralization.

Strong Monitoring, Evaluation, and Learning

To be able to measure progress on nutrition indicators, Kenya has incorporated strong monitoring, evaluation, and learning, coupled with information management and sharing, to guide the implementation of the five-year NNAP. Overseeing these efforts is a nutrition information working group convened by the Unit of Nutrition and Dietetics at the Ministry of Health. The group has set targets as envisioned in the NNAP and developed a monitoring and evaluation framework to support implementation and follow-up actions within the NNAP, including: capacity building on data quality; streamlining and monitoring of processes at the national and county levels; data quality checks and health-sector indicator reviews at the county level; and national review through the technical forum, with an aim of identifying successes, bridging gaps, and building emergency response and preparedness to enhance lifesaving and response to shocks.

Enhanced Human Resources for Health

As evidenced by a capacity assessment done by the Ministry of Health (unpublished), there is increased support for nutrition capacity building at the country level and hence increased human resources to support nutrition. The government and implementation partners have increasingly enhanced the technical and functional capacity of healthcare staff to support the design and delivery of health and nutrition programs in the country, including nutrition counseling through training on HINI, including infant and young child feeding. In addition, Kenya has a strong nutrition workforce that is supported by the Kenya Nutritionists and Dieticians Institute, which regulates training of the nutrition workforce, registration and licensing of nutritionists and dieticians, and standards of nutrition practice (KNDI 2015).

Furthermore, Kenya has adopted a community health strategy in line with the primary healthcare principles as its overarching approach to health promotion in communities (Kenya Ministry of Health 2006). This strategy has seen the establishment of mother support groups and integration of community-level MIYCN activities. The use of community health volunteers has enhanced the improved MIYCN practices at the community level and contributed to increased delivery by skilled birth attendants. The community health volunteers offer counseling and support to mothers. The Ministry of Health has adopted the Baby-Friendly Community Initiative model to enhance these efforts.

Advocacy

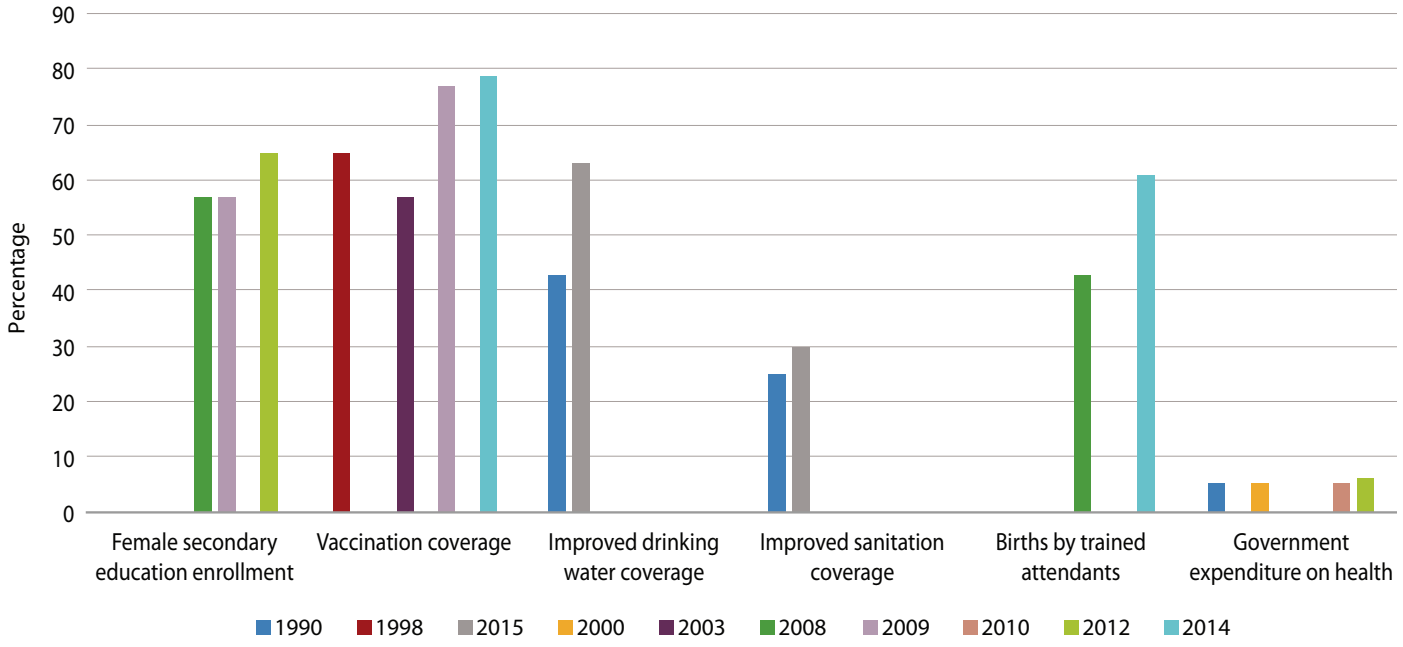
Based on learnings from the *Lancet Maternal and Child Nutrition Series* and the realization that nutrition indicators had stagnated over time, the

nutrition sector embarked on advocacy at both the national and county levels that is geared toward(1) increased resource allocation for nutrition (human resources and monetary), (2) inclusion and prioritization of nutrition in the national Second Medium Term Plan for implementation of Vision 2030 and the Kenya Health Sector Strategic Plan, and (3) advocacy for scale-up of interventions at both facility and community level. Nutrition policy is a core mandate of the Ministry of Health under the current ministerial structure.

Improvement in Underlying Determinants of Malnutrition

Maternal education, access to safe drinking water, sanitation coverage, utilization of antenatal care, and delivery of infants supported by qualified providers are notable underlying determinants for the reduction of malnutrition, and evidence indicates improvement in these indicators (Figure C1.2). Provision of clean, safe drinking water, which has improved, plays a role in reducing illness, especially among children; hence it contributed to improved nutritional status. Provision of improved water and sanitation is a key social pillar in the Vision 2030 strategy.

FIGURE C1.2—UNDERLYING DETERMINANTS OF MALNUTRITION IN KENYA, 1990–2014



Source: Masibo and Makoka (2012); National Bureau of Statistics–Kenya and ICF International (2015); UNESCO Institute for Statistics (2015).

Conclusion

Kenya has made progress to improve the nutritional status of children through strong government leadership and coordination, donor support for interventions, supportive policies and legislation, capacity building of the nutrition workforce, and a strong monitoring and evaluation system, among others. Nevertheless, in order to end malnutrition, more needs to be done, including (1) ratification of the Maternity Protection Convention, (2) enforcement of the Breast Milk Substitute (Regulation and Control) Act of 2012, (3) sensitization of employers to provide the necessary workplace support to enable mothers to successfully combine work with breastfeeding as required by the 2016 bill, (4) scaling up of the Baby-Friendly Community Initiative, and (5) increased investments to sustain the results. Further, the Kenya Vision 2030 platform needs to recognize nutrition as a major social pillar in order to emphasize measures that alleviate the burden of malnutrition. Moreover, systematic investigation and documentation of achievements, challenges, and lessons learned are required to keep track of progress made toward achieving the WHA targets.

CHAPTER 4

Economic Development and Nutrition Transition in Ghana: Taking Stock of Food Consumption Patterns and Trends

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Since the launch of its economic recovery program and the adoption of a market-oriented approach in 1983, Ghana has experienced high economic growth. Ghana's gross domestic product (GDP) grew at an annual rate of 5.6 percent (2.9 percent on a per capita basis) between 1984 and 2014 (World Bank 2016). The value-added share of the agricultural sector in GDP dropped from 52 percent in 1984 to 22 percent in 2014, and the value-added share of the service sector increased from 37 percent to 50 percent (World Bank 2016).[4] As in several other countries south of the Sahara, labor is gradually flowing out of agriculture and into more productive sectors of the economy, contributing to Ghana's high economic growth (Hassen et al. 2016; McMillan, Rodrik, and Verduzco-Gallo 2014; McMillan and Harttgen 2014). Associated with structural transformation of the economy, the urban population increased from an estimated 33 percent in 1984 to an estimated 54 percent in 2014 (UN-DESA 2016). Besides migration of family members or entire families from rural to urban areas, rural households have been increasingly diversifying their livelihoods through participation in the rural nonfarm sector (Kolavalli et al. 2012; Lay and Schüler 2008). High economic growth and economic transformation contributed to Ghana's impressive progress on the Millennium Development Goals (MDGs), in particular, the first goal of eradicating extreme poverty and hunger. Ghana achieved the targets of halving extreme poverty and halving the prevalence of child underweight between 1990 and 2015 as one of the first countries in Africa and ahead of the 2015 deadline (NDPC and UNDP 2015).

Along with continuing, rapid economic development, Ghana—like several other developing countries—is likely to face a rapid "nutrition transition," too. This term describes the shifts in physical activity levels and dietary patterns that go along with improvements in people's living standards and changes in their livelihood activities and lifestyles (Popkin 1993, 1994). For example, motorized transportation replaces walking and carrying of goods, mechanization in agriculture reduces its heavy physical workload, a growing share of the population moves out of agriculture and engages in less physically demanding employment, and sedentary activities and leisure become part of the lives of more people. All of this reduces people's physical energy requirements. Food sourcing increasingly shifts from own production for home consumption to market purchases, and the share of processed foods in people's diet grows. Shifts in dietary patterns include large increases in the calorie density of people's diet and in the per capita intake of animal-source foods (Popkin and Du 2003; Speedy 2003). The proportion of the population that suffers from acute food insecurity drops, and the proportion of people consuming a high-fat diet increases rapidly. Further down the road, the diet of an increasing number of people becomes overly rich in fat—especially from animal-source foods—as well as cholesterol, sugar, and other refined carbohydrates, and low in polyunsaturated fatty acids and fiber.

These shifts in dietary patterns give rise to new nutritional challenges: overweight/obesity and related noncommunicable diseases (NCDs) such as type 2 diabetes, coronary heart disease, stroke, and hypertension become

4 The value-added share of the manufacturing sector in GDP declined from 12 percent in 1985 to 5 percent in 2014 (World Bank 2016).

increasingly prevalent and evolve to become major public health problems. As a consequence, private and public healthcare costs increase, and productivity losses to the individual and the society mount (Finkelstein, Fiebelkorn, and Wang 2003; Finkelstein, Ruhm, and Kosa 2005; Popkin et al. 2006; Trogdon et al. 2008). Globally, overweight and obesity are increasingly prevalent in developing countries. Deaths related to NCDs are projected to increase worldwide by 15 percent between 2010 and 2020, with the largest increases expected to exceed 20 percent in Africa south of the Sahara, Southeast Asia, and the Middle East and North Africa (WHO 2011). Evidence from cross-country comparisons suggests that the described shifts in dietary patterns and physical activity levels are occurring at greater speed and at earlier stages of countries' economic and social development today than in the past (Popkin 2003). A rapid nutrition transition has been observed in many middle-income countries that have experienced high economic growth and economic transformation (Popkin 1998, 1999, 2002). Ghana entered the group of lower-middle-income countries just recently, with implications for the country's continuation on a steady economic development path.

Overweight and obesity typically increase faster than declines in (chronic) undernutrition. This leads to a situation in which overnutrition and undernutrition coexist. This coexistence is often referred to as the "double burden of malnutrition." This double burden may occur not only at the population level (for example, overweight/obesity among the rich and chronic undernutrition among the poor) but also within the same family (for example, overweight/obese mothers with stunted children) and even within the same individual (for example, a stunted but overweight/obese child) (Ecker et al. forthcoming; Prentice 2006; Schmidhuber and Shetty 2005; Shrimpton and Rokx 2012). Where the double burden of malnutrition is common at the family and individual levels, it is possible that the same circumstances the household and the individual face are capable of contributing to both under- and overnutrition. Such circumstances may be partially the result of obsolete or poorly targeted public policies and programs. For example, food and agricultural subsidies as well as household cash transfers—designed to reduce household food insecurity—have been shown to contribute to rising overweight and obesity and to be ineffective in reducing chronic child undernutrition or micronutrient malnutrition (Ecker et al. forthcoming; Jensen and Miller 2011; Kochar 2005; Leroy et al. 2013; Tarozzi 2005).

Hence, countries that face a nutrition transition, like Ghana, are increasingly confronted with new nutritional challenges and may need to revisit established food policies for further advancing people's well-being and economic prosperity. Against this background, this chapter first provides an overview of trends and patterns in key development and food supply indicators in Ghana. Then the analysis turns to the household level and explores household consumption data from the fifth and sixth rounds of the Ghana Living Standards Survey, conducted in 2005–2006 and 2012–2013 (GLSS5 and GLSS6). The household-level analysis describes typical food consumption patterns and shows how the consumption of particular food groups changes with household income growth. The findings from this study may be useful in informing ongoing food policy reform processes and for designing and implementing food security and nutrition–related policies and programs more generally.

The analysis pays particular attention to the consumption of protein-rich foods and especially animal-source foods for several reasons. First, changes in the consumption of animal-source foods (such as meat, fish/seafood, eggs, and dairy products) are key indicators of shifting diets and thus of the nutrition transition described above. Consistent with the theory of consumer demand, households will diversify into higher-value foods such as animal-source foods and, to a lesser extent, vegetables and fruits only when they have satisfied their basic dietary energy needs. Hence, as poor people become richer, they gravitate away from relatively tasteless staple foods and toward more protein- and micronutrient-rich foods that also impart greater taste and therefore utility (Jensen and Miller 2010). In doing so, they tend to substitute vegetal sources of protein with animal sources of protein. Second, in undernourished populations, the consumption of protein-rich foods, and animal-source foods in particular, is associated with improved nutrition outcomes including reduced nutritional deficiencies (Black et al. 2008; Murphy and Allen 2003; Neumann et al. 2003; Sandstrom and Cederblad 1980), improved linear growth of children and reduced risk of child stunting (Allen 2003; Caulfield et al. 2006; Bwibo and Neumann 2003; Marquis et al. 1997; Neumann et al. 2003; Rivera et al. 2003), and improved cognitive functioning (Black 2003, Black et al. 2008; Dror and Allen 2011; Gewa et al. 2009). Animal-source foods, especially meat and fish/seafood, are rich sources of high-quality protein as well as the micronutrients whose deficiencies cause widespread illness in developing countries (including iron, zinc, vitamin A, and folate). Third, (over)consumption of animal-source foods has been linked to overweight/obesity and higher risks of nutrition-related NCDs (Larsen 2003; Popkin and Gordon-Larsen 2004; Popkin 2006, 2009). For example, excess intake of cholesterol is widely known to increase the risk of coronary disease and stroke (HPSCG 2004; LaRosa et al. 1990; Yusuf et al. 2001a, 2001b).

Trends and Patterns in Development and Food Supply Indicators

Economic Growth, Poverty, and Child Undernutrition

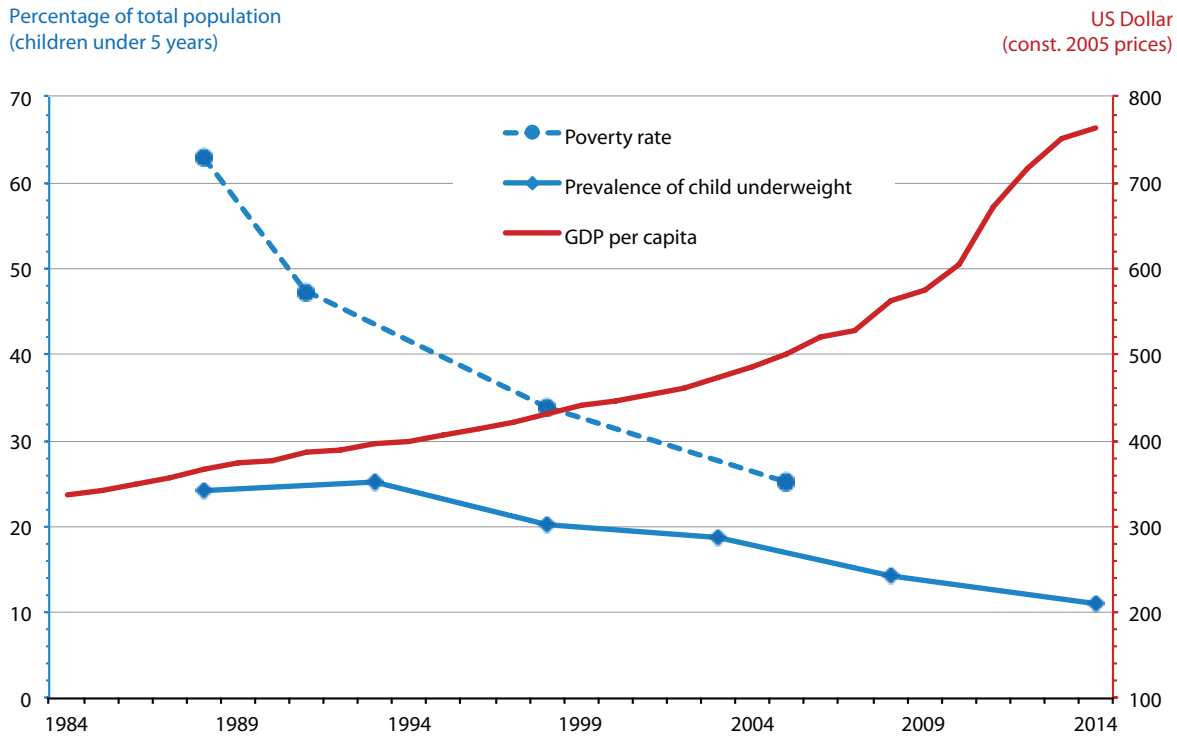
Ghana has been experiencing steady economic growth since 1984—after the launch of an economic recovery program and the adoption of a market-oriented approach. Ghana's GDP grew at an annual rate of 5.6 percent (2.9 percent on a per capita basis) between 1984 and 2014. Economic growth was particularly high during the last of the three decades (Figure 4.1), with average annual growth rates for total GDP of 7.3 percent and for per capita GDP of 4.7 percent. Even the lowest annual growth during this three-decade period—in 1990—was positive and moderate, with a total growth rate of 3.3 percent and a per capita growth rate of 0.5 percent (World Bank 2016). The GDP per capita grew by almost 2.3 times, from US$337 in 1984 to US$764 in 2014 (at constant 2005 prices). During just the last decade, it grew by almost 1.6 times, from US$468 in 2004, compared with 1.4 times during the first two decades.

Ghana's economic growth trickled down to the poor and contributed to a large reduction in poverty. Measured by the international line for extreme poverty, poverty dropped from 62.8 percent in 1988 to 25.2 percent in 2005

(Figure 4.1). This equals an annual average reduction of 2.2 percentage points, or 5.2 percent. Although somewhat less rapidly, poverty reduction has continued at high rates in more recent years. Measured by the national line for extreme poverty (which is higher than the international threshold), poverty dropped from 31.9 percent in 2005–2006 to 24.2 percent in 2012–2013 nationwide (Table 4.1). In absolute terms, the largest share of this reduction occurred in rural areas, where 52.0 percent of the total population lived in 2005 (World Bank 2016).[5] Rural poverty declined from 43.7 percent in 2005–2006 to 37.9 percent in 2012–2013—or by 0.8 percentage points per year (Table 4.1). Nevertheless, poverty remains predominantly a rural phenomenon. The poverty rate in rural areas in both 2005–2006 and 2012–2013 was more than 3.5 times the rate in urban areas. In relative terms, poverty declined slightly faster in urban areas than rural areas—at an annual average rate of 2.2 percent over this seven-year period, compared with 2.0 percent in rural areas.

Ghana also achieved major progress in reducing undernutrition among children younger than five. Between 1988 and 2006, the national prevalence of child stunting—indicating chronic child undernutrition—declined by an annual average rate of 0.4 percentage points or 1.2 percent. The national prevalence rate of child underweight—indicating overall (that is,

FIGURE 4.1—ECONOMIC GROWTH AND REDUCTION IN POVERTY AND CHILD UNDERNUTRITION, GHANA, 1984–2014



Source: Authors' representation based on data from World Bank (2016).

Note: Poverty rate is defined by the international US$1.90-a-day threshold (at 2011 purchasing power parity), marking extreme poverty. GDP = gross domestic product.

[5] Due to considerably higher population growth in urban areas than in rural areas in recent years, more people live in urban areas than in rural areas today. In 2014, the proportion of urban population accounted for an estimated 54.0 percent of the total population (World Bank 2016).

TABLE 4.1—POVERTY AND CHILD UNDERNUTRITION IN GHANA

Indicator	Total	Rural	Urban
Prevalence rates			
Poverty (percentage of total population)[a]			
2005–2006	31.9	43.7	12.4
2012–2013	24.2	37.9	10.6
Child stunting (percentage of children younger than five)[b]			
2008	28.0	32.3	21.1
2014	18.8	22.1	14.8
Child underweight (percentage of children younger than five)[b]			
2008	13.9	16.0	10.6
2014	11.0	13.1	8.6
Annual change (seven-year average)			
Poverty			
Percentage points	–1.1	–0.8	–0.3
Percentage	–3.9	–2.0	–2.2
Child stunting			
Percentage points	–1.3	–1.5	–0.9
Percentage	–5.5	–5.3	–4.9
Child underweight			
Percentage points	–0.4	–0.4	–0.3
Percentage	–3.3	–2.8	–2.9

Source: Authors' representation based on data from [a] World Bank (2016) and [b] ICF International (2016).

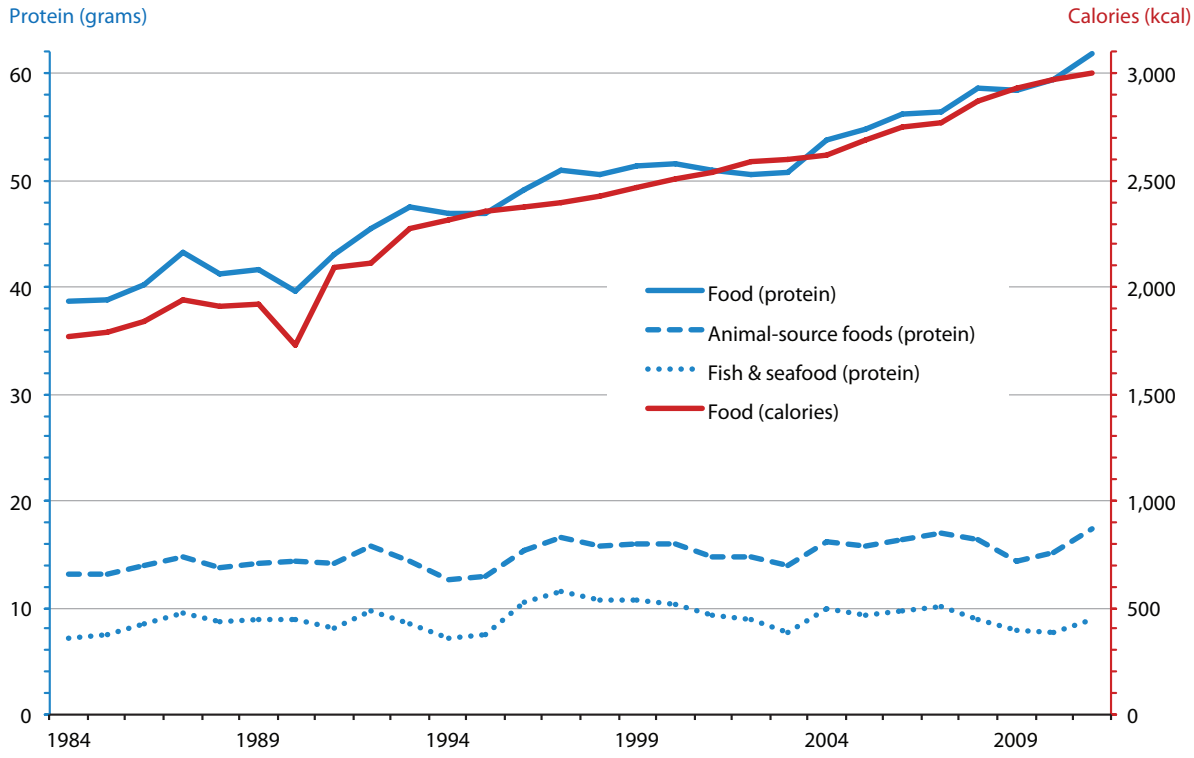
chronic and acute) undernutrition—declined by an annual average rate of 0.6 percentage points or 3.0 percent. Hence, the average annual reduction in the prevalence of both child undernutrition indicators between 1988 and 2005–2006 is lower than that of the poverty rate—in both absolute and relative terms. A slower relative (and absolute) reduction in child undernutrition than in poverty is consistent with international evidence. Nonetheless, Ghana's progress in reducing child undernutrition is clearly above average in the international comparison (World Bank 2016).

In more recent years, Ghana achieved a faster reduction in chronic child undernutrition than in poverty, and this in addition to rapid poverty reduction. The national prevalence of child stunting dropped from 28.0 percent in 2008 to 18.8 percent in 2014 (Table 4.1). This equals an average annual reduction of 1.3 percentage points, or 5.5 percent, over a seven-year period. Over a period of identical length and large time overlap, national poverty declined by 1.1 percentage points, or 3.9 percent, per year, and from a higher initial rate of 31.9 percent. Child stunting declined more rapidly in rural areas than in urban areas, and the rural-urban gap in child stunting prevalence was less pronounced than it was for poverty. Child stunting in rural areas was about 1.5 times more prevalent than in urban areas in 2008 and 2014. The progress achieved in reducing the prevalence of child stunting also reflects in the decline in the prevalence of child underweight. The reduction in chronic child undernutrition points to a significant improvement in the diets of young children and of their mothers during pregnancy and lactation (in addition to improvements in women's and children's health conditions).

Food and Nutrient Availability

The Food Balance Sheets (FBS) database of the Food and Agriculture Organization of the United Nations (FAO 2016) can provide a first glance at long-term trends and patterns of the per capita availability of food, food groups, main food items, and macronutrients at the national level.[6] Ghana's per capita availability of food—expressed on the basis of dietary energy in calories (for comparison across food groups)—has continuously improved between 1984 and 2011, with the exception of a drop in 1990 after a process of gradual devaluation of the Ghanaian cedi and the adoption of a free-floating system (Figure 4.2). The per capita availability of total protein (from food) has increased in great conformity with the per capita availability of total calories, with a correlation coefficient of 0.987 for the period 1984–2011. The fact that protein availability did not grow faster than calorie availability tentatively suggests that the average Ghanaian diet did not become denser in protein-rich foods during this period of almost three decades. Thus, these national data do not provide convincing evidence for a distinct nutrition transition in Ghana at the national level until 2011.

FIGURE 4.2—CALORIE AND PROTEIN AVAILABILITY (PER CAPITA PER DAY), GHANA, 1984–2011



Source: Authors' representation based on FAO (2016).

[6] In the FBS database (FAO 2016), the per capita food supply in a country available for human consumption—referred to as "food availability" in this chapter—is calculated as the residual of total quantity of foodstuffs produced plus the total quantity imported; minus the total quantity exported; adjusted for any change in stocks; and minus the total quantities used for livestock feed and seed, put to manufacture for food and nonfood uses, and lost during storage and transportation. Quantities of per capita food availability are converted into levels of calorie, protein, and fat availability by applying appropriate food composition factors for all primary and processed products (FAO 2016).

There is also no indication of a shift in the composition of total protein availability toward greater shares of protein from animal-source foods at the national level until 2011 (Figure 4.2). Rather, the opposite appears to have been the case. While the per capita availability of total protein steadily increased between 1984 and 2011, the per capita availability of animal protein stayed fairly constant. Accordingly, the increase in the per capita availability of total protein was driven by an increase in per capita availability of protein from vegetal sources. The share of animal protein in total protein declined from a five-year average of 34 percent at the beginning of the period 1984–2011 to a five-year average of 27 percent at the end of the period. The composition of the per capita availability of animal protein at the national level did not change markedly either. Around 93 percent of animal protein stemmed from meat and fish/seafood, a figure that has been quite stable over the time period under consideration. The largest share of total animal protein—around 60 percent—stemmed from fish/seafood. Visual comparison of the trends in animal protein availability and fish/seafood protein availability shows close co-movements (Figure 4.2), indicating limited substitution of fish/seafood with meat (during times of high fish/seafood prices).

Consistent with the trends in extreme poverty and child undernutrition, the trends and patterns in food and macronutrient availability suggest that, at least between 1984 and 2011, Ghana went through a phase of the nutrition transition that is characterized by a steady reduction in ubiquitous, severe food insecurity and hunger, described as a phase of "receding famine" by Popkin (1994).

Although this FBS data analysis can provide a useful first glance at Ghana's long-term trends and patterns of per capita food and macronutrient availability, the precise estimates should not be overinterpreted. The FBS database provides only averages at the country level. Thus, these estimates do not allow us to draw inferences on food and macronutrient availability trends and patterns at the subnational level. For example, they provide no information on whether the observed countrywide food and macronutrient availability trends are mainly driven by changes in urban areas or in rural areas, or on whether food and macronutrient availability trends in southern and northern Ghana conform to one another or vary from each other. Moreover, the FBS data cannot reveal any evidence on actual household food consumption, given the methodology underlying the data computation.[7] For that, detailed food consumption data from household surveys are needed, which, unfortunately, are usually unavailable for extended time series—unlike the FBS data.

Household Food Consumption Patterns and Trends in Southern and Northern Ghana

To complement and specify the first-glance findings of the FBS data–based analysis, the household-level analysis in this section makes use of food consumption data from the GLSS5 in 2005–2006 and GLSS6 in 2012–2013.[8] The analysis consists of two parts. The first part uses descriptive statistics and visualization techniques to examine the composition of average Ghanaian

7 Section A1 in the Technical Appendix (http://resakss.org/node/2190) discusses limitations of FBS data.

8 Section A2 in the Technical Appendix (http://resakss.org/node/2190) describes the GLSS data used and the methodology applied for calculating household food consumption values.

food consumption. The second part interprets estimated Engel curves and discusses elasticities derived from the Engel curve estimates. Engel curves show how food (group) consumption changes with increasing household income, and elasticities provide measures of the percentage changes in food (group) consumption due to a 1 percent change in household income. Given the focus of this study on the expected nutrition transition in Ghana, both parts serve to identify changes in food consumption patterns between 2005–2006 and 2012–2013. Hence, the analysis mainly compares the food consumption patterns captured by the fifth and sixth rounds of the GLSS.

The GLSSs provide household food consumption data for 116 food items.[9] These food items were grouped into six main food groups, considering their total protein content, protein source, and protein quality (FAO and FHI 360, 2016). Within each main group, food products of the same origin were grouped together. Less frequently consumed food items were pooled into "others" categories. The six main food groups are animal-source foods (fish and seafood, beef, chicken, other meats, milk and dairy products, eggs); pulses and nuts (beans, groundnuts, other pulses and nuts); cereals (maize, rice, wheat, other cereals); starchy roots and tubers (cassava, plantain, yams, other roots and tubers); vegetables and fruits (tomatoes, peppers, onions, other vegetables, fruits); and meal additives (palm oil, other oils and fats, sugar and sweets, beverages and miscellaneous).[10] Concerning a sufficient and well-balanced protein nutrition, the consumption of animal-source foods and of pulses and nuts is of particular relevance, because these two food groups are the main sources of high-quality protein, in addition to cereals, which typically provide the bulk of total protein in developing countries (Millward 1999; Pereira and Vincente 2013; Schönfeldt and Hall 2012; Young and Pellett 1994).

The analysis in both parts was conducted separately for rural and urban areas, because there are substantial urban-rural differences in people's living conditions, economic activities, food sourcing, and diets. Within urban and rural areas, the analysis was also conducted separately for southern Ghana and northern Ghana, where agricultural production conditions—and therefore possibly consumption patterns for (own-produced) foods—are quite different. Southern Ghana comprises the Coastal and Forest agroecological zones (AEZs), and northern Ghana consists of the Savannah AEZ. Southern Ghana has one long and one short rainy season and dry season per year, while there is only one rainy and one dry season in northern Ghana. Due to higher rainfall and tropical vegetation coverage, roots and tubers (and to some extent plantains) are traditional staple crops in southern Ghana, whereas cereals are the dominant staple crops in northern Ghana. Ruminant livestock production—especially cattle husbandry—is concentrated in northern Ghana.[11]

Characteristics of Household Food Consumption

Large shares of the foods consumed in Ghanaian households are own-produced on households' farms. Therefore, the availability of macronutrients (carbohydrates, protein, and fat) and micronutrients (vitamins and minerals) in many Ghanaian families is determined in large part by the amounts and

9 See Table A3.1 in the Technical Appendix (http://resakss.org/node/2190).

10 Section A3 in the Technical Appendix (http://resakss.org/node/2190) presents the food group classification in detail.

11 This study differentiates four "regions": (1) urban areas in southern Ghana—the urban south, (2) rural areas in southern Ghana—the rural south, (3) urban areas in northern Ghana—the urban north, and (4) rural areas in northern Ghana—the rural north.

diversity of the food produced by themselves. Tables 4.2 and 4.3 present the percentage shares of own-produced food consumption (measured in monetary value terms) in southern and northern Ghana for total food and for the main food groups at sample means. The tables also show the mean differences in own-produced food consumption shares between 2005–2006 and 2012–2013, and the significance levels of the performed t-tests on the equality of means (for unequal variance of the samples).

Comparisons of mean own-produced food consumption shares suggest that the share of own-produced food in total food consumption is much lower in southern Ghana than in northern Ghana (Tables 4.2 and 4.3), where markets are less developed and consumers' market access is often limited in rural areas (Kolavalli et al. 2012; Quaye 2008). This is consistent with evidence from the agricultural economics literature showing that the link between agricultural production and household food consumption is particularly strong in the presence of market imperfections (Barrett, Reardon, and Webb 2001; de Janvry, Fafchamps, and Sadoulet 1991; Dillon, McGee, and Oseni 2015; Hirvonen, Taffesse, and Hassen 2016). Between 2005–2006 and 2012–2013, the own-produced food consumption share of total food significantly declined in both rural and urban areas in southern Ghana, but it did not change significantly in rural and urban areas in northern Ghana. A possible interpretation is that, in the course of economic development, market integration considerably improved over this seven-year period in the south—and its rural areas in particular—but not so in the north.

TABLE 4.2—SHARES OF OWN-PRODUCED FOODS IN TOTAL FOOD AND FOOD GROUP CONSUMPTION (PERCENTAGES) IN SOUTHERN GHANA

	Urban						Rural					
	2005–2006		*2012–2013*		*Change*		*2005–2006*		*2012–2013*		*Change*	
Food group	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**
Total food	4.5	12.3	3.6	11.0	–0.8	***	24.7	22.1	21.1	22.5	–3.7	***
Animal-source foods	1.1	7.7	0.8	6.7	–0.3	*	5.3	14.5	4.0	12.9	–1.2	***
Pulses and nuts	0.8	7.0	0.6	6.8	–0.2		8.2	24.4	6.4	22.4	–1.8	***
Cereals	2.5	10.0	3.5	12.4	1.0	***	15.6	23.7	15.9	25.8	0.2	
Roots and tubers	10.6	27.0	8.4	24.2	–2.2	***	55.7	40.7	48.4	43.1	–7.2	***
Vegetables and fruits	3.0	11.4	1.6	8.0	–1.4	***	20.8	26.5	14.1	24.0	–6.7	***

Source: Authors' calculation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).
Note: Consumption is measured in monetary value terms. ***, **, * Mean difference is statistically significant at the 1 percent, 5 percent, and 10 percent level, respectively.

TABLE 4.3—SHARES OF OWN-PRODUCED FOODS IN TOTAL FOOD AND FOOD GROUP CONSUMPTION (PERCENTAGES) IN NORTHERN GHANA

	Urban						Rural					
	2005–2006		*2012–2013*		*Change*		*2005–2006*		*2012–2013*		*Change*	
Food group	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**
Total food	11.8	19.2	12.6	20.3	0.8		39.3	27.0	38.2	25.7	–1.1	
Animal-source foods	1.3	7.1	4.5	13.7	3.2	***	9.5	23.2	11.9	23.6	2.4	***
Pulses and nuts	14.8	33.6	17.6	34.3	2.9		56.9	46.1	52.8	45.3	–4.1	***
Cereals	12.7	22.9	15.6	26.9	2.9	**	46.1	36.9	47.8	36.0	1.7	*
Roots and tubers	20.3	36.5	19.1	36.9	–1.2		51.1	47.4	46.8	47.0	–4.3	***
Vegetables and fruits	7.4	19.7	5.9	16.1	–1.4		27.8	33.2	22.3	29.7	–5.5	***

Source: Authors' calculation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).
Note: Consumption is measured in monetary value terms. ***, **, * Mean difference is statistically significant at the 1 percent, 5 percent, and 10 percent level, respectively.

Mean shares of own-produced food consumption are highest for the food groups that contain the main local staple food and—in northern Ghana—for pulses and nuts; they are lowest for animal-source foods (Tables 4.2 and 4.3). In 2012–2013, the consumption of own-produced roots and tubers added up to 48 percent of the consumption of total roots and tubers among households living in rural areas of southern Ghana and to 47 percent among households living in rural areas of northern Ghana. Own-produced food consumption shares for cereals and for pulses and nuts amounted to 47 percent and 53 percent in the rural north, compared with 16 percent and 6 percent in the rural south, respectively. Thus, about half of the vegetal protein food sources came from own-production in rural households in northern Ghana. Even in urban areas in northern Ghana, the mean shares of own-produced food consumption were fairly high, at 19 percent for roots and tubers, 18 percent for pulses and nuts, and 16 percent for cereals in 2012–2013 (compared with 8 percent, 1 percent, and 4 percent, respectively, in urban areas in southern Ghana). The consumption share of own-produced animal-source foods in total animal-source foods has been much higher in northern Ghana than in southern Ghana, too. In 2012–2013, the mean share amounted to 12 percent in the rural north, compared with 4 percent in the rural south. However, even in the rural north, animal protein was largely obtained from foods purchased in the markets, unlike vegetal protein. The mean shares of animal-source foods and cereals in both rural and urban areas in northern Ghana (and cereals in urban areas in southern Ghana) significantly increased between 2005–2006

and 2012–2013, whereas the mean shares of all other food groups across all regions significantly declined or did not change significantly, as one would expect in a transforming economy.

Associated with differences in economic development and agricultural production conditions (Coulombe and Wodon 2012a; Kolavalli et al. 2012; Quaye 2008), the composition of household food consumption varies across Ghana's regions. Tables 4.4 and 4.5 show the total, food, and main food group consumption levels per adult equivalent per day in urban and rural areas of southern and northern Ghana at sample means. The tables also show the average shares of food group consumption in total food consumption and the average shares of food consumption in total consumption expenditure. In addition, the tables show the mean differences in consumption levels and consumption shares between 2005–2006 and 2012–2013, the significance levels of the performed t-tests on the equality of means (for unequal variance of the samples), and the percentage changes at sample means. For a better visualization of the composition of food consumption, Figures 4.3 and 4.4 present tree maps, where the sizes of the nested rectangles match the average consumption shares for the corresponding food groups and subgroups in total food consumption.

The average share of food consumption in total consumption expenditure varied considerably between urban and rural areas and between southern and northern Ghana (Tables 4.4 and 4.5). In 2012–2013, food consumption in urban areas added up to 39 percent of total consumption expenditure in the south and 46 percent in the north. Food consumption shares were much higher in rural areas, at 54 percent in the south and 60 percent in the north. This pattern is largely consistent with regional differences in the prevalence of poverty and household food insecurity found in previous studies (Coulombe and Wodon 2012a, 2012b; Quaye 2008).

The south-north gap in household wealth may also be reflected to a large extent in regional differences in the food consumption shares for animal-source foods (Tables 4.4 and 4.5). Compared with foods of vegetal origin, animal-source foods are typically more expensive sources of dietary energy and considered to have greater taste, both characteristics of superior goods (whose shares in total consumption tend to increase as people's income rises). In 2012–2013, animal-source foods accounted for 30 percent of total food consumption in both urban and rural areas in southern Ghana, compared with 24 percent in urban areas in northern Ghana and only 18 percent in rural areas in northern Ghana. Fish and seafood were the most important sources of high-quality protein across Ghana and especially in rural areas. The food consumption shares of fish and seafood were markedly larger than those of all meats in the urban and rural south and in the rural north. In the urban north, the food consumption share of fish and seafood and that of all meats were about equal.

Mainly because of different local staple foods, the food consumption shares of cereals were higher in northern Ghana than in southern Ghana, and the shares of roots and tubers were higher in southern Ghana than in northern Ghana, especially in rural areas (Tables 4.4 and 4.5). Nonetheless, cereals accounted for sizable food consumption shares in urban and rural areas in both northern and southern Ghana. In 2012–2013, cereals made up 25 percent of total food consumption in the urban north and 29 percent in the rural north. The food consumption shares of cereals in the urban and

rural south were 19 percent. Roots and tubers accounted for 12–13 percent of total food consumption in the urban south and in the urban and rural north; in the rural south the share was 21 percent.

Pulses and nuts accounted for considerable food consumption shares in northern Ghana, but much less so in southern Ghana (Tables 4.4 and 4.5). In 2012–2013, the food consumption share of pulses and nuts was 7 percent in the rural north and 5 percent in the urban north, compared with less than 2 percent in the rural and urban south. Hence, cereals and animal-source foods were the most important protein sources across all regions. However, although animal-source foods were the primary source of high-quality protein across Ghana, pulses and nuts were an important source of high-quality protein in the north—especially in rural areas and probably for smallholder subsistence farmers in particular. In southern and northern Ghana, vegetables and fruits made up 16–17 percent of total food consumption in urban areas and 14–15 percent in rural areas in 2012–2013. Thus, along with economic development, the nutrition transition—as identified by increasing total protein content in the diet and shifts in high-quality protein sources from foods of vegetal origin to foods of animal origin—has advanced most in southern Ghana and least in rural areas in northern Ghana.

Along with increased mean household income levels (as proxied by total consumption expenditure), the average shares of food consumption in total consumption expenditure significantly declined, by 4–8 percent, between 2005–2006 and 2012–2013, depending on the region (Tables 4.4 and 4.5). The largest decline occurred in the rural north, the poorest region, and the smallest decline occurred in the urban south, the richest region. The shares of animal protein–rich foods on total food consumption did not change significantly, except for rural areas in northern Ghana—the region where the nutrition transition has progressed the least. Over the observed period of seven years, the food consumption share of animal protein–rich foods increased by 11 percent in the rural north. At the same time, the share of pulses and nuts increased by 21 percent, and the shares of cereals and of roots and tubers declined by 9 percent and 7 percent, respectively. These changes mark a distinct shift from a food consumption pattern largely dominated by staple foods toward one with higher shares of high-quality protein sources of both vegetal and animal origin.

The changes in the food group consumption shares between 2005–2006 and 2012–2013 indicate two important shifts that were consistent across urban and rural areas in southern Ghana and urban areas in northern Ghana but different from the shifts observed for rural areas in northern Ghana: the food consumption shares of vegetables and fruits increased significantly, and (partial) substitution mainly occurred between the different vegetal food groups (considering that the consumption shares of animal-source foods did not change significantly) (Tables 4.4 and 4.5). As in the rural north, the food consumption shares of the food group containing the main local staple food significantly declined in the urban and rural south and the urban north. The largest increase in the food consumption share of vegetables and fruits occurred in the urban south, amounting to 12 percent between 2005–2006 and 2012–2013. In this region, both the food consumption share of cereals and that of roots and tubers declined at similar rates of 5–6 percent, while the food consumption share of pulses and nuts did not change significantly. In the rural south, the food consumption share of roots and tubers declined by 10 percent, whereas that of cereals increased by

6 percent, implying a partial substitution between different types of staple foods. The food consumption share of pulses and nuts declined by 5 percent, and that of vegetables and fruits increased by the same percentage. The largest (relative) shifts in the food group consumption patterns occurred for the urban north: the food consumption shares of pulses and nuts and of vegetables and fruits increased by 24 percent and 10 percent, respectively, and that of cereals declined by 10 percent. Hence, the food consumption shares for high-quality vegetal protein sources increased in both urban and rural areas in northern Ghana at high rates, but from low (absolute) consumption levels, compared with other food groups.

In summary, the observed changes in the average composition of household food consumption point to overall moderate shifts in dietary patterns at the subnational level between 2005–2006 and 2012–2013. The changes differ in direction and magnitude by region (which may partly explain why

TABLE 4.4—HOUSEHOLD FOOD CONSUMPTION (GHANAIAN CEDI) AND FOOD CONSUMPTION SHARES (PERCENTAGES) IN SOUTHERN GHANA

	Urban							Rural						
	2005–2006		*2012–2013*		*Change*			*2005–2006*		*2012–2013*		*Change*		
Food group	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**	**Percentage**	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**	**Percentage**
Total consumption	7.71	9.38	13.52	12.24	5.81	***	75	4.42	4.25	8.04	8.03	3.62	***	82
Food consumption	3.03	5.74	4.95	5.01	1.92	***	63	2.54	3.42	4.13	4.76	1.59	***	62
Share	41.0	16.4	39.2	16.0	–1.8	***	–4	56.6	15.6	53.7	16.6	–2.9	***	–5
Animal-source foods	0.97	4.45	1.55	1.92	0.58	***	60	0.72	0.83	1.18	1.04	0.45	***	63
Share	29.8	10.5	30.0	12.7	0.2		1	30.2	11.4	29.8	11.8	–0.4		–1
Pulses and nuts	0.04	0.07	0.08	0.13	0.03	***	75	0.04	0.06	0.06	0.12	0.02	***	68
Share	1.6	2.8	1.6	2.8	0.0		1	1.5	1.9	1.4	2.2	–0.1	*	–5
Cereals	0.56	0.68	0.92	1.90	0.36	***	64	0.44	0.85	0.74	0.79	0.30	***	69
Share	20.7	11.2	19.5	11.2	–1.2	***	–6	18.1	10.4	19.2	11.3	1.1	***	6
Roots and tubers	0.39	1.42	0.59	1.64	0.20	***	51	0.67	2.46	0.95	3.51	0.28	***	43
Share	13.0	10.5	12.3	10.6	–0.7	***	–5	23.0	14.7	20.7	15.4	–2.3	***	–10
Vegetables and fruits	0.47	1.73	0.85	1.16	0.38	***	82	0.33	0.63	0.59	1.23	0.26	***	77
Share	15.4	7.8	17.2	8.3	1.8	***	12	13.6	6.9	14.3	7.6	0.7	***	5

Source: Authors' calculation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).

Note: Consumption is measured in monetary value terms, in Ghanaian cedi. Household consumption levels are expressed in units per adult equivalent per day. ***, **, * Mean difference is statistically significant at the 1 percent, 5 percent, and 10 percent level, respectively.

TABLE 4.5—HOUSEHOLD FOOD CONSUMPTION (GHANAIAN CEDI) AND FOOD CONSUMPTION SHARES (PERCENTAGES) IN NORTHERN GHANA

	Urban							Rural						
	2005–2006		*2012–2013*		*Change*			*2005–2006*		*2012–2013*		*Change*		
Food group	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**	**Percentage**	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**Mean**	**Sig. lev.**	**Percentage**
Total consumption	4.59	3.64	8.97	8.27	4.38	***	95	2.52	5.65	4.84	4.87	2.33	***	92
Food consumption	2.16	1.75	3.79	3.17	1.63	***	75	1.60	2.53	2.83	2.97	1.22	***	76
Share	49.0	17.5	46.2	16.0	–2.8	***	–6	64.8	15.5	59.7	16.2	–5.0	***	–8
Animal-source foods	0.54	0.56	0.92	1.00	0.38	***	71	0.27	0.78	0.53	0.82	0.26	***	96
Share	23.9	12.4	23.5	11.1	–0.4		–2	15.7	11.3	17.5	12.3	1.8	***	11
Pulses and nuts	0.08	0.32	0.13	0.29	0.05	***	70	0.09	0.34	0.21	0.64	0.11	***	120
Share	2.7	7.2	3.4	5.0	0.6	*	24	5.6	9.5	6.8	9.4	1.2	***	21
Cereals	0.54	0.53	0.93	1.04	0.39	***	72	0.42	0.96	0.73	0.99	0.31	***	74
Share	28.5	15.9	25.1	14.2	–3.3	***	–12	32.2	19.0	29.2	17.6	–3.1	***	–9
Roots and tubers	0.29	0.38	0.45	0.97	0.16	***	53	0.26	0.59	0.43	1.15	0.17	***	65
Share	12.5	13.1	11.6	13.4	–0.9		–7	13.6	17.6	12.7	17.0	–0.9	**	–7
Vegetables and fruits	0.34	0.61	0.59	0.56	0.25	***	74	0.35	1.72	0.45	0.92	0.10	**	29
Share	14.6	9.6	16.1	7.7	1.4	***	10	15.4	14.6	15.4	10.2	–0.1		0

Source: Authors' calculation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).

Note: Consumption is measured in monetary value terms, in Ghanaian cedi. Household consumption levels are expressed in units per adult equivalent per day. ***, **, * Mean difference is statistically significant at the 1 percent, 5 percent, and 10 percent level, respectively.

there are no clear trends in the FBS data at the national level). This is consistent with the theory of nutrition transition, given that Ghana's regions are at different stages of the nutrition transition. Overall, the observed changes in the average composition of food consumption suggest that the quality of average Ghanaian diets in all regions improved between 2005–2006 and 2012–2013 and provide no evidence for a widespread increase in the risk for nutrition-related NCDs due to a diet overly rich in animal-source foods. However, it is important to note that the average food consumption patterns presented here provide no information on food consumption at different household income levels, such as among the rich and the poor, and on the likely trends in food consumption patterns beyond 2012–2013, when households' income continues to grow. The following section can provide some insights in these respects.

FIGURE 4.3—COMPOSITION OF HOUSEHOLD FOOD CONSUMPTION IN SOUTHERN GHANA

Source: Authors' presentation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).
Note: Consumption is measured in monetary value terms. The tree maps show the average composition of household food consumption per adult equivalent.

FIGURE 4.4—COMPOSITION OF HOUSEHOLD FOOD CONSUMPTION IN NORTHERN GHANA

Source: Authors' presentation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).
Note: Consumption is measured in monetary value terms. The tree maps show the average composition of household food consumption per adult equivalent.

Engel Curves and Food Consumption Elasticities

Figures 4.5 and 4.6 show estimated Engel curves for household food consumption of the main analyzed food groups in urban and rural areas in southern and northern Ghana in 2005–2006 and 2012–2013.[12] The Engel curves illustrate the associations between food group consumption levels and income levels across households, providing evidence on how food group consumption is likely to change when income rises. Table 4.6 presents point elasticities that were derived from the Engel curve estimates. The elasticity estimates are calculated at sample median income levels. The elasticities have large values and may overrate the true effect of household income growth on changes in food (group) consumption levels.[13] Therefore, the precise values of the elasticities should not be overinterpreted. Rather, the elasticities (which are all based on estimation models with identical properties) serve to complement the descriptive analysis of the estimated Engel curves and, in particular, to compare the consumption-income associations of the different food groups with each other. Overall, the results of the estimations based on the 2005–2006 data and the 2012–2013 data are highly consistent.

The shape of the estimated Engel curves suggests that the consumption of all analyzed food groups increases (almost) linearly with rising income across most households of the estimation sample populations (Figures 4.5 and 4.6). A linear curve implies that the marginal increase in food group consumption is constant across the considered income levels. Thus, the estimated Engel curves suggest that households with high incomes and households with low incomes will spend a similar (absolute) amount for the consumption of the considered food group when their incomes grow by the same (absolute) amount.[14]

The slopes of the estimated Engel curves suggest that income growth in southern Ghana is associated with the largest (absolute) increases in the consumption of animal-source foods in both urban and rural areas, followed by increases in the consumption of cereals and—in rural areas—roots and tubers (Figures 4.5 and 4.6). In urban and rural areas in northern Ghana, household income growth seems to come along with the largest (absolute) increases in the consumption of cereals in addition to animal-source foods. The finding that in the rural south and the urban and rural north, household income growth is associated with large (absolute) increases in the consumption of the food groups that contain the main local staple food indicates that household food insecurity is still widespread in these regions. The estimated Engel curves for the consumption of pulses and nuts are flat and show low consumption levels across all regions, suggesting that when income rises, the consumption of pulses and nuts is likely to remain at low (absolute) levels across Ghana, compared with other main food groups.

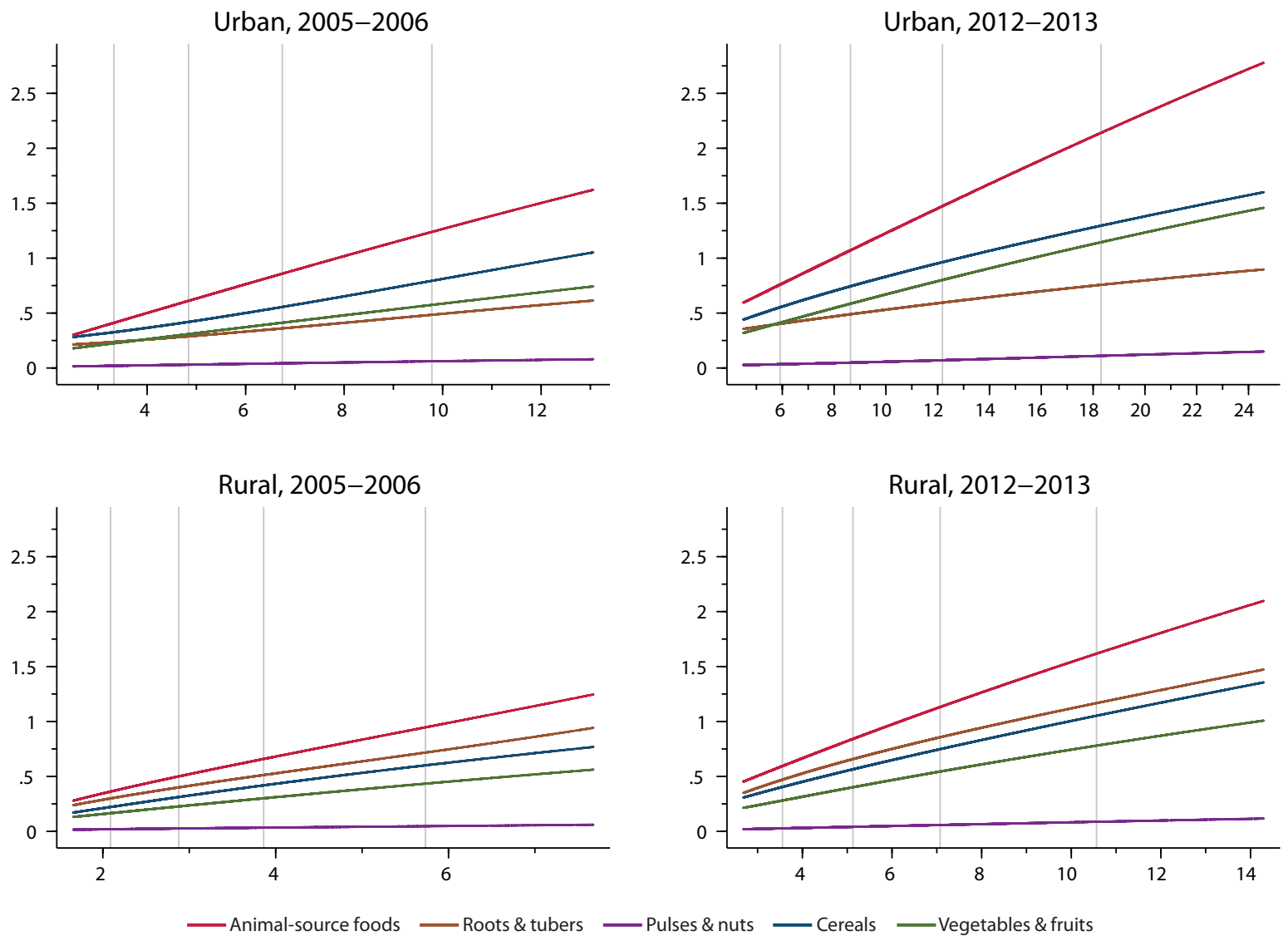
The elasticity estimates suggest that the consumption of animal-source foods increases at higher rates than total food consumption with increasing household incomes in urban areas in southern Ghana and in both urban and rural areas in northern Ghana and at similar rates in rural areas

12 Section A4 of the Technical Appendix (http://resakss.org/node/2190) presents the Engel curve estimations.

13 Large elasticity estimates may be partly due to the chosen reduced-form demand model underlying all estimations (which does not account for structural changes in consumption), omitting of variables from the estimation equations that possibly determine food consumption and are correlated with household income (such as household size, education, food preferences, local food prices, and so on), and using reported household consumption expenditure as proxy for household income (which ignores household saving and income transfers, which occur mostly in richer households).

14 Food consumption is measured in monetary value terms. Hence, differences in food quality and nonnutritive attributes, as well as local price differences, may influence the found relationship.

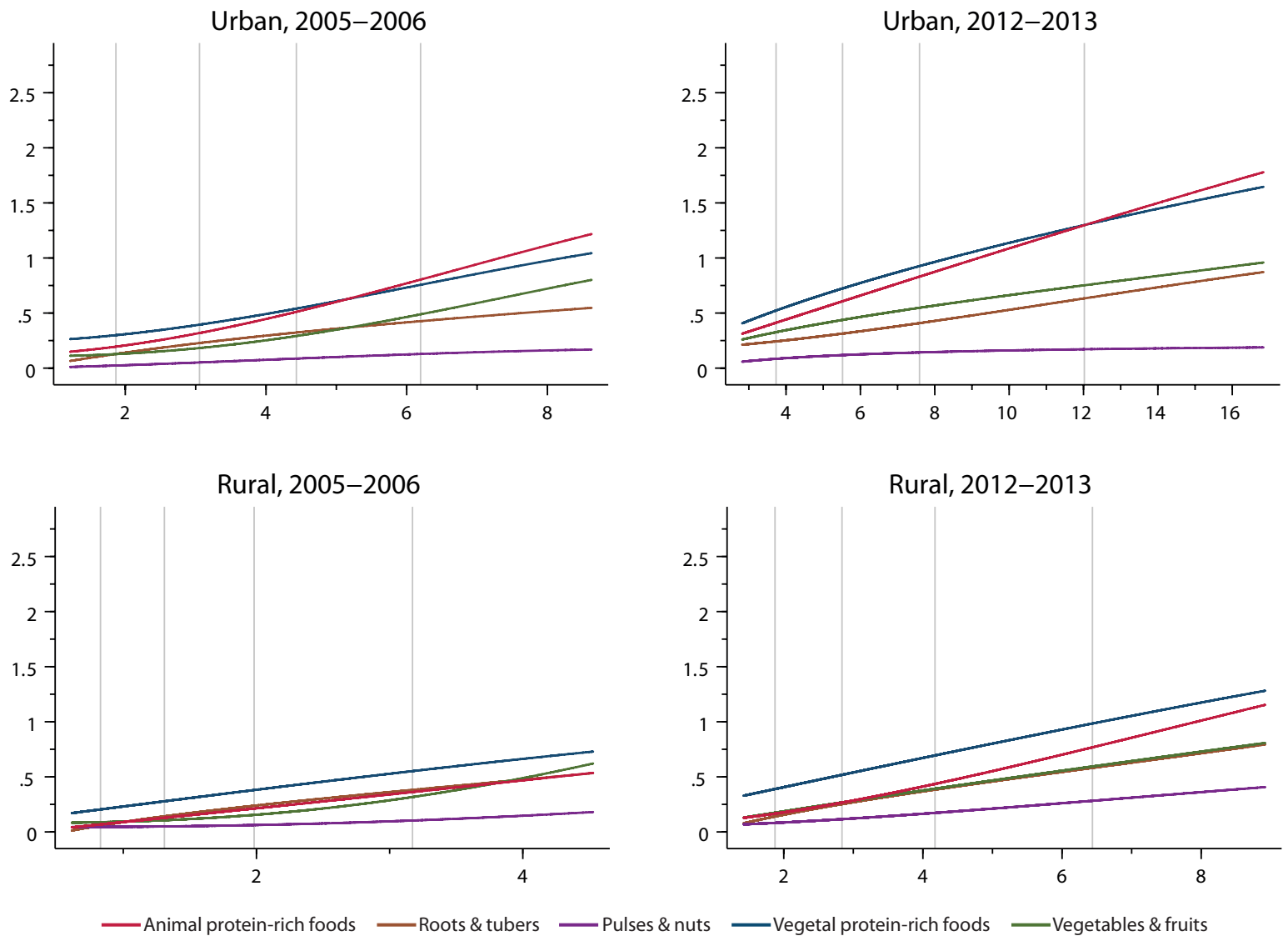
FIGURE 4.5—ENGEL CURVES FOR THE CONSUMPTION OF MAIN FOOD GROUPS IN SOUTHERN GHANA



Source: Authors' estimation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).

Note: The y-axis identifies household food group consumption per adult equivalent per day; the x-axis identifies household income (as proxied by total household consumption expenditure) per adult equivalent per day. The vertical gray lines mark income quintiles in the sample populations. The presented graphs are excerpts of the estimated Engel curves, excluding households with income levels below the 10th percentile and above the 90th percentile of the estimation samples.

FIGURE 4.6—ENGEL CURVES FOR THE CONSUMPTION OF MAIN FOOD GROUPS IN NORTHERN GHANA



Source: Authors' estimation based on Ghana Living Standards Survey 5 and 6 data (2005–2006 and 2012–2013, respectively).

Note: The y-axis identifies household food group consumption per adult equivalent per day; the x-axis identifies household income (as proxied by total household consumption expenditure) per adult equivalent per day. The vertical gray lines mark income quintiles in the sample populations. The presented graphs are excerpts of the estimated Engel curves, excluding households with income levels below the 10th percentile and above the 90th percentile of the estimation samples.

in southern Ghana (Table 4.6). According to the estimates based on the 2012–2013 data, at median income levels, a 1 percent increase in household income is associated with an almost equivalent percentage increase in the consumption of animal-source foods in the urban and rural south and the urban north, and even an overproportional increase in the rural north. In both urban and rural areas of southern Ghana, the consumption of pulses and nuts tends to increase most with rising incomes (in relative terms), and that of vegetables and fruits tends to increase at similar rates to the consumption of animal-source foods (according to estimates based on the 2012–2013 data). The consumption of cereals and of roots and tubers tends to increase at lower rates than total food consumption and the consumption of all other food groups. Thus, the elasticity estimates together suggest that income growth in southern Ghana is associated with diversification of people's food consumption from a heavily staple-laden diet toward a diet richer in high-quality protein foods of both animal and vegetal origin and in vegetables and fruits.

The trends in northern Ghana's food consumption patterns implied by the elasticity estimates seem to differ from the trends observed for southern Ghana mainly regarding the consumption of roots and tubers and of vegetables and fruits (Table 4.6). According to the estimates based on the 2012–2013 data, the consumption of roots and tubers tends to increase at similar rates to total food consumption in urban areas and even at higher

TABLE 4.6—FOOD CONSUMPTION ELASTICITY ESTIMATES

	Southern Ghana				Northern Ghana			
	Median income (Ghanaian cedi)		Rural		Urban		Rural	
Variable	*2005–2006*	*2012–2013*	*2005–2006*	*2012–2013*	*2005–2006*	*2012–2013*	*2005–2006*	*2012–2013*
Median income (Ghanaian cedi)	***5.68***	***10.19***	***3.34***	***6.04***	***3.71***	***6.50***	***1.58***	***3.43***
Food consumption elasticity	0.95	0.86	0.93	0.93	1.13	0.85	1.01	1.01
Consumption elasticity for …								
Animal-source foods	1.02	0.92	0.93	0.92	1.28	0.98	1.22	1.28
Pulses and nuts	1.02	1.08	0.84	1.07	1.39a	0.57a	0.51b	1.04b
Cereals	0.85	0.75	0.99	0.87	0.86	0.77	0.75	0.76
Roots and tubers	0.68	0.57	0.84	0.82	0.93	0.84	1.25	1.08
Vegetables and fruits	0.87	0.91	0.96	0.94	1.28	0.70	0.88	0.99

Source: Authors' estimation based on Ghana Living Standards Survey (GLSS) 5 and 6 data (2005–2006 and 2012–2013, respectively).

Note: The elasticity estimates for food group consumption are derived from the estimated Engel curves shown in Figures 4.5 and 4.6. They are calculated for the reported median household income (as proxied by household total consumption expenditure) per adult equivalent per day. a Overall statistical fit of the estimated regression model is very low, with an R2 value of less than 0.03. The difference between the GLSS5- and GLSS6-based estimates is implausibly large. b Overall statistical fit of the estimated regression model is low, with an R2 value of around 0.09. The difference between the GLSS5- and GLSS6-based estimates is implausibly large.

rates in rural areas. In both urban and rural areas, the consumption of vegetables and fruits tends to increase at somewhat lower rates than total food consumption and the consumption of roots and tubers. As in southern Ghana, the consumption of the food group containing the main local staple food (which is cereals in northern Ghana) tends to increase at lower rates than total food consumption in both urban and rural areas. Thus, the elasticity estimates together suggest that income growth in northern Ghana is associated with diversification of people's food consumption from a cereal-dominated diet toward a diet richer in animal-source foods, denser in (calorie-rich and protein-poor) roots and tubers, and with constant or even declining shares of vegetables and fruits.

Summary and Conclusions

Along with high economic growth over a period of somewhat more than the past three decades, poverty, household food insecurity, and undernutrition have substantially declined in Ghana. Ghana was one of the first African countries that achieved the first MDG, that of eradicating extreme poverty and hunger. Recently, Ghana achieved (lower-) middle-income-country status. Economic growth has been accompanied by a structural transformation of the economy and progressing urbanization.

Household income growth improves people's ability to afford nutritious foods and diversified diets, and allows them to utilize superior healthcare and higher education, contributing to healthier and more productive lives for themselves and their children. However, improvements in people's living standards and changes in their livelihood activities and lifestyle usually also lead to a nutrition transition and give rise to new nutritional challenges, including increasing prevalence of overweight/obesity and related NCDs. To successfully address these new nutritional challenges, governments may need to launch new health and nutrition programs and revisit established food policies that have become inefficient in reducing food insecurity and malnutrition or even detrimental under the new circumstances.

Against this background, this study took stock of food consumption patterns and trends in Ghana. The analysis paid particular attention to the consumption of protein-rich foods and especially animal-source foods, because changes in their consumption patterns are key indicators of dietary shifts and the nutrition transition (Popkin and Du 2003; Speedy 2003); because insufficient consumption of animal-source foods is associated with widespread nutritional deficiencies, child growth failures, and poor cognitive functioning (Black et al. 2008; Dror and Allen 2011; Murphy and Allen 2003; Neumann et al. 2003); and because overconsumption of animal-source foods is associated with higher risks of overweight/obesity and related NCDs (Larsen 2003; Popkin and Gordon-Larsen 2004; Popkin 2006, 2009). To complement a first-glance analysis of long-term trends in food and macronutrient availability at the national level, a household-level analysis explored food consumption patterns and trends at the subnational level in great detail. The findings of the study may be useful in informing ongoing food policy reform processes and for designing and implementing food security and nutrition–related policies and programs more generally.

The national-level analysis suggests that in the 1980s, 1990s, and first decade of the 21st century, Ghana went through a phase of the nutrition transition that is characterized by a steady reduction in widespread, severe food insecurity, hunger, and undernutrition. Until the end of this three-decade period, there had been no indication of a transition into a phase in which overnutrition—especially overconsumption of animal-source foods—and associated adverse health consequences become major public

health problems. The household-level analysis suggests, however, that there are considerable regional differences within Ghana and that some regions are about to transition into this next phase. Urban areas—primarily in the south—are at a later stage of the nutrition transition than rural areas, with the rural north being least progressed. Household food insecurity is still widespread in the rural north, and meeting dietary energy requirements seems to still dominate food choices in many households.

The analysis also provides indications that Ghana as a whole, as well as its single regions appear to closely follow the nutrition transition path that has been observed in other developing countries. The results from the Engel curve estimations suggest that, along with continuing household income growth (and urbanization), the consumption of animal-source foods is likely to rapidly increase primarily—but not exclusively—among Ghana's growing urban middle class. The derived elasticity estimates indicate that with rising incomes, diets in Ghana's urban areas and even in the rural north become denser in protein-rich foods of animal origin. The estimated elasticities also suggest that when incomes grow, the consumption of pulses and nuts tends to increase faster than total food consumption in southern Ghana, where (absolute) consumption levels of pulses and nuts are very low, considerably lower than in northern Ghana. Hence, with rising incomes, the diet in southern Ghana is likely to become somewhat richer in high-quality protein of vegetal origin, too. The consumption of vegetables and fruits tends to increase, at best, at similar rates to that of animal-source foods in all regions, while the consumption of the main local staple food tends to further increase in absolute amounts but at lower rates than that of nonstaple foods.

In conclusion, it is now a good time to review existing food policies (including agricultural subsidies) with respect to their potential nutritional impact and to start reforming those policies that are likely to have adverse effects on people's dietary quality and body weight. Increasing risks of overweight/obesity and related NCDs are normal symptoms of a progressing nutrition transition, but public policy can do a great deal in setting the right (economic) incentives to reduce the potential adverse impact. In contrast, unfavorable food policies can further aggravate the nutritional challenges, as examples from Egypt (Ecker et al. forthcoming), Mexico (Leroy et al. 2013), and other developing countries show. Inaction may come at high costs for private and public healthcare budgets and long-term economic development.

CHAPTER 5

Making African Agriculture and Food Systems Work for Nutrition: What Has Been Done, and What Needs To Be Done?

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* The authors would like to acknowledge the contributions of Judith Hodge and Amanda Lewis (main authors of the LANEA summary report), and Mawuli Sablah, Marie-Caroline Dodé, Matthias Leitner, and Giorgia Nicolo (FAO).

Improving nutrition is a complex challenge that requires contributions from many sectors at many levels, from policy to grassroots action. Direct (nutrition-specific) interventions, usually delivered by the health sector, and indirect (nutrition-sensitive)[15] programs, implemented by a variety of sectors, are needed, both underpinned by enabling policy environments (Black et al. 2013). Even if the recommended package of nutrition-specific interventions put forward by the *Lancet* Maternal and Child Nutrition Series (2013) were scaled up to 90 percent population coverage in the 34 countries with the highest burden of undernutrition, child stunting would fall by only 20 percent (Bhutta et al. 2013). This means that efforts to scale up nutrition-specific interventions need to be paired with investments in nutrition-sensitive development programs and policies that address the underlying drivers of malnutrition.

In Africa south of the Sahara, progress in reducing undernutrition has been lagging behind that of other regions over the last decade (IFPRI 2015). In Africa, the majority of the nutritionally vulnerable population is dependent in some way upon agriculture as a primary source of livelihood—for food, for employment, and for income. Agriculture has close links to both the direct causes of undernutrition (diets, feeding practices, and health) and the underlying factors (such as income; food security; education; access to water, sanitation, and hygiene; access to health services; and gender equity). The sector has huge potential to drive down rates of malnutrition (Kadiyala et al. 2014; Pinstrup-Andersen 2012). Yet, as in many low- and middle-income countries with a high dependence on agriculture-based livelihoods and a high burden of undernutrition, this potential for agriculture is currently not being realized (Ruel and Alderman 2013; Gillespie et al. 2013; Balagamwala and Gazdar 2013; Kadiyala et al. 2014). Agricultural growth may generate more gains for nutrition than gross domestic product (GDP) growth per se (Webb and Block 2012), but nutrition has historically not been a primary concern for agricultural policy makers—for whom aggregate staple crop production is the primary target (Ecker, Breisinger, and Pauw 2011; Headey, Chiu, and Kadiyala 2012). There is also a marked paucity of evidence that agricultural *interventions* are benefiting nutrition (Ruel and Alderman 2013), related to the following factors:

- Failings in terms of the design and implementation of interventions, which are not as nutrition enhancing as they could be.
- Limitations in terms of targeting (relatively few interventions are targeted to the 1,000-day window[16] within the human life cycle).
- Poor design of evaluations, which are seldom rigorous enough (in terms of sample size, valid comparison groups, and so on) to demonstrate impact (Ruel and Alderman 2013).

Agricultural interventions are rarely designed to have impacts on nutrition, and evaluations are rarely empowered to detect such impacts. In

15 Nutrition-sensitive programs draw on complementary sectors such as agriculture, health, social protection, early child development, education, and water and sanitation to affect the underlying determinants of nutrition, including poverty; food insecurity; and scarcity of access to adequate care resources and to health, water, and sanitation services. Key features that make programs in these sectors potentially nutrition sensitive are that they address crucial underlying determinants of nutrition, they are often implemented at large scale and can be effective at reaching poor populations who have high malnutrition rates, and they can be leveraged to serve as delivery platforms for nutrition-specific interventions (Ruel and Alderman 2013).

16 The "1,000-day window" refers to a crucial period (starting with a child's conception and continuing through nine months of pregnancy and the first two years of life) when nutrition is of critical importance for a child's developing brain and body, after which most growth and development deficits are largely irreversible.

short, in terms of both policy and programs, there is an apparent disconnect between agriculture and nutrition.

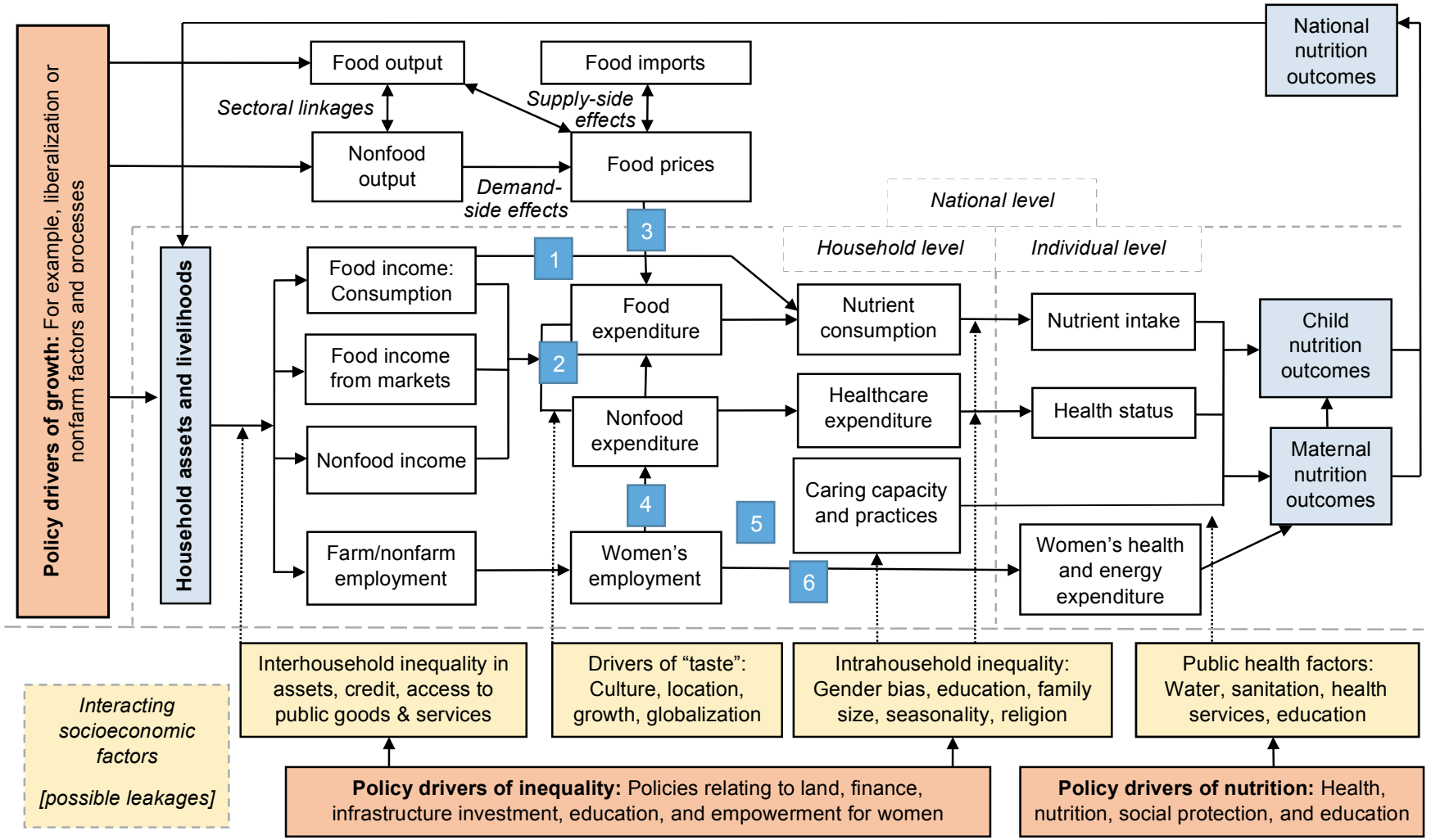
This disconnect represents a challenge—but also an opportunity. The many links between agriculture and nutrition (Figure 5.1) suggest that agricultural policies, interventions, and practices can be better designed to enhance nutrition and health benefits. We need to understand why the disconnect persists and, more importantly, how we can turn agriculture into a powerful lever for raising people's health and nutritional status, while at the same time contributing to other outcomes such as food security, income, equity, and sustainability.

The window of opportunity is open now—as reflected in recent developments in the institutional environment for nutrition. The centrality of food systems and healthy diets to the nutrition agenda has been recognized at the highest political level. The Rome Declaration on Nutrition and its Framework of Action, adopted by 170 countries during the Second International Conference on Nutrition held by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization in November 2014, place a strong emphasis on the role of food systems. In countries that have made nutrition a development priority, in particular members of the Scaling Up Nutrition (SUN) movement, partners in the agriculture sector are strengthening their engagement in multisectoral nutrition efforts. Major development partners have made nutrition a priority of their agriculture and rural development portfolios (European Commission et al. 2014; IFAD 2014; USAID Feed the Future 2014; DFID 2015). The global governance mechanisms for agriculture are also repositioning nutrition as central to the evolution of agriculture and food systems: nutrition is being mainstreamed across the work of the FAO, and nutrition challenges and solutions are discussed in the Committee for World Food Security as well as the committees for agriculture, fisheries, and forestry.

In Africa, similar progress is noted. While a 2010 review of Comprehensive Africa Agriculture Development Programme (CAADP) investment plans showed that very few countries considered nutrition in their agricultural planning, six years later nutrition is becoming central to agriculture investment planning and implementation frameworks. The African Union Maputo Declaration on Agriculture and Food Security places strong emphasis on ensuring food and nutrition security. Three recent Malabo Declarations related to nutrition reinforce this commitment. Nutrition indicators have been incorporated in the CAADP Results Framework, and in partnership with International Food Policy Research Institute (IFPRI) under the Regional Strategic Analysis and Knowledge Support Systems, countries are being supported to report their progress on nutrition commitments biennially. Several subregional organizations are developing or updating their nutrition strategies and including a strong emphasis on the role of agriculture in improving nutrition. The Economic Community for West African States Agricultural Policy, for example, has prioritized nutrition objectives and indicators. Finally, technical assistance on nutrition is being provided to more than 20 countries at different stages of developing their national agriculture and food security investment plans.[17] This progress can be attributed to the efforts of many stakeholders—from government, civil society, the private sector, and development partners—who

[17] These include Angola, Burkina Faso, Chad, Comoros, Democratic Republic of the Congo, Ethiopia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Mali, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Uganda, and Zimbabwe.

FIGURE 5.1—MAPPING THE LINKAGES BETWEEN AGRICULTURE AND NUTRITION OUTCOMES



Source: Gillespie, Harris, and Kadiyala (2012), adapted from Headey, Chiu, and Kadiyala (2012).

have been mobilized through country-led initiatives as well as the SUN movement and the CAADP Nutrition Capacity Development Initiative.

These achievements in generating high-level commitment to enhance the nutrition sensitivity of agriculture are highly significant. But they are just the first step. Much remains to be done to transform this commitment into effective action at scale.

Leveraging agriculture for nutrition implies (1) creating and strengthening institutional and policy environments that enable agriculture to support nutrition and health goals, (2) making agricultural policy and practice more nutrition sensitive and therefore more effective in improving nutrition and health, and (3) developing capacity and leadership to use evidence-informed decision making to enhance the impact of agriculture on nutrition and health.

This chapter has three sections. First, it provides a brief conceptualization of linkages between agriculture and nutrition, before highlighting the findings of a three-country study in eastern Africa (Leveraging Agriculture for Nutrition in East Africa, or LANEA) in the second section. The final section brings together the core findings of this work, contextualizing it within the wider landscape of change, to generate a set of recommendations.

Conceptualizing the Links between Agriculture and Nutrition

Much progress has been made this decade in facilitating communication between agriculture and nutrition stakeholders through elucidating the conceptual basis for links (Gillespie, Harris, and Kadiyala 2012; Ruel and Alderman 2013). Six pathways linking agriculture and nutrition are depicted (and numbered) in Figure 5.1. This figure should be read left to right, starting with the shaded box labeled "household assets and livelihoods" and ultimately leading to the child and maternal nutrition outcomes on the right-hand side of the figure (note also how nutrition outcomes themselves can be *inputs* into future livelihoods—the links are cyclical). The pathways are summarized below. The figure also shows how various policies (relating, for example, to agricultural growth, to equity, and to other policies that more directly affect nutrition) affect the links (for better or worse), via different types of mediating factors.

- **Pathway 1: Agriculture as a source of food for household consumption.** This is the most direct pathway by which household agricultural production translates into consumption (via crops cultivated by the household). In the context of various market failures, farmers may make production decisions with the objective of directly shaping their diets through consumption of their own farm produce.
- **Pathway 2: Agriculture as a source of income for food and nonfood expenditures.** Like other productive sectors, agriculture is a source of household income (raised through wages earned by agricultural workers or through the marketed sale of food produced) and expenditure on nutrition-enhancing goods and services (including health, education, and social services). But agriculture is known to be a more important source of income for the poor and undernourished than other sectors.
- **Pathway 3: Effects of agriculture policy and food prices on food consumption.** The link between agricultural policy and food prices

involves a range of supply-and-demand factors that affect the prices of various marketed food and nonfood crops. These prices, in turn, affect the incomes of net sellers as well as the ability of net buyers to ensure household food and nutrition security (including diet quality).

- **Pathway 4: Effects of women's employment in agriculture on intra-household decision making and resource allocation.** Agricultural labor conditions can influence the empowerment of women and thus their control over nutrition-relevant resources and decision making, particularly regarding food and healthcare.
- **Pathway 5: Effects of women's employment in agriculture on childcare and child feeding**. This pathway relates to the challenges that heavy and prolonged female workloads in agriculture present to ensuring adequate care for young children.
- **Pathway 6: Effects of women's employment in agriculture on their own nutritional and health status.** This pathway relates to the possibility that the often arduous and hazardous conditions of agricultural labor pose substantial risks for maternal nutritional and health status (when their work-related energy expenditure exceeds their energy intake, their dietary diversity is compromised, or they fall sick because of the conditions in which they work).

Agriculture can influence nutrition outcomes through effects on the ability of households and individuals (especially women) to grow, consume, and sell food, and to generate income. Since nonfarm activities do not possess an intrinsic linkage to nutrition, Pathway 1 potentially makes agriculture a special sector, but it also opens up complex dynamic policy tradeoffs (Kadiyala et al. 2014). Pathway 3 also makes agriculture a special sector due to its influence on the composition of diets through macroeconomic linkages. Pathways 4–6, focusing on the conditions under which women engage in agricultural labor and their ability to control and use resources (including time and earned income), have unfortunately been neglected in the past, as we will see in the next section.

Key Recommendations for Improving Nutrition through Agriculture and Food Systems

The pathways described above clearly illustrate how agriculture can contribute to improved nutrition. However, experience and research findings, as also highlighted above, show that the potential positive nutritional impacts of agriculture are seldom fully unleashed and that advances in agriculture can even lead to negative impacts (for example by increasing women's workloads or leading to a decrease in crop and thus dietary diversity). Recognizing that "business as usual" is insufficient for agriculture to improve nutrition, FAO and the Agriculture-Nutrition Community of Practice[18] facilitated a consultation process between 2011 and 2013 to develop a fact sheet titled "Key Recommendations for Improving Nutrition through Agriculture and Food Systems" (FAO 2015a; Box 5.1).

These recommendations are principles that can be applied to the design of agriculture programs to enhance their nutritional impact. They

18 www.unscn.org/en/nut-working/agriculture-nutrition-cop/purpose.php.

are based on a recognition that the selection of interventions must be context specific because the types and causes of malnutrition vary, and that solutions must be adapted to the agroecological, socioeconomic, and cultural conditions of families and individuals. These recommendations were used to review countries' CAADP investment plans and identify opportunities for better integrating nutrition in national agriculture investment plans, through subregional workshops organized by the African Union (AU) / New Partnership for Africa's Development (NEPAD) CAADP Nutrition Capacity Development Initiative between 2011 and 2013 (Dufour et al. 2013). The lessons learned from this process were used to generate the guidelines in the document *Designing Nutrition-Sensitive Agricultural Investments: Checklist and Guidance for Programme Formulation* (FAO 2015b).

It is interesting to note that while the initial focus was on nutrition-sensitive *agriculture*, in recent years the discourse has shifted to a focus on nutrition-sensitive *food systems* (CGIAR 2015). Indeed, an analysis of nutritional problems in the 21st century—as populations become increasingly urbanized and markets globalized—makes it obvious that action is required not only at the level of production but in all stages of the food value chain: from natural resource management and input supply to production, transportation, processing, retailing, and consumption. Delivering and promoting the consumption of safe food that is affordable and of good nutritional quality on a year-round basis thus requires working with a broad range of stakeholders—governments, farmers, agribusiness, retailers, and consumers.

BOX 5.1—KEY RECOMMENDATIONS FOR IMPROVING NUTRITION THROUGH AGRICULTURE AND FOOD SYSTEMS

These recommendations are based on a review of the literature and guidelines produced by various organizations, summarized in Synthesis of Guiding Principles on Agriculture Programming for Nutrition (FAO 2013). This review was complemented by an extensive consultative process through the Agriculture-Nutrition Community of Practice and the FAO Food Security and Nutrition Forum.

1. Incorporate explicit nutrition objectives and indicators into the design of agriculture programs, and track and mitigate potential harms.
2. Assess the context at the local level to design appropriate activities to address the types and causes of malnutrition.
3. Target the vulnerable and improve equity through participation, access to resources, and decent employment.
4. Collaborate with other sectors and programs.
5. Maintain or improve the natural resource base.
6. Empower women.
7. Facilitate production diversification, and increase production of nutrient-dense crops and small-scale livestock.
8. Improve processing, storage, and preservation to retain nutritional value and food safety, to reduce seasonality and postharvest losses, and to make healthy foods convenient to prepare.
9. Expand market access for vulnerable groups, particularly for marketing nutritious foods.
10. Incorporate nutrition promotion and education.

Source: FAO (2015a).

Leveraging Agriculture for Nutrition in East Africa

With a view to shedding light on the policy and institutional challenges to and the opportunities for enhancing the nutrition sensitivity of agriculture in Africa, IFPRI and the FAO collaborated on the LANEA initiative[19] in Ethiopia, Kenya, and Uganda in 2013–2014. LANEA had the following objectives:

- To review the evidence base on linkages between agriculture and nutrition in the region .
- To describe the policy and institutional landscape surrounding the agriculture-nutrition nexus.
- To elicit the perceptions of stakeholders on the challenges and opportunities of leveraging agriculture for nutrition.
- To convene roundtables to debate and discuss the core findings in order to generate consensus on what is known and what needs to be known.

Context

Despite some recent improvement, undernutrition rates in East Africa remain very high. The level of stunting for children younger than five in the region is 42 percent, with Ethiopia above the average, at 44 percent, and Kenya and Uganda both below it, at 35 percent and 33 percent, respectively (UNICEF 2014). Despite significant progress in reducing stunting in Ethiopia (down from 51 percent in 2000), current rates are still very high (Ethiopia Central Statistical Agency and ICF International 2012). Similarly, stunting rates for

BOX 5.2—LEVERAGING AGRICULTURE FOR NUTRITION IN EAST AFRICA STUDY METHODS

Leveraging Agriculture for Nutrition in East Africa (LANEA) assessed three core domains that are key to generating change, as identified in a review of nutrition-relevant policy literature included in the *Lancet Maternal and Child Nutrition Series* (Gillespie et al. 2013). These domains help to structure thinking around the challenges that need to be addressed in order to leverage agriculture to improve nutrition: (1) knowledge, perceptions, and evidence; (2) politics and governance; and (3) capacity and resources. The LANEA study took place from October 2013 to July 2014. It included a structured review of evidence relating to agriculture-nutrition pathways for each country, and key informant interviews with individuals working on nutrition and agriculture. This was followed by stakeholder workshops in each country to disseminate the findings and gain further perspectives and input on agriculture and nutrition linkages, which were then used to inform the country reports and recommendations. Study participants came from government ministries, UN and donor agencies, nongovernmental organizations, civil society, universities, research institutes, and the private sector. In Ethiopia, 19 interviews were conducted and 27 stakeholders participated in the workshop; in Kenya, 15 were interviewed and 43 attended the workshop; and in Uganda, 19 stakeholders were interviewed and 21 participated in the workshop. Interview responses were analyzed using a grid organized around the three core domains described above.

Source: Authors.

19 This section summarizes the findings of the LANEA study, which have been described at length by Hodge et al. (2015). The LANEA study focused on three East African countries. While it thus cannot be assumed to completely represent the situation across the region of Africa south of the Sahara as a whole, the findings are likely to have relevance wherever high burdens of undernutrition exist within poor, rural populations that depend on agriculture as a primary source of livelihood.

Kenya have stagnated in the range of 30 to 35 percent over the last decade (UNICEF 2014). Stunting in Uganda has shown a downward trend from nearly 40 percent in 2000 (UNICEF 2014). In addition, child overweight rates in Africa south of the Sahara are similar to those in Latin America (approximately 8 percent) and are growing at a faster rate than in other regions (Black et al. 2013; UNICEF, WHO, and World Bank 2012).

In each of the LANEA countries, agriculture continues to play an important role in the overall economy, employing a large percentage of the work force. In all three countries, the majority of the population relies on agriculture for its livelihood: 80 percent in Ethiopia, 75 percent in Kenya, and 73 percent in Uganda (FAO 2011). In Ethiopia, agriculture accounts for more than 46 percent of GDP, and nearly 40 percent of rural farmers (about 5 million households) cultivate land of less than half a hectare, from which they produce only half of their annual food needs (FAO and CAADP 2013a). In Kenya, the sector directly contributes 24 percent of GDP and indirectly contributes 27 percent through linkages with manufacturing, distribution, and other service-related sectors (KARI 2012). Agriculture is one of the primary growth sectors in Uganda, accounting for 24 percent of GDP in 2011–2012 (FAO and CAADP 2013b).

Key Findings

Study participants in each country identified a number of similar challenges and opportunities in relation to the enabling environment for agriculture to impact nutrition. Respondents in each country shared similar perspectives on how these environments can be shaped and sustained.

Knowledge, Evidence, Communication, and Advocacy

Knowledge of the linkages between agriculture and nutrition was perceived as being low in all three countries. Table 5.1 shows the breakdown of studies

TABLE 5.1—MAPPING EVIDENCE OF AGRICULTURE-NUTRITION LINKS ALONG IDENTIFIED PATHWAYS IN ETHIOPIA, KENYA, AND UGANDA

Study characteristics	Number of studies		
Pathway	**Ethiopia**	**Kenya**	**Uganda**
1. Agriculture as a source of food for household consumption	12	8	6
2. Agriculture as a source of income for food and nonfood expenditures	3	3	2
3. Effects of agriculture policy and food prices on food consumption	2	1	0
4. Effects of women's employment in agriculture on intrahousehold decision making and resource allocation	3	4	2
5. Effects of women's employment in agriculture on childcare and child feeding	1	1	1
6. Effects of women's employment in agriculture on their own nutritional and health status	2	0	0
Study design			
Randomized controlled trials	0	0	2
Quasi-experimental studies	4	1	0
Observational studies using analytical methods such as multivariate regressions and econometric modeling	7	13	3
Observational descriptive studies	2	2	0
Mixed-method studies (involving quantitative and qualitative methods)	0	0	2
Studies that do not clearly identify a design	1	0	0
Total number of studies identified for each country*	**14**	**16**	**7**

Source: Authors.
Note: * Some studies are included in more than one pathway.

that emerged from the evidence review in 2014, mapping evidence to the six-pathway structure shown in Figure 5.1.

When asked for their perspectives on how agriculture can be leveraged for nutrition, study participants shared a number of ideas indicating a growing awareness of the pathways from agriculture to nutrition. In all three countries, interviewees mentioned Pathway 1—agriculture as a source of food for household consumption—by far the most frequently. Most of the studies (26 of 51) identified in the evidence review mapped to this pathway as well. Stakeholders talked about the role of agriculture in providing food and income for diverse diets, and participants in Uganda and Ethiopia perceived potential negative consequences of agriculture when it is used solely for cash crops and market production at the expense of nutritious foods for local consumption.

Study participants in each country also highlighted the role of gender, with stakeholders in both Uganda and Ethiopia pointing to the importance of land tenure for women, and a Ugandan participant describing the need to have a gender-sensitive lens for integrating nutrition within agriculture. Participants often suggested that when women have control over resources, they are more likely to use the resources on food and care for their children, thus impacting nutrition. However, stakeholders also felt there was insufficient evidence to understand how agriculture can impact nutrition, with further research on the pathways required—especially Pathways 5 and 6, which relate to women's employment in agriculture and its impact on childcare and women's own nutritional status. Only 5 of 51 studies related to these two pathways.

Although research and data are seen as key, stakeholders described these areas as weak. Research on agriculture-nutrition linkages remains low in all three countries, as seen in the evidence reviews. Interviews indicated that even when research knowledge exists, it is often not communicated effectively to policy and program decision makers. Stakeholders stressed the need for more funding for research that is practical and actionable, and that demonstrates "what works" for nutrition-agriculture integration. Informants felt that capacity to collect timely and accurate data on nutrition and agriculture at the national and regional levels was needed, as well as capacity to analyze and communicate such data in a meaningful manner.

This theme of communication was evident in each country, in terms of not only communicating evidence to policy makers but also communicating nutrition messages to households. Participants from all three countries strongly emphasized the need to contextualize messages within social and cultural values that may differ by region and livelihood zone. In Uganda, participants suggested using social marketing for communication, and in Ethiopia, participants stressed the need for different nutrition messaging depending on the audience. Stakeholders also stated that research is needed to understand regional and cultural differences related to nutrition in order to better develop targeted programs. They also suggested learning from other successful cross-sector initiatives such as those related to HIV/AIDS.

Politics, Policies, and Governance

In each country, there is growing momentum to address nutrition, with policies and platforms that either have potential to address or are currently

addressing nutrition multisectorally (Table 5.2). All three of the countries have joined the SUN movement and are taking part in other initiatives such as CAADP, which have the potential to support efforts to leverage agriculture for improved nutrition.

TABLE 5.2—POLICIES WITH POTENTIAL TO ADDRESS NUTRITION MULTISECTORALLY

Country	Policy
Kenya	Food and Nutrition Security Policy; National Nutrition Action Plan; Agriculture Sector Development Strategy
Uganda	National Development Plan; Uganda Nutrition Action Plan; Agriculture Sector Development Strategy and Investment Plan
Ethiopia	Growth and Transformation Plan II; National Nutrition Strategy; Agriculture Sector Policy and Investment Framework

Source: Authors.

Despite the growing momentum, stakeholders in all three countries shared perspectives that the enabling environment to address nutrition through agriculture remains weak (see Table 5.3). One of the reasons cited was a lack of high-level coordination mechanisms and nutrition advocates to ensure multisectoral collaboration and implementation of nutrition-sensitive policies and programs. Even where state institutions have been identified to coordinate for nutrition, as with the Office of the Prime Minister in Uganda, financial and human resources are insufficient to achieve impact, and collaboration across sectors remains weak. Furthermore, there are few incentives for policy makers and others to undertake multisectoral work for nutrition, which still lacks visibility. It may take time for the results of investments in nutrition to become evident, making it difficult to gain political traction. However, stakeholders pointed to a number of factors that can influence policy making, including donor priorities, lessons learned from programs, global and national research and reports, clear and timely data, and demonstration of economic impact. Additionally, participants described a great need for consensus on indicators and metrics for nutrition-sensitive agriculture. Such a consensus would strengthen accountability and monitoring and evaluation, allowing different sectors to better understand their roles in working toward common goals to impact nutrition.

TABLE 5.3—PERCEPTIONS OF KEY FACTORS PREVENTING NUTRITION FROM BEING PRIORITIZED IN AGRICULTURE

Country	Perceptions
Ethiopia	• Nutrition seen as health and emergency issue • Focus on export/cash crops at expense of crops for local consumption • Multisector platforms in place but coordination needs strengthening • Lack of harmonized messages between agriculture and health sectors • Lack of nutrition indicators/accountability in agriculture sector • Lack of practical evidence of what works
Kenya	• Food and Nutrition Security Programme: no legal framework, so no accountability • Lack of coordination between sectors—no forum to work together • Lack of incentives to integrate at policy, program, and field levels • Lack of common language between sectors • Lack of leadership and advocacy
Uganda	• Nutrition doesn't win votes • Nutrition not seen as agriculture mandate • Focus on market-oriented agriculture at expense of nutrition • Lack of multisectoral coordination • Lack of trained professionals • Lack of evidence for nutrition-sensitive agriculture

Source: Authors.

Capacity and Financing

Study participants in each country highlighted the need for training and education at a number of levels—from educating policy makers on nutrition-sensitive agriculture to training agriculture extension workers on how to incorporate a nutrition lens in their work with households, to educating donors on the need for longer-term investments in order to impact nutrition through agriculture- and food-based programs. To build knowledge and capacity at all levels, strengthening nutrition education from the primary to the university level is needed, with emphasis on integrating nutrition into agriculture curricula and research.

Participants also pointed to the need for simply increasing their numbers in order to have an impact. In Uganda, a participant pointed out that agriculture extension reaches less than 20 percent of farmers, and in Ethiopia, even the largest-scale food and nutrition security projects (the Productive Safety Net Program and the Agricultural Growth Program) reach only 10–15 percent of the population. Numbers of nutritionists in each country are low, and their practical training is limited. Even more limited is any cross-sector training, although participants from both Uganda and Kenya described agriculture-nutrition training manuals developed for fieldworkers and the need to scale up the distribution of these and other tools.

Study participants in all three countries stressed the need for increased funding for nutrition. The gap between developing multisectoral policies and being able to implement them at scale depends on adequate funding as well as the capacity to coordinate and collaborate across sectors. Leveraging financial and other resources across sectors can include efforts to harmonize messages as well as to develop public-private partnerships, as participants from Uganda and Ethiopia suggested. Developing stakeholders' capacity to move beyond competition and develop stronger collaboration within and between government ministries and sectors, as well as between national and regional levels, is key.

The Way Ahead

In this section, we build on the LANEA study results, other recent research findings, and ongoing experience in providing technical assistance on agriculture-nutrition linkages at the regional and country levels to indicate where we believe specific attention and investments are needed to accelerate the path to success. We use the same three core domains (those used to organize the LANEA study) to summarize these recommendations.

Knowledge, Evidence, Communication, and Advocacy

There is a clear need for continued sensitization of decision makers toward greater integration of nutrition in agriculture. While awareness of nutrition problems, the need for a multisectoral approach, and the role of agriculture and food systems has increased, those convinced are still too few, especially in departments and ministries responsible for financial allocations. Continued advocacy and sensitization efforts are thus required, backed up by convincing data on the cost of inaction, on what works, and at what cost. Addressing nutrition must be seen as an *investment with high potential returns* (in terms of reduced health costs, increased productivity, and so on) and not a financial burden. The Cost of Hunger in Africa study (by the United Nations Economic Commission for Africa), which is carried out

in 12 countries, has proven instrumental in convincing decision makers, in particular ministries of finance, of the need to act. Carrying out similar studies around the continent will contribute to raising political and financial commitments in favor of nutrition. In addition, advocacy efforts should be oriented toward holding governments to account for food and nutrition security–related promises they have made by signing recent declarations (for example, the Sustainable Development Goals and the Second International Conference on Nutrition, SUN, and CAADP commitments).

A key message concerns the need to integrate clear nutrition objectives, indicators, activities, and investments in agriculture investment plans and to align these plans with multisectoral nutrition plans. These steps will require strong dialogue across departments within the ministry or ministries responsible for agriculture, livestock, fisheries, and natural resources, as well as continuous dialogue with other ministries, in particular health. This dialogue needs to occur at a sufficiently high level of decision making to ensure that policy decisions can be made and acted upon.

Advocating for action is not enough. Decision makers in both the public and private sectors need information on what exactly can be done and at what cost, and they need to be held to account for doing it. Currently, most national information systems are not equipped to provide such information. Three types of information are key—on outcomes, on policies, and on financing. We discuss the first two here, with the financing discussion in the final section.

First we consider information on *outcomes*. Agriculture contributes to improved nutrition primarily by improving diets. But currently, very few governments collect information on individual food consumption, especially for women and young children.[20] Without knowing what people eat, it is difficult to design programs that can address dietary gaps and to monitor whether these gaps are effectively addressed. A new methodology for measuring the minimum dietary diversity of women (MDD-W) has recently been developed by various stakeholders (FAO and IRD 2015) and is being taken up by several countries and promoted by development partners. The MDD-W is also included in the CAADP Results Framework, and several countries (including Niger, Nigeria, and Ethiopia) are working to include the indicator in national surveys. Supporting countries in developing the capacity to collect and analyze this information to inform food system and agricultural policy and program design, and to monitor their impacts, is key. Linked to consumption is the critical issue of access to a healthy diet, which also needs better tracking (Herforth 2015; Global Panel on Agriculture and Food Systems for Nutrition 2015).

Second, we look at information on *policies for nutrition-sensitive agriculture and food systems*. Improving existing policies and programs requires an understanding of what is already going on, and whether and how it is working. Unfortunately, few countries have effective policy monitoring and analysis systems, particularly with regard to food security and nutrition. With the rising focus on nutrition, several policy mapping exercises have taken place—for example in the context of the SUN movement—but these are often one-time exercises, led by development partners and conducted with donor funds. There is thus a need to strengthen national systems of policy mapping and analysis to ensure

20 Individual food consumption provides a measure of dietary adequacy; household food consumption indicators are a measure of household *access* to food.

that they are closely tied to policy formulation and decision making. This is not an easy enterprise, given methodological difficulties (for example, deciding what to map) and institutional difficulties (collating and analyzing information from various sectors and ministries). Nevertheless, positive examples are emerging, such as that of Zimbabwe (Box 5.3).

BOX 5.3—ZIMBABWE'S FOOD AND NUTRITION SECURITY INFORMATION SYSTEM

Zimbabwe's national integrated Food and Nutrition Security Information System (FNSIS) is managed by the Food and Nutrition Council (FNC), the central coordinating body for all food and nutrition–related issues. The FNSIS monitors and reports on the food and nutrition security situation and program implementation. A greater emphasis is now being placed on using policy information and analyses to better plan programs and improve monitoring on a subnational level. Thirty district-level food and nutrition security committees (FNSCs) have been created to support action at a decentralized level. The FNSCs facilitate data collection and analysis, as well as informed decision making and effective knowledge transfer, to all stakeholders, from the local to the provincial and national levels. At the heart of the FNSIS is a repository that brings together food security and nutrition data, information, and knowledge from various national and subnational information systems in the country. In addition to gathering food and nutrition security data, the FNC is starting to monitor food and nutrition security policies, programs, and legal frameworks in terms of content, objectives, and level of implementation. While this process is still in an early stage, these efforts receive strong political support and have been extended continuously.

Source: Authors.

Policy mapping and analysis is also key to informing regional planning processes and supporting accountability on countries' commitments such as those embodied in the Maputo Declarations. Countries are also interested in learning from one another and building on success stories implemented by their neighbors. The need for regional information sharing on relevant policies clearly emerged as a follow-up to the workshops conducted through the AU/NEPAD Nutrition Capacity Development Initiative. NEPAD has thus initiated the development of a Food and Nutrition Security Knowledge-Sharing and Monitoring Platform, with technical assistance from FAO, starting with a focus on southern Africa in collaboration with the South African Development Community (Box 5.4).

BOX 5.4—NEPAD'S FOOD AND NUTRITION SECURITY KNOWLEDGE-SHARING AND MONITORING PLATFORM

The objective of this platform is to stimulate sharing of information and experiences across sectors and countries and to improve the strategic use of data and information on food and nutrition security at both the country and regional levels. The New Partnership for Africa's Development (NEPAD) knowledge portal is expected to foster evidence-based dialogue and a multisectoral approach among countries and regional stakeholders. This process was initiated through consultations in the South African Development Community region, and the aim is to scale it up to the rest of the continent. This work is inspired by the Plataforma de Seguridad Alimentaria e Nutricional,[a] which plays a central role in stimulating learning and accountability at the regional and country levels in the Latin America Without Hunger 2025 initiative.

Source: Authors.
Note: [a] www.plataformacelac.org

Politics, Policies, and Governance

Overall, in terms of policy and governance, the need for cross-sectoral (horizontal) coherence is evident. For agriculture to be accountable for nutrition, high-level coordination, clear indicators, and mechanisms to share and foster dialogue at all levels are needed.

While undernutrition remains a priority problem for Africa, most countries are also faced with a growing prevalence of diet-related noncommunicable diseases, such as diabetes, cardiovascular disease, and obesity. These are tied to evolutions in consumption patterns—that is, greater consumption of fat- and carbohydrate-rich foods and processed foods—that go hand in hand with urbanization and integration into global markets. The response to such trends lies only partly in national agricultural production policies. There is a large role for policies related to marketing and labeling of foods, consumer awareness, retail, and trade. The challenge is to ensure that such policies generate incentives for the private sector (from production to retail) to provide for healthier diets, and for consumers to consume healthier diets. Unfortunately, the evidence of what works and how to simultaneously address nutrition concerns and economic objectives is scarce, inasmuch as the world is collectively facing this new challenge (Hoddinott, Gillespie, and Yosef 2015; Dangour et al. 2013).

Capacity and Financing

Capacity-building efforts aimed at strengthening knowledge and skills are important not only at the policy level but also in terms of building human resources for integrating nutrition across sectors. Capacity development, knowledge building, and coordination efforts all require extra funding.

In terms of *capacity at the grassroots*, there is considerable interest in integrating nutrition into agricultural extension systems, including participatory approaches such as farmer field schools and pastoral field schools. This integration can lend great value toward ensuring that various sectoral institutions with complementary messages reach families in communities with information and skills regarding nutrition. This field is fraught with several challenges, including understaffing and underresourcing of agricultural extension systems, leading to poor coverage and difficulty in reaching households; the great variety of topics to be covered by extension agents, making it difficult for them to have knowledge and skills related to each one, as well as time to communicate about each one; lack of clarity regarding what extension workers should focus on and what is best done by other community-based workers (for example, whether extension workers should do cooking demonstrations, or whether imparting knowledge about the nutritional value of foods to inform cropping choices is sufficient). The good news is that several initiatives are under way to integrate nutrition into extension systems in various countries. There is thus an opportunity to learn from these initiatives, improve the quality and effectiveness of the activities, enhance their coverage, and work to gradually make nutrition a core preservice training component of agricultural training institutes.

With regard to *financing* improvements in the nutrition sensitivity of agricultural and food systems, better information is needed on both costs and public expenditures. Few countries have a proper tracking system for public expenditure on agriculture in general, making it all the more difficult to track what part of that investment contributes to nutrition. Key questions that planners are struggling to address include how much it costs to make agriculture nutrition sensitive and what variables should be tracked. The answers to these questions are not straightforward. The types of interventions required to enhance the nutrition sensitivity of agriculture

will differ from one context to the next (that is, in one context the priority may be agricultural diversification and in another, access to safe drinking water for agricultural workers), and thus the cost also differs. Moreover, in some cases, there may not be a direct cost (for example, the total investment may be the same for nutritious crops as it is for a common staple crop with limited nutritional value), but there may be an opportunity cost (for example, if the market returns on the staple crop are higher). It may be possible to identify "win-win" opportunities—for example, investing in diversified cropping systems (including crop rotation and reduced pesticide use) that generate benefits both for the environment (in terms of climate change adaptation) and for nutrition. Another win-win emerges when farmers choose to grow crops that have good nutritional value as well as high market value.

Studies of *costs and benefits* are under way, in particular by partner countries in the SUN movement, by international financial institutions (the World Bank, the International Fund for Agricultural Development), and by the FAO. As lessons are learned from countries, the methodological challenges of costing and financial tracking need to be addressed. During the Public Finance for Nutrition in Asia workshop (April 25–27, 2016, organized by the SUN movement and UNICEF), several priority challenges emerged in costing and tracking, including absorptive capacity of line ministries; lack of publicly available, disaggregated information on programs at different levels (from central to local); and deciding what to measure—all set against a backdrop of complexity due to a multitude of actors, institutions, ministries, and programs. Similar challenges may apply to Africa south of the Sahara, but work is needed to determine these challenges.

Conclusion

The food and agriculture sector is pivotal not only to addressing undernutrition but also to containing and preventing the spread of diet-related noncommunicable disease. This context requires action throughout the food system, from sustainably managing natural resources and input supplies to enabling consumption of healthy diets and promoting gender equity. Political commitment is growing, but much remains to be done in terms of strengthening the information base to support strategic decision making, and developing capacities for implementation at scale. In April 2016, the UN General Assembly enacted a Decade of Action for Nutrition, and nutrition is directly or indirectly related to all of the Sustainable Development Goals. This enabling environment at the global level should foster further progress in the region, and conversely, African countries can inspire other regions of the world by pursuing innovative approaches for unleashing the latent potential of the agrifood sector to drive positive change in nutrition.

CHAPTER 6

Lessons Learned from the Evaluation of Helen Keller International's Enhanced Homestead Food Production Program

Deanna Olney, Andrew Dillon, Marie Ruel, and Jennifer Nielsen

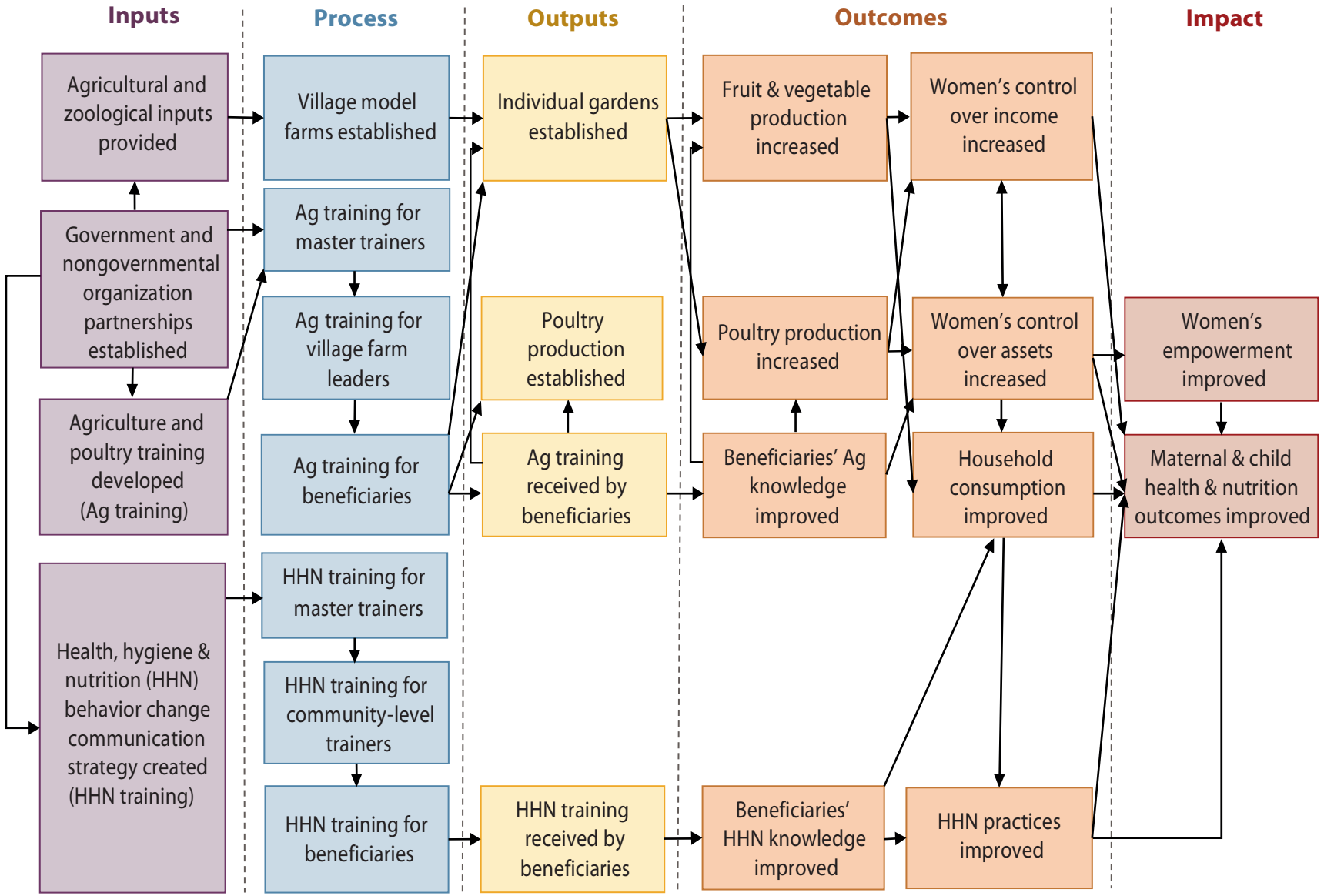
The agriculture sector has great potential to contribute toward improving nutrition, especially through integrated agriculture and nutrition programs. However, there is little causal evidence based on randomized controlled trials that have measured impacts of such programs on nutrition outcomes (for example, child growth, maternal underweight, and anemia) (World Bank 2007; Masset et al. 2012; Girard et al. 2012). This limited evidence is due to weaknesses in program targeting, design, and implementation, and equally important, poor evaluation designs (Girard et al. 2012; Ruel and Alderman 2013).

In addition, very few studies have examined how integrated agriculture and nutrition programs work along the hypothesized program impact pathways to achieve impacts (Olney et al. 2009; Leroy et al. 2009; Girard et al. 2012). One study that has examined the impact pathways in this type of program found positive impacts on increasing the production and consumption of vegetables, on maternal and child dietary diversity, and on reducing fever prevalence among children. However, the study found no impacts on anthropometric or anemia outcomes (Olney et al. 2009). To better understand these results, the International Food Policy Research Institute (IFPRI), together with Helen Keller International (HKI), conducted a process evaluation of the same program—HKI's Homestead Food Production (HFP) program in Cambodia—and revealed a number of program areas that, if improved, could lead to better impacts on maternal and child health and nutrition outcomes (Olney, Vicheka, et al. 2013). These studies again highlighted the need for rigorously designed research to assess program impacts, understand how these impacts were achieved (for example, assessing program delivery, utilization, and intermediary outcomes), and understand how to further optimize impacts (Olney et al. 2009; Olney, Vicheka, et al. 2013).

To address some of these weaknesses in the existing body of evidence (that is, limited causal evidence due to weaknesses in program targeting, design, implementation, and evaluation, as well as limited consideration of program impact pathways), IFPRI and HKI worked together to evaluate HKI's Enhanced Homestead Food Production (EHFP) program in Burkina Faso. As part of this collaboration, HKI improved potential weaknesses identified in HFP program targeting and design, by HKI or through prior research conducted by IFPRI, to create the EHFP program in Burkina Faso. Second, to address issues related to poor study designs, IFPRI researchers designed a comprehensive evaluation using a cluster-randomized controlled study design and included a longitudinal impact evaluation and two rounds of process evaluation. Importantly, both the impact and process evaluations were designed based on a program theory framework and associated program impact pathways jointly developed by HKI and IFPRI (Figure 6.1). This framework was also used to interpret the results from the process and impact evaluations, enabling identification of program areas that could be strengthened and adding plausibility to the findings from the impact evaluation.

This chapter summarizes the primary results from the impact evaluation and two rounds of process evaluation described above that have been previously published in journal articles (van den Bold et al. 2015; Olney et al. 2015, 2016) or program evaluation reports (Olney, Behrman, et al. 2013; Dillon et al. 2012). The chapter brings together these different findings to describe the overall impacts that HKI's EHFP program in Burkina Faso had on maternal and child health, nutrition, and well-being outcomes during the program period, and discusses how these impacts may have been achieved along the hypothesized program impact pathways. In addition, we discuss ideas about how this type of program could be further

FIGURE 6.1—PROGRAM THEORY FRAMEWORK FOR HELEN KELLER INTERNATIONAL'S ENHANCED HOMESTEAD FOOD PRODUCTION PROGRAM IN BURKINA FASO



Source: Olney et al. (2013).

leveraged to optimize impacts on maternal and child health, nutrition, and well-being outcomes in future programs.

Program Design

For more than 20 years, HKI has been implementing an integrated agriculture and nutrition program, known as the HFP (Homestead Food Production) program. HFP originated in Bangladesh and expanded across Asia, and in 2010 the program was introduced for the first time in Africa, in Burkina Faso. The standard model targeted women in vulnerable households (that is, households with low socioeconomic status and a child less than five years old, an orphan, a person living with HIV or AIDS, or a disabled person) and included a home gardening and small animal production component complemented with nutrition education. When the HFP program was introduced in Burkina Faso, a number of changes were being made to the original program design in an effort to increase program impacts on nutritional outcomes, referred to as the EHFP program. The enhancements included replacing more didactic nutrition education with a behavior change communication (BCC) strategy designed around essential nutrition actions (ENAs) and targeting women with children less than two years old. In designing the research study, the intervention was further modified to target families with children 3–12 months of age at baseline in order to increase the likelihood that the program would benefit children during the critical "first 1,000 days" window of opportunity over the course of the two-year program. Also in Burkina Faso, the program used a farmer field school approach with village gardens as the demonstration sites, rather than the privately owned village model farms more commonly used in Asia.

For the production component, in the first year, land for the village garden in each village was secured and each community elected four village farm leaders (VFLs) from among the beneficiaries to serve as managers of the village gardens and the source of technical support for the other beneficiary mothers. Master trainers employed by HKI or its local nongovernmental organization collaborator, *Association d'Appui et de Promotion Rurale du Gulmu* (APRG), trained these VFLs in best practices in homestead food production, such as the use of raised beds, compost, and natural pest control methods, and the importance of vaccinations for poultry. Both master trainers and VFLs provided the same training to all beneficiary mothers as well as ongoing technical support throughout the program period. In addition, HKI provided agriculture inputs (seeds—such as amaranth, tomato, and carrot; seedlings—mango and papaya; and tools—such as watering cans, axes, and hoes) and chickens to the beneficiary mothers and for the village gardens. In year two, the VFLs continued to cultivate the village garden while the other mothers received support to establish household gardens. The goal of the training and inputs was to enable mothers to grow a variety of micronutrient-rich plants with emphasis on the "dry-season" period, when staple crops are not commonly grown, thus allowing time for vegetable production and filling in food and nutrient gaps.

The BCC strategy was designed using the ENA framework, which focuses on the evidence-based practices identified by the *Lancet Series on Maternal and Child Undernutrition* (Bhutta et al. 2013). It also used the "negotiating for behavior change" approach to behavior change communication (BCC), designed to encourage beneficiaries to adopt and adhere to optimal practices such as increasing consumption of micronutrient-rich foods, and to help beneficiaries find ways to overcome any barriers that may have prevented

them from adopting or adhering to these best practices. The training for the BCC strategy used a cascade training approach, in which master trainers employed by HKI or APRG trained community-level trainers and provided them with technical support and supervision throughout the program period. These community-level trainers, in turn, trained the beneficiary mothers. At the community level, the BCC strategy was implemented by two distinct groups— the health committee (HC) group, consisting of male and female village members, and the older women leader (OWL) group, comprising older influential women from the villages, with the objective of comparing the influence of the two groups on improving the knowledge of beneficiary mothers and increasing their adoption of the promoted health and nutrition practices for their children. These two types of actors were selected due to their relative strengths. HC members often work with local health services to deliver health and nutrition interventions in rural villages and thus have experience with this type of intervention and can facilitate linkages with existing services. OWLs, on the other hand, may not have experience in working with the existing health services but may be more influential in changing infant and young child feeding (IYCF) and care practices, given their role in prenatal and postnatal counseling and care in rural areas (Aubel 2012). HC members and OWLs were given the same technical training by the master nutrition trainers and were instructed to implement the BCC strategy in the same way.

Taking these agriculture and nutrition components together, the EHFP program was expected to improve maternal and child health and nutrition and women's empowerment outcomes through three main pathways:

1. Increasing the availability of micronutrient-rich foods through increased household production of these foods, especially during the dry season
2. Raising women's control over productive assets through the provision of inputs and training, and the sale of surplus production
3. Increasing knowledge and adoption of optimal health and nutrition practices through the provision of training and support

Study Design

The impact evaluation used a cluster-randomized controlled trial. Fifty villages in Gourma Province with access to water in the dry season were randomly selected to include 25 control villages and 30 intervention villages. The intervention villages included 15 villages that received an agriculture component and a BCC component implemented by HC members (HC villages) and 15 villages that received the same agriculture and BCC components but with the BCC component delivered by OWLs (OWL villages) (van den Bold et al. 2015; Dillon et al. 2012). All households in these villages who had children between 3 and 12 months of age at baseline were invited to participate in the baseline survey (2010) for the impact evaluation and were also asked to participate in the endline survey (2012) (Table 6.1). Those households that were eligible to participate in the baseline survey and lived in the intervention villages were invited to participate in the EHFP program that was implemented between 2010 and 2012. Within participating households, the mothers of the targeted children were the primary program beneficiaries and the primary respondents for the impact evaluation. However, other household members were welcome to participate in program activities.

Participants for the process evaluation were randomly selected from each of the 29 included intervention villages (1 village dropped out of the

program and evaluation due to internal conflicts) and from 15 (of the 25) control villages that had participated in the baseline survey. For the first round of the process evaluation (2011), five households within each selected village were randomly chosen from the list of households that had participated in the baseline study to participate in the process evaluation (Table 6.1). The same households participated in the first and second rounds of qualitative research (2011 and 2012) to the extent possible. If a household from the first round of qualitative research was not available to participate in the second round, a replacement household was randomly selected from the list of households that had participated in the baseline survey. Additionally, a purposeful sampling method was used to identify key informants including master and community-level agriculture and nutrition trainers.

Methods

The impact evaluation used household surveys and clinical assessments conducted at baseline (February–May 2010) and endline (February–June 2012). The household survey included a wide range of questions for both the household head and the beneficiary mother. The household head was asked about the composition of the household and members' health, education and dwellings. Both male and female respondents were then interviewed separately about issues including asset and animal ownership and value (Dillon et al. 2012). In addition, the beneficiary mother was asked about her diet, her IYCF practices, her health- and nutrition-related knowledge, and her child's health, among other topics. Agriculture production was measured in kilograms, and asset and animal ownership were assessed using both counts and monetary value. Indicators for dietary diversity were constructed using standard measures for households (Swindale and Bilinsky 2006), women (Kennedy,

TABLE 6.1—OVERVIEW OF SELECTED METHODS AND NUMBERS OF PARTICIPATING HOUSEHOLDS FROM HEALTH COMMITTEE, OLDER WOMEN LEADER, AND CONTROL VILLAGES

Impact evaluation				
	Intervention villages			
	HC villages	OWL villages	Control villages	Total
Number of villages	15[a]	15	25	55
Number of households				
Baseline (2010)				
Household interview	511	512	734	1,757
Endline (2012)				
Household interview	436	444	590	1,470
Process evaluation				
	Intervention villages			
	HC villages	OWL villages	Control villages	Total
Number of villages	14[a]	15	15	44
Number of households				
First round (2011)				
Basic semi-structured interviews	70	75	75	220
Second round (2012)				
Semi-structured interviews	70	75	75	220

Source: Van den Bold et al. (2015).

Note: [a] One village dropped out of the program and evaluation due to internal conflicts, leaving 14 HC villages in the endline impact evaluation and the two rounds of process evaluation. HC = health committee; OWL = older women leader.

Ballard, and Dop 2011), and children (WHO 2010) available at the time of the baseline evaluation. Finally, indicators for women's empowerment were derived from a 30-question module from which the data were reduced through exploratory factor analysis. The factor analysis suggested seven unique components: meeting with other women, spousal communication, social support, purchasing decisions, family planning decisions, healthcare decisions, and IYCF decisions. Indicators for women's empowerment in this study included scores within each of these components and a total score, which was the sum of the scores for the individual components.

The clinical assessments included anthropometric measures for the beneficiary mother and target child and a hemoglobin measure for the target child. For anthropometric measures, weight was measured (to the nearest 100 g) using an electronic scale. The weight measure was first taken for the mother and child together and second for the mother alone. The difference was recorded as the child's weight. Recumbent length of children younger than two years, and standing height of children older than two and of mothers, was measured to the nearest 0.1 cm using a wooden length board (from Shorr Productions). Maternal body mass index (BMI) was calculated based on weight and height measures (kg/m2), and underweight was defined as BMI < 18.5 kg/m2. Height-for-age z-score (HAZ) and weight-for-height z-score (WHZ) values were calculated using the 2006 World Health Organization growth reference standards (World Health Organization Multicentre Growth Reference Study Group 2006). Stunting was defined as HAZ < -2 standard deviations (SDs) and wasting as WHZ < -2 SDs. To assess anemia, capillary blood from a finger prick sample was used to immediately measure hemoglobin (Hb) (using equipment from HemoCue AB). Anemia was defined as Hb < 11.0 g/dL and severe anemia as Hb < 7.0 g/dL. Diarrhea (defined as watery stool) in the past week was measured by maternal recall.

For the first round of process evaluation, semi-structured interviews (SSIs) were conducted with key informants and with a subset of mothers in intervention and control villages. In the first round, SSIs with intervention households covered a range of issues related to the primary program components, such as participation in agriculture and home gardening activities; perceptions of ownership of and control over assets and produce from home gardening activities; and barriers to and facilitators for the adoption of optimal agriculture, health, hygiene, and nutrition practices (Olney, Behrman, et al. 2013). The second round used SSIs to delve deeper into understanding men's and women's views about acquisition, use, and ownership of land and other agricultural assets and related to agricultural decision making, again in both intervention and control communities. Intervention households were asked additional questions about their participation in the program, and the impact of the program on changes in control over different types of assets.

In addition to the household interviews for the process evaluation, key informant interviews were conducted with 13 agriculture and 24 nutrition master trainers, 58 VFLs, and 58 community-based nutrition trainers (either OWLs or HC members). These interviews focused on the trainers' background; their agriculture or nutrition knowledge, as appropriate; the trainings that they received; and those they provided. Additionally, they were asked whether they felt that they were knowledgeable, motivated, and compensated enough to effectively carry out their program-related responsibilities.

Data Analyses

For the evaluation, impacts were estimated for specific outcomes by comparing results in the intervention and control villages, using difference-in-difference models. The models included baseline characteristics of the household, mother, or child, depending on the impact being measured. The regressions were estimated with corrections for clustering at the level of the village (the unit at which the intervention was assigned) and for attrition using inverse probability weights. Impacts on children's health and nutrition outcomes were analyzed by comparing each of the two treatment groups with the control group, whereas those for maternal outcomes were analyzed using the pooled treatment groups compared with the control group. (For further information on the impact analyses, please see Olney et al. 2015, 2016).

For the process evaluation, qualitative data were manually coded by grouping similar responses and looking for common themes among them. (For further information, please refer to van den Bold et al. 2015 and Olney, Behrman, et al. 2013).

Results

Results from the impact evaluation demonstrate several positive impacts of the EHFP program on children's nutrition and health outcomes (Olney et al. 2015) and mothers' nutrition and empowerment outcomes (Olney et al. 2016) among program beneficiaries, as compared with those living in control villages.

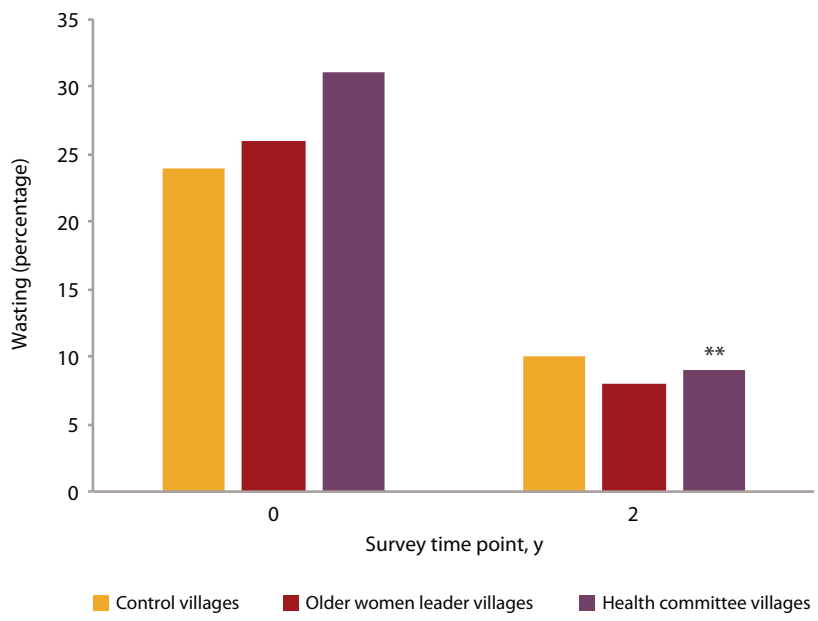
Program Impacts on Children's Health and Nutrition Outcomes

The prevalence of stunting, wasting, and anemia in this population were high at baseline (31 percent, 27 percent, and 89 percent, respectively). Over the two-year program period, the EHFP program significantly reduced the prevalence of wasting (Figure 6.2) and anemia (Figure 6.3) relative to the control group, but not stunting. Specifically, the EHFP program with the BCC component implemented by HC members reduced the prevalence of wasting among children 3–12.9 months by 9 percentage points (Figure 6.2) and of anemia among children 3–5.9 months by 15 percentage points (Figure 6.3); this impact on anemia was limited to the younger cohort of children. In addition, the EHFP program implemented by either HC members or OWLs reduced the prevalence of diarrhea among children 3–12.9 months at baseline by 16 percentage points (HC members) and 10 percentage points (OWLs) compared to the control group. Among children in the control villages, the prevalence of diarrhea decreased from about 17 percent at baseline to 12 percent at endline, whereas it decreased from about 31 percent to 12 percent and from 26 percent to 14 percent in HC and OWL groups, respectively, over that same period.

Program Impacts on Maternal Nutrition and Empowerment Outcomes

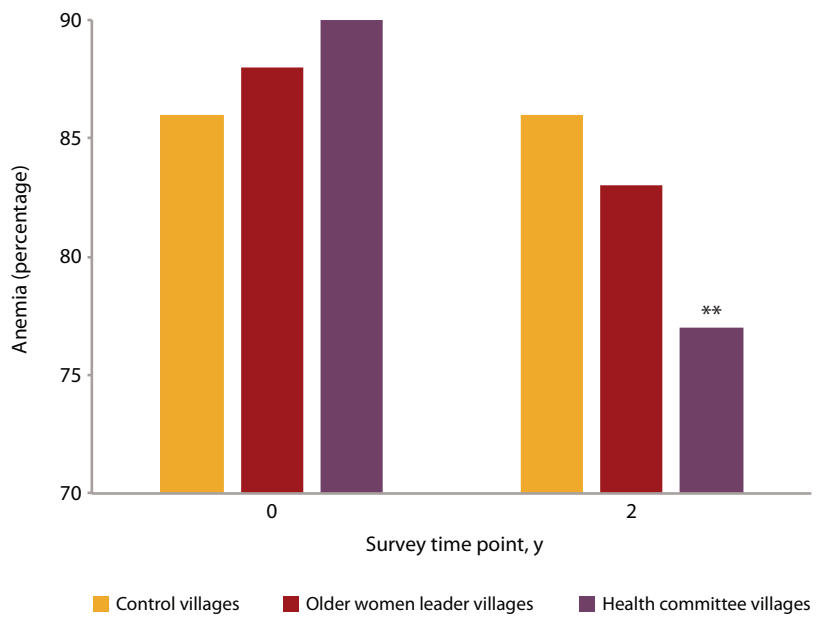
In addition to the positive program impacts on improving children's nutrition and health outcomes, the EHFP program also improved maternal nutrition and empowerment outcomes. In this population, maternal underweight at baseline was relatively high, at 23 percent in program villages and 15 percent in control villages. Over the two-year program period,

FIGURE 6.2—UNADJUSTED MEAN PREVALENCE OF WASTING (WHZ < -2 SD) AT BASELINE AND AFTER 2 YEARS AMONG CHILDREN 3–12.9 MONTHS OF AGE AT BASELINE, BY GROUP



Source: Olney et al. (2015).
Notes: ** p < 0.05. WHZ is weight-for-height z-score.

FIGURE 6.3—UNADJUSTED MEAN PREVALENCE OF ANEMIA (HB < 11.0 G/DL) AT BASELINE AND AFTER 2 YEARS AMONG CHILDREN 3–5.9 OF AGE AT BASELINE, BY GROUP



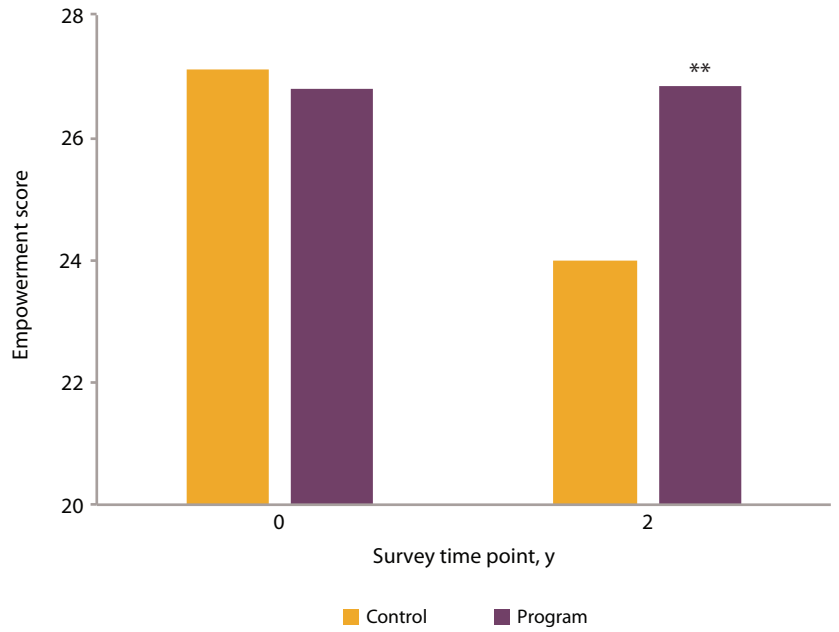
Source: Olney et al. (2015).
Notes: ** p < 0.05. HB is hemoglobin.

the prevalence of underweight among mothers in the program villages decreased by about 8 percentage points, whereas it remained the same among mothers in the control villages, resulting in a significant program impact of 8 percentage points.

The EHFP program also significantly improved measures of empowerment among mothers in the program compared with those in control villages. For example, among mothers in program villages, there was a significantly greater increase in participation in purchasing decisions and less of a decrease in participation in healthcare decisions compared with those in control villages. In addition, there was an overall decline in the total empowerment score for women in control villages, compared with a slight increase among those living in program villages over the two-year program period, resulting in a significant program impact of about 3 points out of a possible 37 (Figure 6.4).

Our analyses suggest that these positive changes in child nutrition and health outcomes and maternal nutrition and empowerment outcomes in program villages were likely related to the observed positive impacts of the EHFP program on intermediary outcomes along the three primary program impact pathways (Dillon et al. 2012; van den Bold 2015; Olney et al. 2016; Quisumbing et al. 2016). Likewise, findings indicate shortfalls in impacts on some indicators may have been due to limitations in program delivery or utilization or due to the need for additional program inputs.

FIGURE 6.4—UNADJUSTED TOTAL MEAN SCORE OF WOMEN'S EMPOWERMENT AT BASELINE AND AFTER 2 YEARS, AMONG BENEFICIARY AND NONBENEFICIARY MOTHERS



Source: Olney et al. (2016).
Note: ** $p < 0.05$.

Results along the Availability of Micronutrient-Rich Foods Pathway

We found evidence from the process evaluation that the program was generally being delivered and utilized as planned along the first program impact pathway. However, certain program components were identified as needing improvement. The vast majority of program beneficiaries reported receiving program inputs, attending the agriculture trainings, and having a home garden (114 out of 136, or 84 percent). Whereas, only a few of the nonbeneficiaries interviewed had home gardens (3 out of 74, or 4 percent). In addition, beneficiaries reported having newly adopted some of the practices promoted by the program, such as building a fence around their gardens (111 out of 114, or 97 percent) and using raised beds (96 out of 114, or 84 percent). Through their pariticpation in the program and establishment of their home gardens and animal raising activites, beneficiaries believed that their vegetable, chicken, and egg production had increased and that their overall food situation had improved.

Despite these positive findings, a number of areas needed improvement with regard to program delivery and utilization. For example, issues related to water availability and the quantity and quality of some of the agriculture inputs were identified as needing improvements. In addition, some of the master agriculture trainers did not feel adequately compensated and thus did not feel very motivated. This was far less of a problem among the VFLs, who generally believed that they received enough compensation through participating in the program, although some mentioned the challenge of finding time to fulfill their responsibilities.

Sufficient, convenient access to water for irrigation was repeatedly listed as one of the primary constraints to increasing production of fruits and vegetables in the village and household gardens. Although villages

were included in the program and evaluation only if they had some access to water for irrigation, water supplies were less than ideal. During the process evaluation, program implementers and beneficiaries discussed these constraints, their perceived impacts, and potential solutions, a number of which were eventually adopted (for example, creating new wells or boreholes, repairing existing water sources, or using water-saving technologies). In addition to the water-related problems, many of the VFLs stated that they were not given enough supplies to create and maintain the village gardens. They especially cited needing more watering cans and seeds, and more seed varieties. The master agriculture trainers also expressed some concern that some of the seeds and supplies were not of a high enough quality. Among program beneficiaries, the general perception of the program inputs was that they were sufficient and of good quality, but some beneficiaries felt they needed additional resources such as seeds, fencing materials, and small gardening tools for their home gardening activities.

Complementing the findings from the process evaluation, evidence from the impact evaluation revealed significant although modest program impacts on a number of the intermediary outcomes, such as increased production of micronutrient-rich plants and poultry, as well as increased intake of nutrient-rich foods among mothers (Olney et al. 2016) and dietary diversity among children (Olney et al. 2015). These positive outcomes, in turn, likely contributed to the positive program impacts we saw on maternal and child nutrition outcomes.

Results along the Income and Assets Pathway

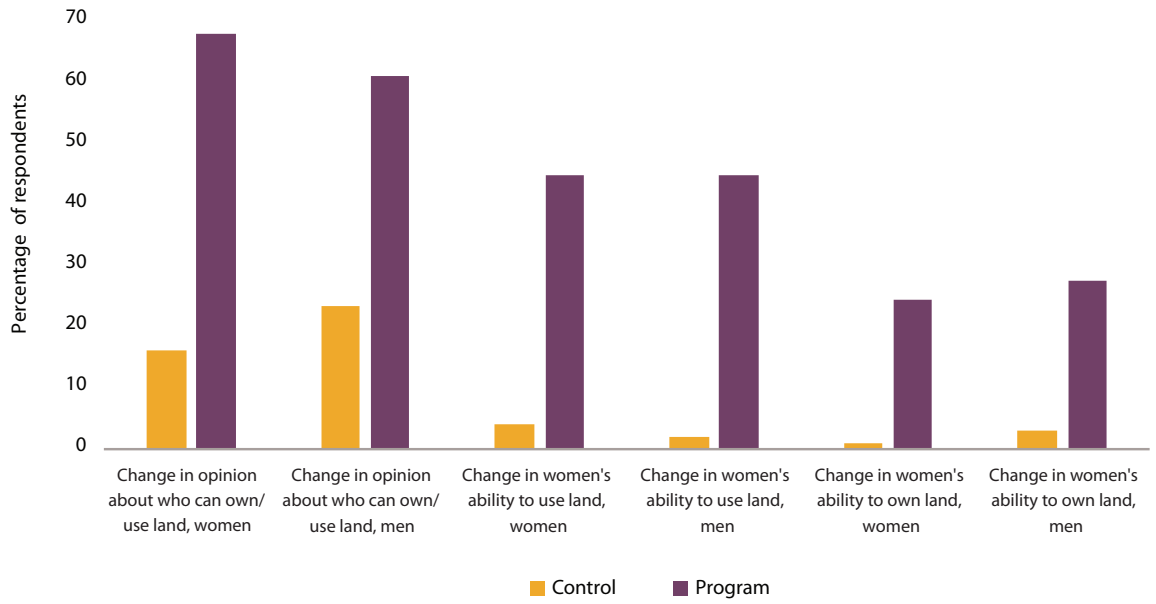
The program components along the income and assets pathway were almost entirely the same as those for the availability of micronutrient-rich foods pathway with the exception of the intermediary outcomes of increased women's control over income and assets. The process evaluation revealed that a greater proportion of male and female respondents in the treatment (compared with control) villages reported changes in women's land ownership and use and in opinions related to these issues over the two-year program period (Figure 6.5). In addition, the majority of beneficiary mothers stated they were able to maintain control of their gardens, the foods produced in those gardens, and any income generated from the sale of that produce. Most also reported that they preferred to use their EHFP-related products to meet their household food needs rather than to earn income (van den Bold et al. 2015). Among those who did generate income from the sale of foods, beneficiaries were more likely to use the money to buy food, whereas nonbeneficiaries favored saving the money for future use.

The findings from the impact evaluation complement those from the process evaluation. For example, the impact evaluation revealed significant positive program impacts on women's ownership of agricultural assets and small animals (van den Bold et al. 2015). Taken together, the findings indicate that the EHFP program influenced women's asset accumulation as well as social norms regarding women's participation in agricultural activities and their ability to own and use land for these purposes. It is plausible that changes in these outcomes contributed to the positive impacts we saw on women's empowerment, and possibly on maternal and child health and nutrition outcomes.

Results along the Knowledge about and Adoption of Optimal Health, Hygiene, and Nutrition Practices Pathway

Along the knowledge pathway, a few areas were identified in the first process evaluation as needing improvement, such as provision of home visits, and

FIGURE 6.5—REPORTED CHANGES BETWEEN 2010 AND 2012 RELATED TO VIEWS OF OWNERSHIP AND USE OF LAND FOR AGRICULTURAL PURPOSES, AMONG WOMEN AND MEN, BY GROUP



Source: van den Bold et al. (2015).

knowledge about feeding children during illness and preventing anemia. In addition, there was some indication that improvements were needed in relation to the motivation and compensation of the master and community-level nutrition trainers. Findings also suggested that the community-level nutrition trainers, especially OWLs, could benefit from additional training and support from the EHFP program.

Among the beneficiaries who participated in the semi-structured interviews, fewer than three-quarters had received a home visit or attended a nutrition training session, and fewer than half had received the recommended two visits in the past 30 days. In addition, HC members were almost twice as likely to report visiting mothers to check on their adoption of optimal practices rather than just their knowledge of these practices, as compared with OWLs. HC members were also more likely to have elicited support from other family members when mothers were having trouble adopting or adhering to the promoted practices. Supporting these reports by HC members and OWLs, we also found that beneficiary mothers in HC villages were more likely to say that they received support from their family or community members to adopt practices, as compared with those living in OWL villages (Olney, Behrman, et al. 2013). Many beneficiaries believed that an increase in home visits and clearer explanation of the recommended practices would be useful. Community-level trainers, on the other hand, requested more visual aids to support their home visits and nutrition discussions.

Master nutrition trainers generally demonstrated good understanding of the health and nutrition topics covered in the nutrition training sessions. However, they identified two topics that were more challenging: how to feed children when they are sick and how to identify foods suitable for infants and young children. Beneficiaries, like the master and community-level trainers, also mentioned difficulty understanding how to feed a sick child. Thus, this topic clearly needed to be reinforced during the EHFP program and in future

programs. Responses to a question about how to prevent anemia revealed another area that needed reinforcement in the BCC. Although nearly three-quarters of the master nutrition trainers correctly identified two ways to prevent anemia, only about one-third of the community-level nutrition trainers (lower among OWLs than among HC members) and less than one-third of the beneficiaries correctly named two ways to prevent anemia. Given that anemia among young children in Burkina Faso was almost universal at the time of the study, this was highlighted as a program area that required immediate improvement. This information was shared with HKI while the program was ongoing, and HKI immediately organized additional training on these topics at all levels.

The master nutrition trainers interviewed stated that they enjoyed their work, but many thought coverage of per diems and transport costs were too low. By contrast, the HC members and OWLs were satisfied with incentives provided, whether in the form of a T-shirt or a per diem. Those who were dissatisfied with their perceived compensation discussed having to travel long distances and sacrifice fulfilling some of their other responsibilities. Money, transportation, or food donations were mentioned as appropriate types of compensation. Master trainers suggested that HC members and OWLs should receive more topical trainings or review trainings, along with literacy training and monetary incentives.

The impact evaluation showed significant program impacts on reducing the prevalence of anemia in the HC villages. This suggests that the program adjustments in response to the process evaluation were effective in HC villages where the community-level trainers had a higher level of knowledge and were more likely to verify adoption of promoted practices and to elicit support for their adoption compared to their counterparts in OWL villages. (Olney, Behrman, et al. 2013).

Discussion and Conclusions

This is the first study to use a randomized controlled trial to evaluate the impact of this type of integrated agriculture and nutrition program. The results from the impact evaluation clearly demonstrate positive impacts on children's health and nutrition status and on women's nutrition and empowerment. However, it also illustrates that more needs to be done to address child stunting in this population and to further reduce the prevalence of diarrhea and anemia. The in-depth qualitative work indicated that there may have also been normative changes in women's access to and control over productive assets, due to the program. In addition, this comprehensive evaluation highlighted how improvements in these outcomes were likely achieved along the three hypothesized program impact pathways. The study revealed some potential shortcomings in program delivery and utilization that, if addressed, could lead to greater impacts.

The program impacts noted in this chapter should be appreciated in light of the short duration of the program and the fact that this was the first adaptation of the model to an African cultural context and to the Sahelian climatic zone. Despite the program's success, undernutrition in the study population was still highly prevalent at the end of the study (anemia prevalence in the control, OWL, and HC groups was 82 percent, 81 percent, and 78 percent, respectively, and stunting prevalence was between 44 percent and 48 percent). The results from the evaluation formed the basis of several recommendations for enhancing the impacts of EHFP on children's health and nutritional status:

1. Intervene earlier in the 1,000-day window (for example, during pregnancy)

2. Conduct the intervention for a longer period in order to support families in adopting recommended practices in a more sustainable way
3. Have both HC members and OWLs deliver health, hygiene, and nutrition messages according to their respective knowledge, strengths and skills.
4. Re-examine issues related to the motivation and compensation of trainers at different levels
5. Include additional program components to address other underlying causes of undernutrition, such as suboptimal hygiene and health practices, morbidity, and the exceptionally high nutritional needs of young children

The larger impact of the program on reducing the prevalence of anemia among the younger cohort of children indicates that intervening earlier may confer greater nutritional benefits for children. In addition, experience shows this type of program requires time to start up and for beneficiaries to realize program benefits. For example, inputs need to be distributed, trainings at all levels held, gardens planted, produce grown, harvested and finally consumed or sold to generate income. This alone can take between 6 months and a year. Thus if children are 3–12 months old at baseline, they will be 9-24 months old before they directly benefit from the micronutrient-rich foods produced through program activities. Similarly, BCC trainings at all levels must be delivered, beneficiaries must understand the practices being promoted, believe they are important to adopt, and then obtain the resources necessary to utilize the new practices. Building sustainability also requires time.

In this study, we learned that although the two types of BCC implementers were given the same training and materials for working with the beneficiary mothers, there were differences in their knowledge, the type of knowledge they transferred most effectively to mothers, and the way in which they conducted home visits. HC members were more knowledgeable about health-related topics and transferred this information more effectively to mothers; they were also more likely to check on whether or not mothers had been able to adopt the promoted practices, overcome barriers to adoption and enlist support from other household members. Beneficiaries in HC villages also reportedly felt more supported than those in OWL villages, echoing what was reported by the OWLs and HC members themselves. These findings, along with the greater impacts on children's nutritional status found among children in the HC villages, indicate that HC members were more effective at implementing the BCC strategy, which may have contributed to the positive impacts on children's nutritional status.

Worker motivation and compensation, training, and support were also highlighted in the process evaluation as possible barriers to optimal program delivery. Master trainers in both agriculture and nutrition felt that they should be better compensated for their work and especially mentioned increases in per diems and fuel reimbursements. Although there was less dissatisfaction among the VFLs, the issues mentioned by HC members and OWLs regarding time constraints, adequate training, support, and incentives should be considered for these community-level trainers. Although these can be difficult issues to navigate, they are important to carefully consider when successful program delivery depends on these different levels of trainers.

Finally, although the program had a number of positive impacts on children's nutrition and health outcomes and mothers' nutrition and empowerment outcomes, the prevalence of anemia remained high at endline and the high prevalence of stunting was not affected by the program. It is possible that additional program inputs are needed to further reduce anemia and to address stunting in this population. Moving forward with a second phase, researchers and implementers agreed to add new components in order to have greater impact. This included more intensive attention to the prevention and treatment of malaria, water hygiene and sanitation, and including a ready-to-use fortified complementary food to meet the high nutrition needs of children 6–24 months of age. HKI and IFPRI also agreed to continue their rigorous research to evaluate this second phase of the program in Burkina Faso—Creating Homestead Agriculture for Nutrition and Gender Equity (CHANGE).

Thus the CHANGE project, which began in 2014, has continued the EHFP program, but includes two additional components and a factorial research design to compare the original model with (1) a model enhanced with a water, sanitation, and hygiene / malaria prevention (WASH/MP) component and (2) a model enhanced with both a WASH/MP component and provision of a lipid-based nutrient supplement (LNS) to children aged 6–23 months. The four components of the CHANGE program (agriculture, BCC, WASH/MP, and LNS) are expected to lead to additional or synergistic benefits that could not be achieved through one component on its own. For example, by increasing access to micronutrient-rich foods and providing a fortified complementary food, the program may reduce stunting among children who receive the LNS in addition to the other EHFP program components. By improving the prevention of the two most prevalent illnesses through increased use of insecticide-treated bed nets; improved WASH practices; and prompt, effective treatment of infections, the improvements in maternal and child health and nutrition outcomes may be further increased.

It is widely accepted by the nutrition and development community that the causes of undernutrition are multifactorial and require multisectoral interventions. The EHFP program provides an example of how a multisectoral program can work to improve nutrition outcomes; however, it is possible that integrating interventions from additional sectors can further optimize these program impacts. CHANGE is an example of such a program designed to leverage actions across the relevant sectors of agriculture, nutrition, WASH, and health to improve nutrition. Given the complexity of multisectoral programming, however, program implementers, investors, and policy makers need robust evidence from rigorous evaluations to confirm that integrated programs do indeed create synergies and benefits, and do not overload program implementers and beneficiaries. The strong partnership built between HKI and IFPRI is working to these ends.

CHAPTER 7

The Role of Biofortification as Part of More Diverse Diets in Africa: Progress, Challenges, and Opportunities

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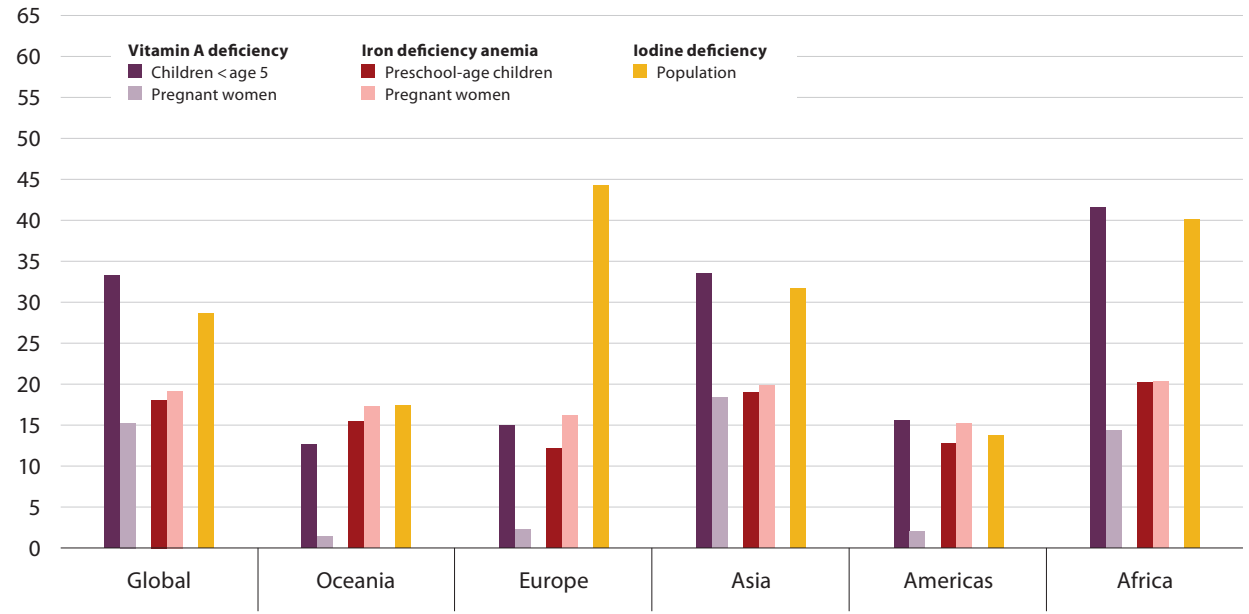
Micronutrient deficiency affects more than 2 billion individuals, or one in three people globally (FAO 2013). Also known as "hidden hunger," micronutrient deficiency results from poor-quality diets, characterized by a high intake of staple foods, such as rice and maize, and low consumption of micronutrient-rich foods, such as animal-source foods, fruits, and vegetables. Hidden hunger particularly affects populations living in poverty, who often do not have the means to grow or purchase more expensive micronutrient-rich foods. Hidden hunger contributes significantly to the global disease burden of children by limiting proper cognitive development, impairing physical development, and increasing susceptibility to infectious diseases. These health issues can have long-term effects on an individual's livelihood by substantially curtailing one's ability to capitalize on economic opportunities (Bryce et al. 2003; Alderman, Hoddinott, and Kinsey 2006). The international nutrition community recognizes vitamin A, iron, iodine, and zinc as the micronutrients whose deficiency in diets is most limiting (Black et al. 2013). Prevalence of these micronutrient deficiencies is especially high in Africa (Figure 7.1).

Although there are several underlying causes of micronutrient deficiencies, a systematic inquiry into food consumption datasets identified dietary quality as an important one (Bouis and Haddad 1990). Increasing dietary diversity is one of the most effective ways to sustainably prevent micronutrient deficiencies (Thompson and Amoroso 2010). Dietary diversity is associated with better child nutritional outcomes, even when controlling for socioeconomic factors (Arimond and Ruel 2004). A variety of cereals, legumes, fruits, vegetables, and animal-source foods provides adequate nutrition for most people, although certain populations, such as pregnant women, may need supplements (FAO 2013). However, most people in developing countries, especially those in rural areas, do not have access to diverse diets throughout the entire year. Effective ways to promote dietary diversity

FIGURE 7.1—PERCENTAGE OF POPULATION WITH SELECTED MICRONUTRIENT DEFICIENCIES



Source: Black et al. (2013), cited in von Grebmer et al. (2014).

involve food-based strategies such as home gardening, livestock production programs, and education on better feeding practices for infants and young children, as well as food preparation and storage/preservation methods to prevent nutrient loss (von Grebmer et al. 2014).

One potential solution to improve dietary quality and diversity is biofortification—the process of breeding staple food crops with higher micronutrient content (Bouis et al. 2011; Saltzman et al. 2013). Because food staples are regularly consumed in large quantities, biofortification is an efficient and cost-effective way of increasing micronutrients in the diets of the poor. It contributes to improving the diet quality of populations and can be viewed as integral to dietary diversity. Biofortification is not promoted to increase the consumption of staple foods. Rather, it is used to substitute some or all of the nonbiofortified equivalent staples from the diet with improved, micronutrient-rich varieties (Kennedy and Moursi 2015).

Evidence from several ex ante impact analysis studies reveals that biofortification could be a cost-effective and sustainable strategy for alleviating micronutrient deficiencies, especially in the long term, in rural areas of developing countries where poor households' diets mostly comprise staple foods and where access to food supplements and commercially marketed fortified foods is limited (Qaim, Stein, and Meenakshi 2007; Meenakshi et al. 2012; Birol et al. 2014; Fiedler and Lividini 2014). In several developing countries, a comparison of biofortification with dietary supplementation and fortification interventions revealed that biofortification is a potentially significant and cost-effective complementary intervention (Meenakshi et al. 2012; Birol et al. 2015) and, in some cases, combining biofortification with these other interventions may yield a higher impact at lower costs (Fiedler and Lividini 2014).

Even though the ex ante impact evidence is promising, for biofortification to be considered a feasible and effective approach to alleviating hidden hunger, three conditions should be met:

1. Conventional breeding will add extra nutrients to crops without reducing yields.
2. When consumed, the increased nutrient levels will make a measurable and significant impact on human nutrition.
3. Farmers are willing to grow biofortified crops and consumers are willing to eat them.

The first aim of this chapter is to present the most up-to-date breeding, nutrition, and monitoring and evaluation evidence supporting these three conditions, with a particular focus on Africa. The second aim is to discuss the challenges faced in implementing biofortification interventions, and the final aim is to present opportunities for scaling up and mainstreaming biofortification to reduce micronutrient deficiencies.

Current Evidence: Breeding of Biofortified Crops

Today, biofortified crops—including vitamin A–rich orange sweet potatoes (OSP), iron beans, iron pearl millet, vitamin A yellow cassava, vitamin A orange maize, zinc rice, and zinc wheat—have been officially released for production in more than 30 countries and are being tested and grown in more than 50 countries. These releases, approved by the official national release committees of these countries, demonstrate that it is possible to increase the micronutrient content of these crops (that is, biofortify them)

using conventional breeding without sacrificing other production and consumption attributes that farmers and consumers prefer. Crop improvement continues, with researchers developing varieties with ever-higher levels of vitamins and minerals that are adapted to a wide range of agroecological conditions, and ensuring that the best germplasm for climate-adaptive as well as food quality traits is used in the breeding of biofortified crops. Biofortified germplasm and nutrient-rich breeding lines are made available as public goods to national governments, which can test and further improve these materials for subsequent official release as new crop varieties. Table 7.1 presents the status of the biofortified varieties of crops developed for Africa.

TABLE 7.1—STATUS OF BIOFORTIFIED VARIETY TESTING AND RELEASE IN AFRICA (AUGUST 2016)

Status of biofortified varieties	Iron beans	Yellow cassava	Orange maize	Orange sweet potatoes
Tested in # of countries	6	8	10	> 14
Released in # of countries	6	5	7	> 14
# of varieties released	28	10	31	> 90

Source: Data drawn from HarvestPlus (2016).

Current Evidence: Nutrition Impact

The consistency of results from nutrient retention and bioavailability studies has proven that when consumed regularly and in sufficient quantities, biofortified crops can improve the nutritional outcomes of target populations. Moreover, the results have justified expanding research from the target population of nonpregnant, nonlactating women and children four to six years of age to adolescent women, in order to understand how consuming biofortified crops affects nutritional outcomes in pregnant women and in children during the first two years of life (Saltzman et al. 2016). The results of bioavailability studies with children younger than three (Chomba et al. 2015; Kodkany et al. 2013) and women of childbearing age (Li et al. 2010; La Frano et al. 2013; Rosado et al. 2009; Cercamondi et al. 2013) indicate that substantial proportions of the estimated average requirements for iron, zinc, or vitamin A can be delivered by single biofortified crops.

There is a considerable and ever-growing number of randomized, controlled efficacy trials for several biofortified crops. Efficacy trials for vitamin A OSP (van Jaarsveld et al. 2005; Low et al. 2007), vitamin A orange maize (Palmer et al. 2016; Gannon et al. 2014), vitamin A yellow cassava (Talsma et al. 2016), iron pearl millet (Finkelstein et al. 2015; Scott et al. 2014; Pompano et al. 2013), and iron beans (Luna et al. 2012; Haas et al. 2016) provide promising evidence that biofortification improves micronutrient status among target populations. To further expand the evidence base for biofortified crops, research is under way to conduct iron, zinc, and vitamin A crop efficacy trials with children younger than two in India and Zambia.

Effectiveness evidence available to date also reveals positive results. Evidence from rural Uganda shows that the delivery of vitamin A OSP significantly increased vitamin A intake among children and women, and measurably improved vitamin A status among some children, with a 9.5 percent reduction in the prevalence of low serum retinol (Hotz et al. 2012b). In Mozambique, the delivery of OSP doubled vitamin A intakes, with OSP providing almost the entire total vitamin A intake for children (Hotz et al. 2012a). Consumption of OSP also reduced the prevalence and duration of diarrhea among children (Jones and de Brauw 2015). Among children who consumed OSP, the prevalence of diarrhea was 11.5 percentage points lower for children younger than five, and 19 percentage points

lower for children younger than three, compared with children who did not consume OSP. Similarly, children who consumed OSP suffered from less diarrhea—0.6 days (for those younger than five) to 1.3 days (for those younger than three) less per week—than children who did not consume OSP (Jones and de Brauw 2015). These results reveal that biofortification could improve child health (Jones and de Brauw 2015). In order to complete the effectiveness evidence on all three micronutrients, an iron bean effectiveness study is currently being implemented in Guatemala, and there are plans to conduct a zinc wheat effectiveness study in Pakistan in the coming years.

Adoption and Consumption Evidence

Since the delivery of biofortified crops began in 2012, efforts have focused on five HarvestPlus target countries in Africa: Democratic Republic of the Congo, Nigeria, Rwanda, Uganda, and Zambia. In 2015, these efforts reached more than 1.5 million farming households with biofortified planting materials. Table 7.2 presents the numbers of households HarvestPlus and its partners have reached annually since 2012 in each of the HarvestPlus target countries in Africa. These figures are considered a lower bound because they do not include (1) delivery by other organizations (such as the International Potato Center, known as CIP, which delivers vitamin A OSP) and by national governments in HarvestPlus target countries or in other countries in Africa, and (2) households who receive biofortified planting material through diffusion channels (such as through their social networks or through purchasing grain in local markets to use as planting material).

TABLE 7.2—NUMBER OF HOUSEHOLDS (IN THOUSANDS) REACHED IN TARGET COUNTRIES IN AFRICA, 2012–2015

Crop/country	2012	2013	2014	2015
Iron beans, Rwanda	105	609	332	480
Iron beans, Dem. Rep. of Congo	60	241	128	175
Iron beans, Uganda	29	69	43	37
Vitamin A maize, Zambia	0	11	104	110
Vitamin A cassava, Nigeria	0	106	360	520
Vitamin A cassava, Dem. Rep. of Congo	0	25	75	180
Vitamin A orange sweet potatoes, Uganda	33	76	107	132
Total	**227**	**1,137**	**1,149**	**1,634**

Source: Data drawn from HarvestPlus (2016).

In several target countries, studies have been conducted to understand farmers' evaluation of various production and consumption traits of these biofortified crops vis-à-vis conventional ones, and to assess future adoption and diffusion patterns. These studies suggest that farmers like the various production and consumption attributes of biofortified varieties and that they plan to plant these crops in forthcoming seasons, often on larger areas, and give some planting material or information about these varieties to others in their social networks.

A participatory farmer field day evaluation study conducted in 2012 in Zambia confirmed a strong preference by farmers for both the production and consumption attributes of orange maize varieties compared with conventional white maize varieties (Chibwe et al. 2013). Farmers appreciated the yield, cob size, and cob-filling characteristics of the new varieties, as well as the taste and aroma of orange maize preparations. Participants also indicated a willingness to pay (as a proxy for demand) for the seed of the orange maize varieties, with an average premium of 40 percent more than conventional white maize varieties.

A farmer feedback study was conducted in Rwanda in 2012 among the first adopters/growers of iron bean varieties (Murekezi et al. 2013). The results revealed that iron bean adopters liked the various consumption and production attributes of these varieties at least as much as, if not more than, their most popular varieties. The primary reason for adopting iron bean varieties was the yield potential promised by the improved seed. About 80 percent of farmers said that they wanted to plant these varieties in the following season, of whom 85 percent stated that they wanted to allocate a larger area to iron bean varieties. With regard to diffusion, more than half said that they had recommended the variety to an average of four other farmers in their social networks (such as neighbors, relatives, and friends) and one-quarter of them gave some iron bean grain to an average of three others in their social networks.

In Uganda and Mozambique, an effectiveness study, the Reaching End Users (REU) project, implemented from 2006 to 2009, evaluated the impact of two delivery models (one more intensive in terms of planting material delivery and nutrition and agronomic training, and hence more expensive than the other) on OSP adoption, vitamin A intake, and vitamin A status outcomes of beneficiary households. The findings on the impact of the interventions on vitamin A intake and status are reported in the section above on nutrition impact. The study found that 61 (Uganda) to 68 (Mozambique) percent of beneficiary households adopted OSP. Further, it found no significant differences in the adoption, vitamin A intake, and vitamin A status outcomes resulting from the two delivery models (de Brauw et al. 2010). In 2011, a follow-up study conducted in Uganda found that the adoption rates had fallen in one study area but remained high in the other two. The area with the lower adoption rates became a major supplier (but not consumer) of OSP. Most of the nutrition information given through the trainings of the REU project had been retained, which may have helped sustain the impact of the project in terms of its stable levels of adoption over the two areas (McNiven, Gilligan, and Hotz 2014). Similarly, a follow-up study conducted in Mozambique in 2012 revealed that adoption rates had fallen to 30 percent; this figure is noteworthy given that a drought in 2011 had destroyed a large proportion of OSP vines (de Brauw et al. 2015).

More recently, an impact assessment study was conducted in Rwanda in 2015 to assess the adoption rates of iron bean varieties after eight seasons of intensive delivery efforts. Preliminary analysis of the nationally representative survey data revealed that 29 percent of rural bean-producing households, almost half a million households, had planted at least one iron bean variety in at least one of the past eight seasons (Asare-Marfo et al. 2016). Also, in the first bean-growing season of 2015, an estimated 21 percent of all bean growers in Rwanda, that is, more than 300,000 rural households, grew iron beans (Asare-Marfo et al. 2016). These results align with the monitoring evidence from this country (reported in Table 7.2). Further analysis is being conducted to understand the adoption and diffusion rates; farm-, farmer-, and market-level factors that affect adoption; and farmer evaluations of iron beans vis-à-vis conventional varieties.

Evidence of consumer acceptance of the biofortified varieties has been promising. Birol and colleagues (2015) reviewed evidence on consumer acceptance of vitamin A and iron crops from both economic and food science literature. According to that review, target consumers like biofortified crops, in some cases even in the absence of information about their nutritional benefits. Despite this finding, information and awareness campaigns often have an important role to play. This finding is important for proving the acceptability of both vitamin A biofortified crops—which have a different color and other organoleptic characteristics than conventional

crops, due to their beta-carotene content—and mineral crops, which don't have any visible changes and hence may not be perceived as more nutritious than their conventional counterparts. Consumer acceptance studies provide more evidence about how preferences differ by crop as well as between and sometimes within countries.

Sensory evaluation studies conducted in Uganda (Chowdhury et al. 2011), Mozambique (Stevens and Winter-Nelson 2008; Laurie and Van Heerden 2011), and South Africa (Pillay et al. 2011) showed that consumers like the sensory attributes of OSP as well as various processed products (such as bread, chips, and doughnuts) made with OSP. Studies conducted in rural areas of Uganda revealed that, when provided with nutritional information on the benefits of OSP, consumers valued orange varieties more than white ones. Another study, conducted in Mozambique, found that consumers valued OSP and that the value was influenced by nutritional benefit information (Naico and Lusk 2010). These studies highlight the importance of information campaigns in driving the demand for OSP (Chowdhury et al. 2011).

In rural Zambia, a consumer acceptance study found that consumers valued nshima (a thick maize porridge consumed with vegetables, animal-source foods, or both) made with orange maize more highly than nshima from white and yellow maize varieties, even in the absence of nutritional information (Meenakshi et al. 2012). Providing information on the nutritional value of orange maize, however, translated into consumers' giving even more value to this variety. Two media channels (simulated radio messaging and community leaders) were used to convey the nutrition message. The study found that consumers valued orange maize similarly regardless of the media source, implying that radio messaging, which is significantly less costly than face-to-face message delivery, can be used to convey nutrition information. Another study, conducted in rural Ghana, found that consumers valued kenkey made with orange maize less than kenkey made with either white or yellow maize, but the provision of nutrition information reversed this preference. An information campaign will be key to driving consumer acceptance of orange maize in Ghana (Banerji et al. 2013).

In Nigeria, a consumer acceptance study conducted in the states of Imo and Oyo tested light- and deeper-colored yellow cassava gari against local gari. The tested local gari was white in Oyo but yellow (mixed with red palm oil) in Imo, in accordance with regional preferences (Oparinde, Banerji, et al. 2016). In Imo, consumers preferred the local gari to that made with either light- or deeper-colored yellow cassava varieties. Once told about the nutritional benefits of yellow cassava, however, consumers preferred the gari made with the deeper-colored yellow cassava. Nutrition campaigns are thus paramount in this state. In Oyo, consumers preferred the gari made with light yellow cassava over local gari even in the absence of nutrition information. Once consumers received information about the nutritional benefits of yellow cassava varieties, light-colored yellow cassava remained the most popular variety, but gari made with deeper-colored yellow cassava was preferred over the local variety. In Oyo, the light-colored yellow cassava could become a popular variety even without nutrition campaigns. These results also allude to the diverse preferences evident in large countries such as Nigeria and highlight that no single approach or variety could be universally applied in such settings.

Another study on yellow cassava, this time in Kenya, combined a discrimination test and a social psychology theory of planned behavior. This study found that both caregivers (18- to 45-year-olds) and children (7- to 12-year-olds) preferred yellow cassava over white cassava because of its soft texture, sweet taste, and attractive color (Talsma et al. 2013). More recently, a yellow cassava acceptance study was conducted in the western provinces

of the Democratic Republic of the Congo (Taleon, Diressie, and Kandenga, forthcoming). This study tested consumer acceptability and preference of cassava products (fufu and chikwangue) made with white cassava and yellow cassava. Results revealed that chikwangue made with yellow cassava had the most potential among the yellow cassava products evaluated. The study also found that to improve the acceptability of and preference for yellow cassava products, in particular fufu made with yellow cassava, the nutritional and socioeconomic benefits of yellow cassava should be strongly promoted.

Consumers similarly like the foods made with iron-biofortified crops, though the nutrition trait is invisible. Consumer acceptance studies conducted in rural Rwanda showed that even in the absence of nutrition information, consumers in the Western and Northern provinces preferred the sensory attributes of two of the iron bean varieties tested more than those of the local variety (Oparinde, Birol, et al. 2016). In urban retail markets, consumers liked one of the iron bean varieties more than the local variety and the other iron bean variety tested. In both rural and urban markets, information on the nutritional benefits of iron bean varieties had a positive effect on consumers' valuation of each of the iron bean varieties tested.

Challenges and Opportunities

Challenges

This section presents some of the challenges and lessons learned following almost 15 years of research, delivery, and demand generation efforts around biofortification, with a particular focus on those related to Africa.

There are challenges associated with both vitamin A and mineral (iron and zinc) biofortified crops. The high content of phytates in crops being developed for enhanced levels of iron or zinc interferes with the absorption of these minerals, which results in a deficiency. Lowering the phytate content of the edible portions of these crops without sacrificing plant health is a proven concept; however, further development is necessary, particularly for legumes, such as beans. Addressing consumer preferences in new varieties is a goal shared by all breeders, regardless of whether micronutrients are included. Because there is an inverse relationship between beta-carotene levels and dry matter content in sweet potatoes and cassava, biofortified varieties of OSP and yellow cassava tend to have higher moisture than other varieties. This may be a barrier to adoption for some consumers who prefer a drier sweet potato or cassava product. Nonetheless, it should be noted that consumer preferences are not homogenous, and large segments of consumers accept biofortified varieties, as explained above.

Vitamin A crops (OSP, yellow cassava, and orange maize) are bred for increased beta-carotene content and hence undergo a color change from white or cream to yellow and orange (that is, for these crops vitamin A content is a visible trait). This color change makes these crops easy to visually identify as biofortified varieties. Crops bred with minerals such as iron and zinc, however, look identical to the nonbiofortified varieties (that is, for these crops mineral content is an invisible trait). At harvest, biofortified crops with visible micronutrient content look different from their non-biofortfied counterparts. As a result, consumers need to be educated on the color change and what it signifies (higher vitamin A content), regardless of whether the consumer is the farmer who grows the crop or the person who purchases the produce. Vitamin A, presented within child health and immunization campaigns, is widely familiar to parents who take their children for supplementation. As a result, vitamin A crops benefit from being linked to vitamin A campaigns, which are widely implemented in the

developing world. While consumers of invisible biofortification-trait crops (iron beans and pearl millet, and zinc wheat and rice) need less explanation because the biofortified crops look the same as the nonbiofortified varieties, it is harder to differentiate between biofortified and nonbiofortified seed and harvested grain. Measures and mechanisms to identify and protect authentic biofortified seed and grain must be in place to ensure that farmers and consumers can plant and consume those crops that deliver higher iron and zinc. Such measures include the use of X-ray fluorescence machines that can determine the mineral levels and differentiate biofortified grain from nonbiofortified grain.

With respect to engendering demand for biofortified crops, based on the premise that "nothing ever becomes real until it is experienced," considerable emphasis is placed on experimental marketing activities (for both planting material and food), whereby the target audience engages with the planting material, crop, or product; this makes communication with consumers more meaningful and memorable, and generates conversation and momentum within the community. During these activities, consumers usually have a chance to see, touch, and taste biofortified crops, products, or both, but such activities can be costly to implement at scale, and the quality and reliability of the information shared is challenging to standardize and monitor.

In most African communities, entertainment in the form of music, dance, theater, and film is an important part of the culture. HarvestPlus and its partners have therefore used and tested various forms of edutainment (entertainment-education) as a vehicle to engender demand for biofortified crops and food. Notable examples are the iron beans pop song by Rwanda's top musicians and a "Nollywood" (Nigeria's successful movie industry) film on yellow cassava. Another means for engendering demand for biofortified crops is "ambassadors" in the form of community, religious, and school leaders as well as health workers. HarvestPlus and partners work with these "champions" to lend credibility to biofortification in communities where farmers and consumers may be skeptical about adopting new behaviors proposed by external actors. The challenge is how best to use these mechanisms to stimulate demand cost-effectively and at scale.

Even when farmer and consumer demand for biofortified crops is high, seed production remains a constraint in many countries. Crops with a commercial value, such as rice, wheat, pearl millet, and maize, are of interest to the commercial (private) seed companies, who wish to market new biofortified varieties as long as they assess that their customers want them. When this is the case, the seed can be packaged and branded. Seed companies have established delivery channels so that farmers can access seed through familiar sources. The challenge in this case is to ensure that communities and farmers who do not participate in formal seed systems (who often happen to be less wealthy and more marginalized, and hence to have lower-quality diets) have access to biofortified seeds.

Root and tuber crops, however, are different because they are vegetatively propagated through vines and stems that cannot be packaged or stored for any length of time. Thus commercial seed companies are not interested in including them in their portfolios. As a result, vines and stems tend to be produced by farmer groups and sold locally. The aim is to have the seed as close to the farmers as possible so that the cost of and loss during transportation of vines and stems are minimized. Developing sweet potato and cassava seed systems is time and resource intensive, yet these crops will not reach as many farmers as crops propagated by self- or cross-pollinated seed. Quality regulation of this community-produced seed is difficult

because of the small scale and geographic scattering of production. As a result, there is less interest from seed companies and governments.

Similarly, the production of bean seeds suffers because for larger seed companies the profit margin is smaller for beans than for hybrid maize, for example. Farmers tend to recycle their bean seeds and so purchase bean seed less frequently than maize, rice, and wheat seed. Farmer cooperatives or smaller (more local) seed companies may produce and market bean seed, but at low volumes. Seed regulation is similarly problematic. The seed sector—biofortified or not—is susceptible to fraudulent imitation, and measures are being sought to protect authentic seed and educate farmers on how to protect themselves. Governments and the seed sector must be involved and equipped to verify authentic seed through analysis. Even seed with visible traits (that is, seeds of vitamin A biofortified crops) is susceptible to forgery—for example, varieties of orange maize that do not contain vitamin A have been identified—and thus it is imperative that seed be verified and labeled accurately. HarvestPlus has identified and built capacity for small- and medium-scale seed multipliers (individual and cooperative farmers) for iron beans, Vitamin A cassava, and OSP.

Finally, the introduction of biofortified staple crops to consuming households is an opportunity to improve diets. These crops, however, should not be construed as a "silver-bullet" solution because micronutrient malnutrition is multifactorial and may be affected by infection rates, parasites, or antinutrients, making a strong case for a food basket approach as well as holistic approaches that include partnerships with strong water and sanitation programs. Governments worldwide advocate a balanced diet with consumption of a variety of foods, and biofortified crops are best presented within this context. However, implementing nutrition interventions and education programs is not a priority for many governments simply because they are costly and intensive, and other more urgent health problems take precedence over nutrition.

Opportunities for Scaling Up

As the evidence for biofortification builds, including the success of the Second Global Conference on Biofortification (HarvestPlus 2014a) and the resultant Kigali Declaration on biofortified nutritious foods (HarvestPlus 2014b), various stakeholders are increasingly interested in investing in this intervention as a cost-effective means for reducing hidden hunger. These stakeholders include donor agencies, international and national nongovernmental and government organizations from both the agriculture and health sectors, and private seed and food companies. Stakeholders need evidence-based information on where to target specific biofortified crops to achieve nutrition and hence health impacts cost-effectively.

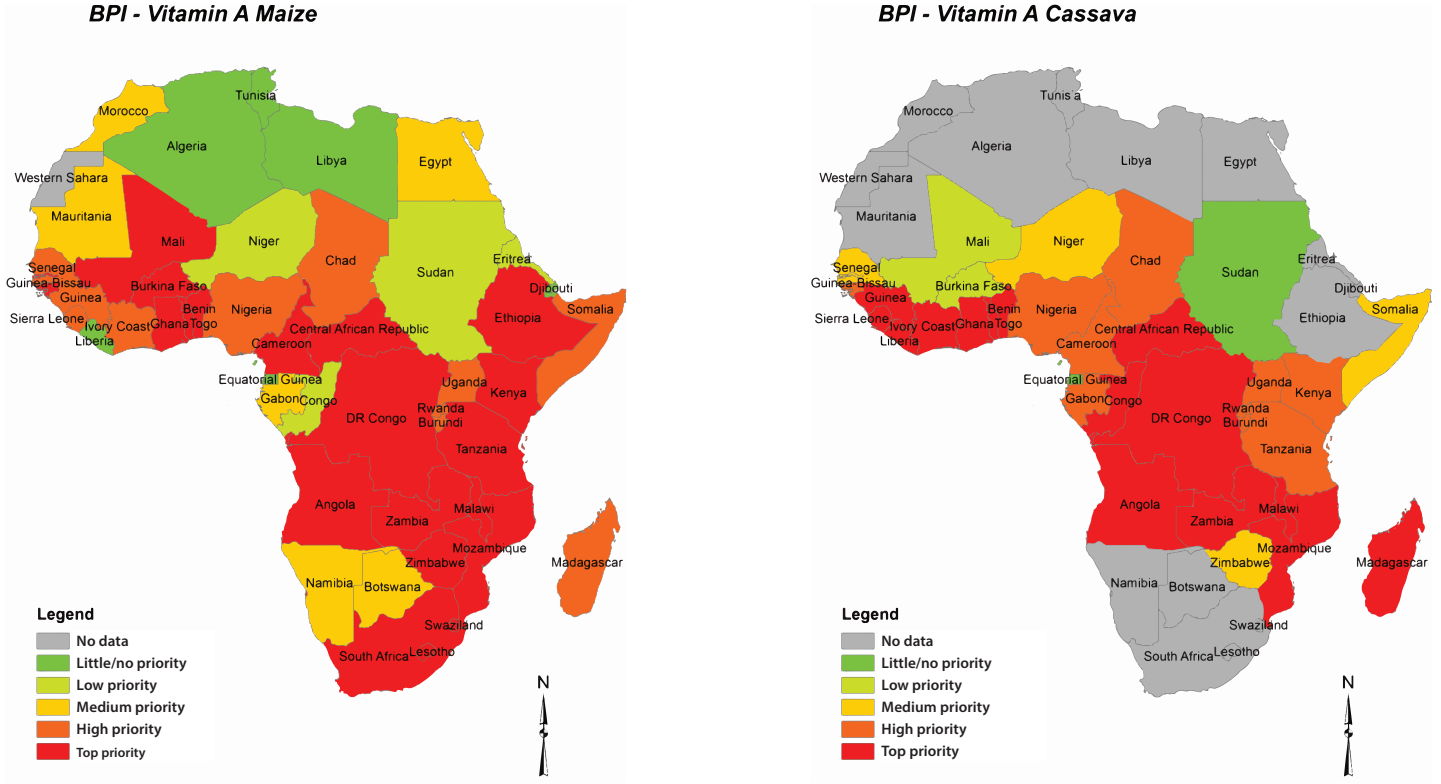
To assist stakeholders with their biofortification investments, HarvestPlus has developed a country-, crop-, and micronutrient-specific Biofortification Priority Index (BPI) (Asare-Marfo et al. 2013). The global BPI is a tool that ranks each of the seven aforementioned staple crops according to their suitability for investment in biofortification in 127 countries in Africa, Asia, and Latin America and the Caribbean (LAC). The BPI is calculated by using secondary, country-level data compiled from various sources including the Food and Agriculture Organization of the United Nations, the World Health Organization, and the US Department of Agriculture. Similar to the Human Development Index (UNDP 1990) and the *Global Hunger Index* (IFPRI and Welthungerhilfe 2006), the BPI comprises three subindexes: (1) The production subindex calculates the extent to which a country is a producer of

the staple crop while factoring in the amount of output retained for domestic consumption. (2) The consumption subindex captures the proportion of the crop under domestic production that is consumed by the country's population. (3) The micronutrient subindex calculates the extent to which a country's population suffers from the respective micronutrient deficiency, that is, vitamin A, zinc, or iron.

The BPI allows stakeholders to identify countries by their priority—top, high, medium, low, or little/no—for investment in each biofortified crop. HarvestPlus has recently developed an online, interactive BPI tool, which is a global map that illustrates the countries most suitable for biofortification investment in the seven crops, based on the countries' BPI ranking (Prasai and Asare-Marfo 2015).[21]

Overall, global BPI rankings reveal that African countries rank highest for vitamin A crops and Asian countries rank highest for zinc cereals. For iron beans, several countries in Africa and some in LAC surface as having high return-on-investment potential, and for iron pearl millet, both Africa (especially West Africa) and South Asia constitute suitable candidate sites

FIGURE 7.2—BIOFORTIFICATION PRIORITY INDEXES FOR VITAMIN A MAIZE AND VITAMIN A CASSAVA, AFRICA MAP



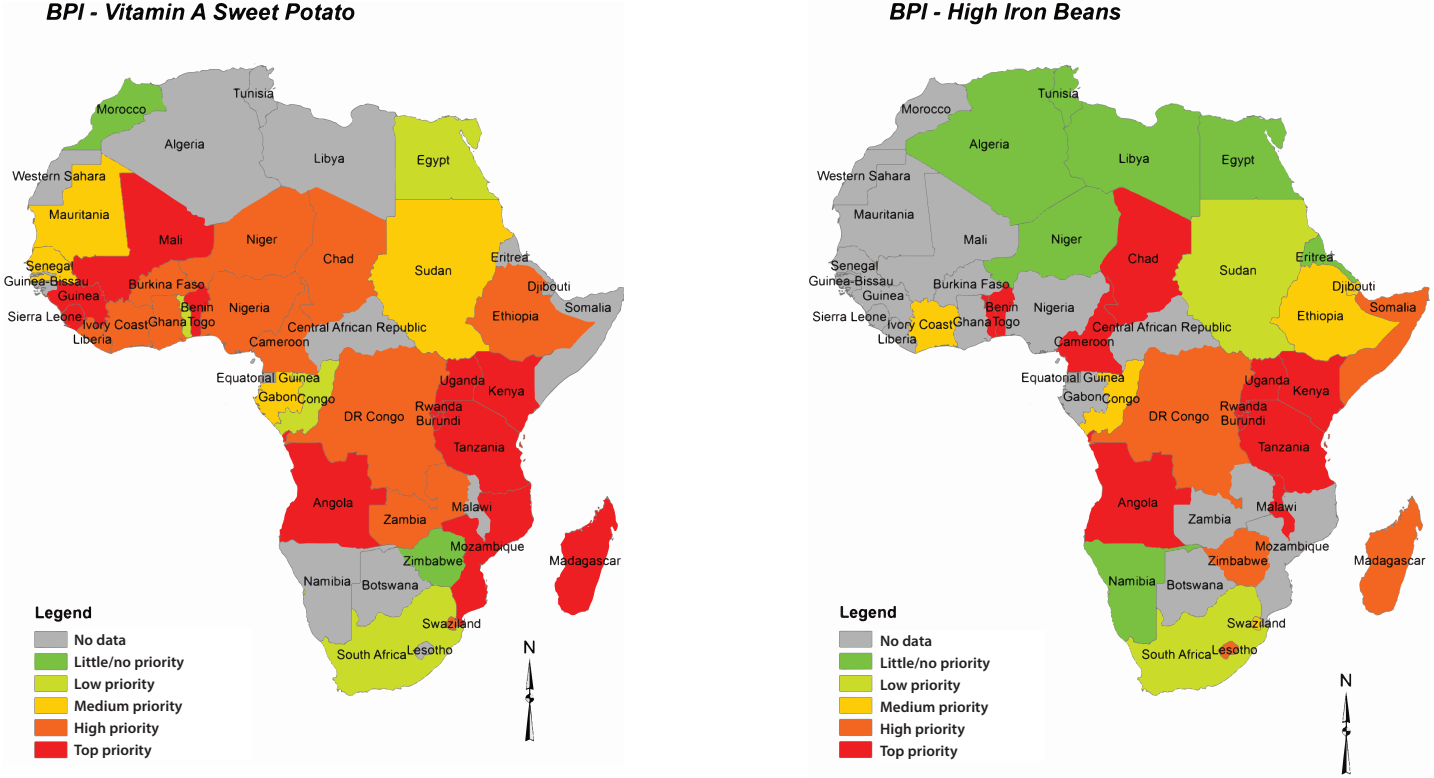
Source: Asare-Marfo et al. (2013).

21 The tool can be accessed at www.ifpri.org/tools/bpimappingtool.

for investment. Africa BPI figures for the four top biofortified crops bred for Africa are presented in Figures 7.2 and 7.3.

According to the Africa BPI figures, vitamin A maize is a suitable vehicle for improving vitamin A status in several countries in southern, East, and West Africa; vitamin A cassava would be a high-return investment in several countries in the center of the continent as well as in the east and the west; and OSP is a suitable crop for combating vitamin A deficiency in several countries in the east and also in the west of Africa. Iron beans have the highest potential for investment to reduce iron deficiency mainly in countries in the east of Africa, as well as in several countries in the center of the continent.

FIGURE 7.3—BIOFORTIFICATION PRIORITY INDEXES FOR VITAMIN A SWEET POTATOES AND IRON BEANS, AFRICA MAP



Source: Asare-Marfo et al. (2013).

Both the BPI rankings (Asare-Marfo et al. 2013) and the tool have been extensively used by both HarvestPlus and its partners, as well as by various stakeholders and organizations interested in investing in biofortification. For example, breeders in several CGIAR centers have been using the BPI to determine in which countries or agroecologies they should breed biofortified varieties or adapt existing biofortified varieties; the US Agency for

International Development has used the tool to identify which biofortified crops could be introduced in Feed the Future mission countries, and World Vision International has used it to select countries in which to include biofortified crops as part of its portfolio.

Opportunities for Mainstreaming

Full proof of concept that biofortification works will pave the way for mainstreaming and long-term sustainability of biofortification. In the coming years, biofortification is expected to be increasingly integrated into international and national crop development programs, crop and food value chains, and national policies and standards.

HarvestPlus investments have filled breeding pipelines with varieties that are agronomically competitive, disease resistant, and drought tolerant, and that have preferred end-use qualities and full target levels of micronutrients. To sustain this investment, CGIAR centers and national agricultural research system (NARS) partners must mainstream biofortification, using micronutrient-dense materials throughout their breeding programs. This will ensure that biofortification is sustainable and that new, climate-adaptive varieties contain the micronutrient traits. Directors general of CGIAR centers have committed to mainstreaming biofortification in their conventional food crop development programs (CGIAR 2014).

Demand for biofortified seeds continues to grow from a wide variety of partners, including private seed companies, international nongovernmental organizations, and multilateral agencies. In countries with robust private seed systems that reach smallholder farmers, private seed companies are a natural partner. HarvestPlus has pushed for a delivery strategy in which private seed companies are licensed to produce and market biofortified seed. This approach is particularly advantageous in the case of crops where hybrid seeds predominate, for example, hybrid maize distributed by Zamseed in Zambia, and where seed companies operate regionally, such as SeedCo in Zambia and Zimbabwe. Additionally, HarvestPlus has developed a memorandum of understanding with World Vision to introduce biofortified crops into World Vision's agricultural programs, which are then linked to its health/nutrition programs. The World Food Programme's Purchase for Progress program is interested in local purchasing of biofortified crops and is developing partnerships in several countries.

Significant progress has been made in mainstreaming biofortification into regional and national policies. At the Second International Conference on Nutrition in 2014, representatives from Bangladesh, Malawi, Nigeria, Pakistan, and Uganda highlighted the role of biofortification in their national strategies to end malnutrition by 2025. Panama and Colombia were among the first countries to include biofortification in their national food security plans. Several HarvestPlus target countries have integrated biofortification into their national nutrition and agriculture plans, including the Rwanda Nutrition Action Plan, the Zambia National Nutrition Strategy, the Nigeria Micronutrient Deficiency Control Guidelines and Agricultural Transformation Agenda, and the Democratic Republic of the Congo Multisectoral National Plan of Nutrition. HarvestPlus and its partners are engaged in regional and global processes, such as the African Union's Comprehensive Africa Agriculture Development Programme and the Scaling Up Nutrition movement, to ensure an enabling environment for biofortification. Efforts to include biofortification in global standards and guidelines for food products and labeling, such as the Codex Alimentarius, are well under way.

Concluding Remarks

Over the past 15 years, conventional breeding efforts have resulted in varieties of several staple food crops with significant levels of the three micronutrients whose deficiency can be most limiting to humans: zinc, iron, and vitamin A. Evidence from nutrition research has revealed that these varieties provide considerable amounts of bioavailable micronutrients, and consumption of them can mitigate micronutrient deficiency and hence improve health status among target populations. Termed "biofortification," the development and delivery of these micronutrient-rich varieties could reduce hidden hunger, especially among rural populations whose diets rely on staple food crops.

By 2016, more than 30 countries had officially-released biofortified crop varieties, and more than 20 additional countries had commenced testing these varieties. CGIAR centers have included biofortification in many plant breeding programs and provide biofortified varieties as a public good to NARSs. While biofortification is being increasingly mainstreamed on the supply side, there is ever-growing evidence to support the growing interest levels for biofortification on the demand side. In 2015, HarvestPlus—the global leader in biofortification—and its partners reached more than 1.5 million farming households with biofortified planting material. Farmer feedback and participatory evaluation research reveal that farmers like the various production and consumption characteristics of these biofortified varieties as much as, if not more than, their most popular conventional varieties. Similarly, consumer acceptance research shows that consumers like the various organoleptic characteristics of biofortified varieties as much as those of conventional ones, often in the absence of nutrition information, and informing consumers about the nutritional benefits of biofortified staple food crops improves the demand for these varieties. Moreover, consumer acceptance research reveals that the different (yellow or orange) color of vitamin A biofortified crops (that is, yellow cassava, OSP, and orange maize) does not hinder consumer acceptance. Demand for biofortified crops and food will be further enhanced when major players in the food value chain such as international food processors and supermarket chains become interested in aggregating and processing biofortified products to serve a more urban clientele. The prime potential of biofortification is and will be to address hidden hunger among the farming and rural populations.

In the future, it will be important not only to focus on strengthening domestic supply and demand of biofortified staple food crops, targeted to those crop-country combinations identified in the BPI, but also to facilitate and strengthen international trade. On the supply side, regional agreements for the testing and release of varieties could reduce nontariff trade barriers in the international trade of seed, allowing spillover of technology from pioneer countries in biofortification to neighboring countries. For international trade in biofortified raw material as well as processed food, standards are needed, for example, under the Codex Alimentarius. However, voluntary standards developed by multinational food companies will certainly contribute to the spread of biofortification over time. Using biofortified raw products may potentially complement fortification efforts by the food industry and lead to mutual positive outcomes for markets and target clienteles that are part of the formal food chain.

CASE STUDY 2

Potential Linkages between Zinc in Soils and Human Nutrition in Ethiopia

Samuel Gameda, Kalle Hirvonen, James Warner, Leah Bevis, Tekalign Mamo, Hailu Shiferaw, and Masresha Tessema

Zinc is an essential element in human nutrition; and zinc deficiency in the diets of children and women of reproductive age can have significant impact. The Ethiopian Public Health Institute completed a national micronutrient survey in 2015, and preliminary unpublished findings indicate that 35 percent of all target groups showed zinc deficiency. Zinc deficiency may be linked to zinc-deficient soil, which results in low zinc content of grains grown on these soils. In this study, Ethiopia is used as an example to illustrate the case of zinc-deficient soils and the possible impact on zinc intake.

Ethiopia recently launched the Ethiopian Soil Information System (EthioSIS), whereby it has undertaken an extensive soil fertility survey and land-resource mapping initiative. Findings show that a significant portion of Ethiopia's agricultural soil is deficient in zinc. This case study focuses on exploring how zinc deficiency in soils may be associated with observed stunting prevalence under cereal production systems. To do so, it links the EthioSIS soil fertility survey data to anthropometric data from a large household survey conducted in five regions of rural Ethiopia by Feed the Future in 2013 and 2015. The study sample is limited to households that grow cereals; about 49 percent of these households' children were stunted.

We find that higher soil zinc content is generally associated with lower stunting rates, and this association is more pronounced when the sample is constrained to children living in households that grow wheat. Across most of the distribution of soil zinc levels, stunting rates fall as zinc levels rise. These patterns hold in a multivariate regression framework, in which we control for agroecological factors as well as for household wealth, income, and agricultural output. These findings suggest that soil zinc content may be related to the prevalence of child stunting. When all cereal production systems are considered, a stunting prevalence of 50 percent was noted in areas with zinc-deficient soils; stunting prevalence was about 3 percentage points lower in areas with zinc-sufficient soils. This effect was particularly pronounced under wheat production systems, where stunting prevalence was about 8 percentage points lower in areas that had zinc-sufficient soil compared with those that had zinc-deficient soils.

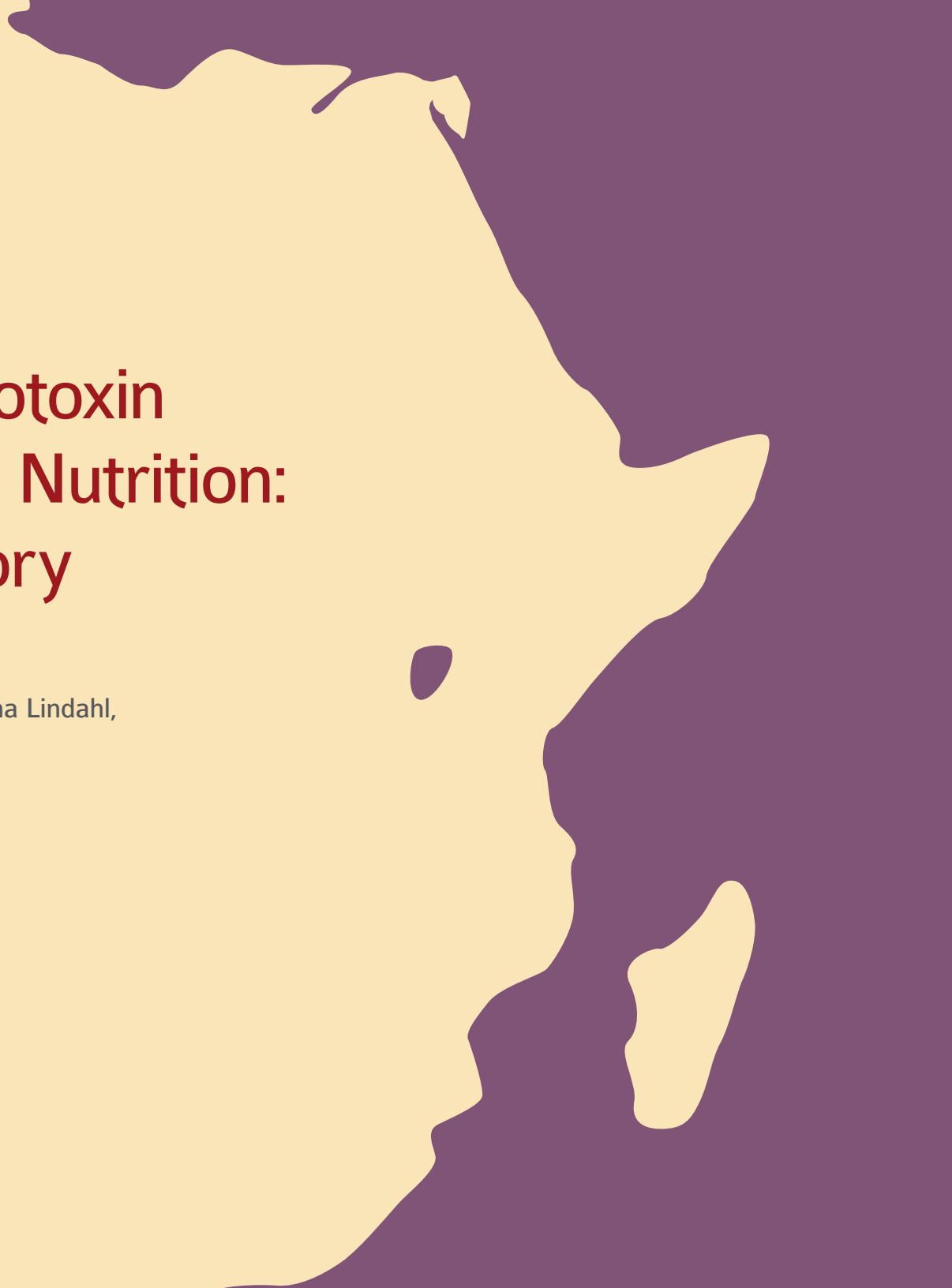
These results are preliminary; as such, inferences from them should be considered with caution and should take into account that the estimates reported above are associations, not causal effects. Further studies are needed to fully understand the links between soil zinc status and stunting. Efforts should be made to control for other factors, such as dietary diversity and access to clean water and sanitation, which can also contribute to stunting.

As a consequence of the EthioSIS survey's findings on the prevalence of zinc-deficient soils, beginning in 2014, the country introduced zinc-containing fertilizers (blended or compound) in areas found to be zinc deficient. Agronomic biofortification can play a role in addressing malnutrition, as well as a complementary role to such measures as supplementation and staple food fortification designed to increase expected zinc intake.

CHAPTER 8

The Role of Mycotoxin Contamination in Nutrition: The Aflatoxin Story

Amare Ayalew, Vivian Hoffmann, Johanna Lindahl,
and Chibundu N. Ezekiel



Over the past decade, there has been increasing recognition that the quantity of food alone guarantees neither food security nor adequate nutrition as measured by metrics such as hunger, malnutrition, and stunting. Increasingly, policy and decision makers understand the need to include nutritional aspects into improvements of food systems. However, not as fully recognized is that unsafe, contaminated foods thwart these efforts and maintain an unacceptable status quo in food insecurity, poverty, and a range of health-related problems. All of this makes sustainable development more challenging. In 2010, foodborne hazards caused 600 million illnesses and 420,000 deaths across the world, with 40 percent of this disease burden occurring among children under five years of age (Global Panel on Agriculture and Food Systems for Nutrition 2016). Yet food safety has become an important precondition for access to global food markets and, increasingly, for high-value domestic markets in developing countries.

Contamination of food with mycotoxins is a prominent food safety challenge in tropical regions. In Africa, the most important mycotoxins from both a human health and an economic perspective are aflatoxins and fumonisins (IARC 2015). Much of the public- and private-sector's attention has focused on aflatoxin due to its high pre- and postharvest contamination potential, which causes widespread occurrence in diverse food matrices, and its extreme toxicological significance to humans and animals, with impacts on food safety, nutrition, public health, and markets and income. Aflatoxin is a potent liver cancer–causing chemical, and there is mounting evidence that aflatoxin interferes with nutrient absorption and plays a role in inhibiting immune system function, potentially retarding child growth (Turner et al. 2012). With respect to food processing and trade, much of African produce is affected by aflatoxin, diminishing the region's access to high-value export markets. Food-processing firms serving emerging domestic high-value markets are also testing for the contaminant in the production chain. This chapter focuses on the nutritional and economic consequences of aflatoxin contamination in Africa and on the opportunities for its management.

Nutrition and Health Implications

The health and nutrition implications of food contamination by aflatoxins cannot be overstated. Several excellent reviews from Williams et al. (2004), Turner et al. (2012), IARC (2015), and Gong, Watson, and Routledge (2016) highlight the adverse health and nutrition effects of dietary exposure to aflatoxins. Children can be exposed to aflatoxins during pregnancy as the toxins pass from mother to fetus through the placental cord (Wild et al. 1991). This exposure may continue during breastfeeding (Polychronaki et al. 2006, 2007; Adejumo et al. 2013; Magoha et al. 2014b) and extend through the first 1,000 days of life during the introduction of complementary weaning foods (Gong et al. 2003; Kimanya et al. 2014). Individuals may also be exposed at any time of life through consumption of contaminated foods. Particularly susceptible foods include maize, groundnuts, sorghum, tree nuts, and processed cassava.

The consequences of exposure largely depend on a range of factors, including age, sex, and health status of exposed individuals (and, for animals, the species exposed to the toxin), as well as the quantity of toxin consumed, which in turn depends on toxin level in the food and amount of food consumed (Williams et al. 2004). There can be acute or chronic exposure effects. Acute effects resulting from consumption of high doses of contaminated diets include hemorrhagic necrosis of the liver, edema,

lethargy, blindness, and death (Lewis et al. 2005). The few documented incidents of acute aflatoxicosis in Africa were linked to highly contaminated maize (Lewis et al. 2005; Probst, Njapau, and Cotty 2007; Yard et al. 2013). Chronic aflatoxicosis, which is linked to exposure to low to moderate levels of aflatoxins, is characterized by an array of adverse health effects with symptoms that are usually difficult to recognize, including carcinogenicity and hepatic disease, mutagenicity, teratogenicity, immune suppression, and growth faltering in children (Williams et al. 2004; Turner et al. 2012). In animals, immunocompromised systems and interference with protein metabolism and micronutrients have been observed, indicating that these symptoms may also occur in humans. Recent evidence related to health and nutrition outcomes of aflatoxin exposure includes the following:

- **Hepatotoxicity and cancer:** More than 95 percent of Africans are chronically exposed to aflatoxins (Turner et al. 2012), while about 5–10 percent of the African and East Asian populations are chronic hepatitis B virus (HBV) carriers (IARC 2015). Aflatoxin B1 (AFB1) is regarded as a potent carcinogen and interacts synergistically with HBV (Kensler et al. 2011), causing 5–28 percent of all global hepatocellular carcinoma (HCC) cases, 40 percent of which are recorded in Africa south of the Sahara (Liu and Wu 2010). Aflatoxin further increases the risk of developing HCC in HBV-positive individuals approximately 30-fold (Groopman, Kensler, and Wild 2008). A recent study in the aflatoxin-endemic village of Makueni, Kenya, showed a strong association between aflatoxin exposure and chronic hepatomegaly in schoolchildren (Gong, Watson, and Routledge 2012).
- **Immunosuppression:** The review by Bondy and Pestka (2000) is widely cited for describing immunomodulation effects from aflatoxin exposure, which are well established in several animal models; however, few studies involving human subjects are available. Several studies have suggested the potential of aflatoxin to play suppressive roles on the immune function, increasing susceptibility to infectious diseases or reactivating chronic infections, and decreasing vaccine and drug efficacy (Berek et al. 2001; Turner et al. 2003; Jiang et al. 2005, 2008; Oswald et al. 2005). Specifically, recent studies conducted in Ghana and The Gambia indicate that aflatoxins may play a role in the progression of HIV infection to AIDS by modulating cell-mediated immunity (Keenan et al. 2011; Jolly et al. 2013; Jolly 2014).
- **Childhood nutrition and stunting:** Child growth faltering due to aflatoxin exposure has been a study priority in Africa (Khlangwiset, Shephard, and Wu 2011). However, several confounding factors, including poverty, poor food quality, and infectious diseases, cause difficulties when attributing the effect to the cause (Gong, Watson, and Routledge 2016). Childhood nutrition is critical to a healthy and balanced adult life; thus, safe and nutritious food should be prioritized. Aflatoxin can undermine infant nutrition and development (cognitive and physical) in the following ways:
  a) It interferes with absorption and metabolism of vitamins A and D, iron, selenium, and zinc. Reduced plasma micronutrient levels were found in animals exposed to aflatoxins (Turner et al. 2012).
  b) It is linked to protein malnutrition, or kwashiorkor (Tchana, Moundipa, and Tchouanguep 2010)
  c) It plays a role in gastrointestinal toxicity by disrupting intestinal wall structure and enzymatic proteins (Campbell, Elia, and Lunn 2003); this is potentially mediated by the introduction of

complementary foods to infants, as these may be of less nutritional quality and may be prone to contamination by infectious agents or toxic chemicals (Turner et al. 2012)

d) It contributes to low birth weight and growth faltering/stunting in early childhood: 85–100 percent of children (from in utero to late infancy) in African countries have either detectable levels of serum aflatoxin-albumin or urinary aflatoxins (Gong et al. 2004; Turner et al. 2007; Shuaib et al. 2010; Hoffmann, Jones, and Leroy 2015; Leroy, Wang, and Jones 2015). Recent research associates aflatoxin exposure with growth impairment via induction of changes in insulin-like growth factor proteins in Kenyan schoolchildren (Castelino et al. 2015) and epigenetic changes involving white blood cell DNA methylation in utero in pregnant women from The Gambia (Hernandez-Vargas et al. 2015).

- **Reduced fertility:** An effect on male fertility and sperm quality was observed in animals (Hafez, Megalla, and Mahmed 1982; Hafez et al. 1983; Ortatatli et al. 2002; Fapohunda et al. 2008) and suggested an association with reduced fertility in humans (Eze and Okonofua 2015). This indication is further supported by a case control study in Nigeria on higher aflatoxin levels in blood and semen of infertile human males with abnormal sperm profiles than in fertile males (Uriah, Ibeh, and Oluwafemi 2001).

Economic Impacts

The impact of aflatoxin contamination on exports is difficult to estimate due to the multitude of factors affecting global trade and infrequent changes in regulatory standards. Africa south of the Sahara was the dominant groundnut-exporting region during the 1960s; however, in the 1970s, its share of the global market experienced a sharp decline from which it never rebounded. Analysts attribute the crash to a combination of factors, including currency overvaluation, drought, the emergence of major new global suppliers, and the inability of supply chains to upgrade to higher-quality standards as the global demand for peanuts shifted from stock for oil production to nuts for direct consumption (Revoredo and Fletcher 2002; Rios and Jaffee 2008). Interviews with groundnut importers in the Netherlands and the United Kingdom indicate that aflatoxin regulations have led to changes in firms' procurement systems and that suppliers' reputation for compliance has become an important competitive factor (Rios and Jaffee 2008). Though not the only challenge facing African exports, aflatoxins need to be managed if the continent is to reclaim a share in global groundnut trade.

Impact on Smallholder Market Access

Agricultural growth is increasingly concentrated in high-value commodities and markets (Gulati et al. 2007; Swinnen, Colen, and Maertens 2013), and food safety is an indispensible prerequisite for participation in these markets (Ashraf, Giné, and Karlan 2009; Van Beuningen and Knorringa 2009). This is increasingly true of premium domestic markets. In 2015, for example, the Cereal Millers Association of Kenya, representing 80 percent of the country's maize flour industry, formally joined Aflatoxin Proficiency Testing and Control in Africa (APTECA 2015). The APTECA program offers independent testing of duplicate samples to improve the capacity of private and government laboratories, as well as offering voluntary labeling of products. In Nigeria, maize grown with Aflasafe, an aflatoxin biocontrol product, has

been met with increasing demand by food-processing firms (A. Akande, personal communication, November 9, 2015). Smallholder farmers unable to comply with food safety standards will thus be denied an important opportunity for income growth. Indeed, failure to comply with aflatoxin standards has led the World Food Programme (WFP), which offers farmers premium prices for high-quality, safe food, to reject maize consignments from India, Kenya, and Mali (Méaux, Pantiora, E., & Schneider, 2012) and sorghum from Kenya (O. Miriti, personal communication, October 30, 2015). While representing a challenge to smallholders' market access, safety standards enforced by WFP and by the formal private sector represent an important opportunity for encouraging the adoption of better on-farm, storage, and handling practices for aflatoxin management.

Impact on Livestock Productivity

Animals are more or less susceptible to the effects of aflatoxins. To a varying extent, aflatoxins affect livestock weight gain and productivity and can lead to clinical aflatoxicosis in high levels. In addition to direct effects of aflatoxins on feed intake and weight gain, aflatoxins exhibit an immunosuppressive effect, and the antibody response to multiple diseases may be reduced in livestock that is fed aflatoxin-contaminated feed, with a synergistic effect between infections and aflatoxin exposure (Williams et al. 2004). A challenge in many low-income countries is that animals are often fed suboptimal feeds with low protein levels and are exposed to a high level of infectious diseases, causing reduced productivity, which may further increase the effects of aflatoxins. A further complication is that aflatoxins may interact with other mycotoxins commonly present in Africa; these interactions may be synergistic or additive, causing larger or other symptoms than anticipated (Grenier and Oswald 2011).

Pigs are considered to be very susceptible to aflatoxins. Two meta-analysis papers have analyzed the experimental effects of mycotoxins on pig growth (Dersjant-Li, Verstegen, and Gerrits 2003; Andretta et al. 2012); both showed that aflatoxins were among the mycotoxins that affected feed intake the most. Feed conversion ratios and weight gain were also negatively affected due to reduced feed intake. However, the effects of mycotoxins could be compensated by intake of more nutritious feed—for example, increased protein (such as methionine) intake increased weight in exposed pigs (Andretta et al. 2012).

Turkeys, ducks, and quail are considered more sensitive to aflatoxins than chicken, but the effects in the animals are basically the same (Monson, Coulombe, and Reed 2015). The effects of aflatoxins on poultry production have been reviewed (Feddern et al. 2013; Monson, Coulombe, and Reed 2015), showing an association with reduced egg production, reduced egg weight, and increased poultry mortality due to renal, hepatic, gastrointestinal, and immunological impacts. However, the data on how aflatoxin affects weight gain in poultry are not consistent, and some experiments with aflatoxins up to 2.5 ppm have failed to show effects (Dersjant-Li, Verstegen, and Gerrits 2003). AFB1 can also be transferred into eggs and be residual in meat and liver, thus posing a danger to humans (Feddern et al. 2013). In one study, transfer into eggs could only be shown for the highest dose given the hens, and a transmission rate of 5000:1 has been estimated (Oliveira et al. 2000). Fish species vary from highly

susceptible to resistant, and honeybees are relatively resistant (Atherstone et al. 2016).

The relative resistance of cattle has been attributed to the microbial activities in the rumen; calves, where this activity is less developed, are more sensitive. In dairy cattle, aflatoxin-contaminated feed has been associated with reduced milk production, increased morbidity, and reduced reproductive success. A concern with aflatoxin exposure in dairy animals is milk contamination. AFB1 consumed by the dairy cow is metabolized into aflatoxin M1 (AFM1) and is excreted into milk, with a carryover of 1–7 percent (Masoero et al. 2007; Fink-Gremmels 2008). The levels of AFM1 transferred depend not only on the levels in the feed but also on the stage of lactation and productivity of the cows, with more aflatoxins being transferred to the milk in higher-yielding cows (Masoero et al. 2007; Prandini et al. 2009; Britzi et al. 2013).

In addition to the above effects, aflatoxins have been shown to contribute to reduced birth weight and teratogenic effects in livestock such as pigs and rabbits (Wangikar et al. 2005). Regarding the effect on male reproduction, aflatoxins may reduce sperm quality and fertility for roosters, bulls, mice, and rabbits (Hafez, Megalla, and Mahmed 1982; Hafez et al. 1983; Ortatatli et al. 2002; Fapohunda et al. 2008). Although pigs are considered highly sensitive to aflatoxin, the effect on reproduction appears limited (Hintz et al. 1967; Kanora and Maes 2009).

If the source of aflatoxin exposure (mainly feed or feed ingredient) is effectively controlled or withdrawn, animals can recover from acute health effects after some weeks, and residues are no longer detected (Singh et al. 1987; Feddern et al. 2013). There have not been many estimates of the economic consequences of aflatoxin exposure in Africa's livestock subsector; in fact, the complex nature makes it difficult to estimate.

Prevalence of Aflatoxins in Major Food Supply Chains

The occurrence of aflatoxin is largely determined by ecological conditions, agricultural production, and postharvest practices. Half a century of research documenting aflatoxin prevalence in Africa shows that the eastern and western African regions exhibit the highest rates of contamination and the highest levels of the toxin. Although aflatoxins have been identified in a wide range of foodstuffs, the most severely contaminated crops are maize and groundnuts, both of which are major staples across Africa. Shephard (2003) and Darwish et al. (2014) provide excellent reviews on aflatoxin prevalence and public health risk in Africa up to 2002 and 2013, respectively. The foregoing summary draws heavily upon and updates these reviews, with a focus on maize, groundnut, and animal-source foods. Other foods, including sorghum, tree nuts, spices, and processed cassava, can also be important sources of aflatoxins, though they tend to either contain lower levels of the toxin or constitute smaller shares of the diet.

African Regions

East Africa

High levels of aflatoxin contamination have been documented throughout East Africa, particularly in Kenya, the site of several lethal aflatoxicosis outbreaks in the early 2000s (Lewis et al. 2005; Probst, Njapau, and Cotty 2007; Yard et al. 2013; IARC 2015). Extensive sampling efforts show that a large proportion of the maize supply in the central and eastern parts of the country consistently exceeds allowable limits; in addition, a subset of samples contains dangerously high levels of contamination. In 2005 and 2006, for example, 41 percent and 51 percent (respectively) of maize samples

from household stores in the affected region were found to contain more than 20 parts per billion (ppb) of aflatoxin; the maximum levels reported were 48,000 and 24,400 ppb, respectively (Daniel et al. 2011). In nonoutbreak years, contamination rates are lower but still substantial. For example, 16 percent of maize samples tested above 20 ppb (max: 2,500 ppb) in 2007 (Daniel et al. 2011), while 15 percent of maize from western Kenya was above 10 ppb (Mutiga et al. 2015). Groundnut samples (7.5 percent) from western Kenya were also contaminated above 20 ppb (Mutegi et al. 2009). The data from Kenya reiterate seasonal and regional/agroecological variation of aflatoxin contamination.

Rates of contamination in marketed maize in Kenya appear to be similar to those found in household stores. Okoth and Kola (2012) reported that only 17 percent of 144 maize kernels and flour purchased in Nairobi markets from 2006 to 2009 complied with the current regulatory limit of 10 ppb; the maximum value was 4,594 ppb. According to Moser and Hoffmann (2015), in 2013, 25 percent of more than 900 packaged maize flour samples from markets in eastern and central Kenya exceeded 10 ppb, with substantial heterogeneity in contamination rates across brands.

In Uganda in the 1960s, groundnuts contained as much as 10,000 ppb (Lopez and Crawford 1967, as cited in Kaaya 2004). Among 480 samples from household stores and markets in 17 districts of Uganda (Alpert et al. 1971), beans, maize, sorghum, and groundnuts were the most highly contaminated commodities, with 71.9 percent, 44.9 percent, 37.7 percent, and 17.8 percent, respectively, containing detectable aflatoxin—that is, toxin levels reaching greater than 1,000 ppb. Results for beans are somewhat uncertain due to the presence of an interfering fluorescent substance. Widespread aflatoxin contamination of Ugandan maize has also been documented (69–88 percent of samples across three agroecological zones), with contamination level increasing over time during storage and means exceeding 20 ppb after 6 months of storage (Kaaya and Kyamuhangire 2006).

Maize from markets and villages in Tanzania and Republic of the Congo showed mean aflatoxin levels ranging from 0.04 to 120 ppb (Manjula et al. 2009). More recently, two separate studies conducted in Rombo, Northern Tanzania, measured aflatoxin levels in 41 (32 percent detectable) and 67 (58 percent detectable) samples of maize-based complementary foods obtained from mothers of infants or young children. Among samples in which aflatoxin was detected, levels ranged from 0.11 to 386 ppb and from 0.33 to 69.47 ppb, respectively (Kimanya et al. 2014; Magoha et al. 2014a). These data indicate overwhelming challenges of aflatoxin exposure among infants from complementary foods introduced at early infancy (within three months of childbirth).

In Ethiopia, up to 26 ppb of AFB1 was detected in 8.8 percent of 352 sorghum, barley, teff, and wheat samples, respectively (Ayalew et al. 2006). Previously, Fufa and Urga (1996) reported 8.33 percent and 13.33 percent prevalence and 100–500 ppb and 250–500 ppb levels in shiro, a processed blend of legumes and spices, and ground red pepper, respectively.

West and Central Africa

Most of the literature implicating aflatoxins in child stunting is based on data from West Africa (see for example Gong et al. 2002, 2003, 2004; Turner et al. 2007). The high levels of exposure observed in children in these studies can be explained both by the importance of maize and groundnuts in local diets and by the high contamination rates and levels across much of the region. For example, AFM1 and AFB1 were found in three milk-based samples (4.6, 127.6, and 530 ppb) and two maize-based samples (181.6 and 4,806 ppb) of seven weaning foods purchased from open markets in

Ibadan, Nigeria (Oluwafemi and Ibeh 2011). Samples of maize (45 percent), maize cakes (80 percent), and maize rolls (12 percent) in Nigeria contained aflatoxin, with means in those with detectable levels 200, 233, and 55 ppb, respectively (Adebajo, Idowu, and Adesanya 1994, cited by Shephard 2003). Furthermore, all of 29 groundnut cake samples from Nigeria contained AFB1 levels reaching 2,824 ppb (Ezekiel et al. 2013). A separate study, also in Nigeria, found that 30 percent of samples of groundnut-based snacks, 62.5 percent of maize-based snacks, and both of two samples of groundnut/maize-based snacks contained detectable aflatoxin, at mean levels (among those detectable) of 362 ppb, 69.5 ppb, and 12 ppb, respectively (Kayode et al. 2013). In Benin, 15 groundnut cake samples contained total aflatoxins in the range of 10–346 ppb (Ediage et al. 2011). These snacks are widely consumed by preschool- and school-age children, and the contamination levels indicate the extent of the threat to human (especially child) health.

Studies on groundnuts tend to suggest that visible damage of the kernels may be correlated with aflatoxin contamination. For example, groundnuts from vendors in 21 major markets across all 10 regions of Ghana contained aflatoxins in varying levels based on sorting for visual quality: visibly damaged kernels, constituting 1.50–9.25 percent of the total lot, contained aflatoxin levels up to 22,168 ppb, and 50 percent of the undamaged samples contained detectable aflatoxin (max: 12.2 ppb) (Awuah and Kpodo 1996). Other studies from The Gambia, Nigeria, Cameroon, and Senegal indicate widespread aflatoxin contamination of groundnuts and related products, such as groundnut sauce/soup, roasted groundnut and peanut oil (Hudson et al. 1992; Diop et al. 2000, as cited by Shephard 2003; Abia et al. 2013; Ediage, Hell, and De Saeger 2014; Afolabi et al. 2015).

Aflatoxin prevalence has widely been studied in maize in this region. Data suggest large regional and seasonal variation; they also indicate the influence of storage structures and duration of storage on aflatoxin contamination. In Accra, Ghana, maize samples contained aflatoxin at levels reaching 662 ppb (Kpodo et al. 2000, as cited in Shephard 2003). In Nigeria, a survey of five agroecological zones (AEZs) found that contamination levels were influenced by storage structures and that 33 percent of samples were contaminated, with means reaching 125.6 ppb (Udoh, Cardwell, and Ikotun 2000). Significant rates of contamination (AFB1 prevalence = 18 percent; mean level = 22 ppb) were later found in preharvest maize grown in southwestern Nigeria (Bankole and Mabekoje 2004). Atehnkeng et al. (2008) found that aflatoxin prevalence was higher in maize from the Southern Guinea Savanna zone (72 percent), which had the highest mean (507.9 ppb; range = 113–1,102 ppb). A more recent report by Adetunji et al. (2014b) found that the humid Derived Savanna zone had both the highest number of aflatoxin-contaminated stored maize samples (75.8 percent) and the highest mean total aflatoxin level (596.85 ppb). There was also a stronger correlation between storage structures and aflatoxin levels in that zone (Adetunji et al. 2014a). In addition, contamination of maize from 300 farmers' stores across four AEZs in Benin over a two-year period was modest at harvest (between 21.4 percent and 8.8 percent detectable by region); however, it increased markedly during storage. In the hottest and driest region, the proportion contaminated above 100 ppb increased from 2.2 percent at harvest to 24.2 percent after six months (Hell et al. 2000).

In Cameroon, surveyed maize during 1996 and 1997 in two AEZs indicated low rates of infection with A. flavus and aflatoxin contamination (0–5.7 percent) across years and regions (Ngoko et al. 2001). Data from a multiyear (2009–2011), multi-AEZ study indicate that only 22 percent of 165 samples contained aflatoxins (Ediage, Hell, and De Saeger 2014). Levels of AFB1 were highest in the Humid Forest zone during both samplings

(range: 6–645 ppb) and were higher in 2010/2011 than in 2009 (mean: 81 and 35 ppb, respectively). More recently in Cameroon, higher prevalence and higher mean aflatoxin levels were reported in maize samples from Yaoundé (50 percent; 3.5 ppb) than in samples from Bamenda (6 percent; less than 0.13 ppb) (Abia et al. 2013).

Aflatoxin contamination data for other food commodities have well been summarized in a recent compendium of abstracts (Edema et al. 2015). However, a few other nonlisted studies indicate aflatoxin contamination of sorghum, cassava flour, and soybean (Abia et al. 2013; Ediage, Hell, and De Saeger 2014).

North Africa

Contamination rates of maize, groundnuts, and tree nuts are also high in North Africa. Maize was the most contaminated grain in an extensive survey of cereals in Egypt conducted in 1996–1997 by El-Tahan et al. (2000, as cited by Shephard (2003), with 86.7–100 percent prevalence (means: 63.6–107.7 ppb). Another study in Egypt (Selim et al. 1996, as cited by Shephard 2003), found that 21.4 percent of cereal grains contained mean AFB1 level of 36 ppb (max: 92), while 82.4 percent of nuts and seeds were contaminated (mean: 24 ppb; max: 74 ppb). More recently in Egypt, 11.4 percent of 44 and 22.9 percent of 35 maize samples collected in 2014 and 2015 had AFB1 at levels reaching 206.2 ppb and 165.8 ppb, respectively (Abdallah et al. 2015). High levels of contamination were found in both tree nuts and groundnuts in Egypt: hazelnuts up to 175 ppb (Abdel-Hafez and Saber 1993) and peanuts up to 1,056 ppb (El-Gohary 1996). Only 5.8 percent of soybean meal was contaminated in the El-Tahan study (maximum: 25 ppb), while earlier, 35 of 100 samples of soybean seeds were contaminated (maximum: 35 ppb) (El-Kady and Youssef 1993). Maize and peanut butter in Sudan were also contaminated at levels reaching 15 ppb (Abdel-Rahim et al. 1989, as cited by Shephard 2003) and 170 ppb (Elamin et al. 1988, as cited by Shephard 2003).

Southern Africa

Maize in the southern tip of Africa (including Botswana and South Africa) is rarely affected by aflatoxin, according to Shephard (2003), though contamination with other mycotoxins—in particular, fumonisins—appears to be more significant (Darwish et al. 2014). Routine testing of commercial maize and maize products shows an absence of the toxin at detectable (greater than 2 ppb) levels in most years, though levels reached 20 ppb in less than 5 percent of samples after extreme drought stress in 1991–1992. Only one study shows sporadic incidence of aflatoxin in maize from smallholder farmers (Dutton et al. 1993, cited by Shephard 2003). In Zambia, however, 21.4 percent of household maize samples in three AEZs contained aflatoxin levels of up to 108.4 ppb (Kankolongo, Hell, and Nawa 2009). Peanuts in southern Africa appear to be more often affected, with 46 percent and 8 percent of nuts above the allowable limit of 10 ppb in Zimbabwe during the 1995 and 1996 seasons respectively (Henry et al. 1998) and with the concentration reaching 1,000 ppb in peanut butter and 5,350 ppb in groundnuts at harvest (Ismail et al. 2014). A recent paper by Njorge et al. (2016) argues for regular aflatoxin monitoring in peanut butter in Africa.

Mycotoxins in Animal Feeds

The most comprehensive global survey (2004–2012) of mycotoxins in feed analyzed 19,757 samples (mainly finished feed and maize) for aflatoxins, fumonisins, ochratoxin A, deoxynivalenol, and zearalenone. The highest proportions of samples positive for aflatoxins were found in South Asia and Southeast Asia (78 percent and 50 percent positive, respectively). From

Africa, 302 samples were analyzed for aflatoxins, with 40 percent positive. The study reported common co-occurrence of different mycotoxins in samples (Schatzmayer and Streit 2013).

Commercial feed has repeatedly been found to be contaminated with aflatoxins and other mycotoxins. However, smallholders in low-income areas can seldom afford concentrates to a large extent, and livestock often get homegrown crops. In Kenya, a recent study in five counties found that 0–68 percent of farmers fed their cattle commercial concentrates. Sampled concentrates contained up to 9,661 ppb AFB1, with 75–100 percent positive samples (Senerwa et al. 2016). Similarly, up to 100 percent of feed samples from feed manufacturers and retailers were positive for AFB1. More than 80 percent of feed samples from farmers, manufacturers, and retailers in Kenya contained AFB1 up to 595 ppb (Kang'ethe and Lang'a 2009). In Ethiopia, 90 percent of dairy feed samples around Addis Ababa contained more than 10 ppb AFB1, with noug cake (up to 397 ppb) being the highest-contaminated ingredient (Gizachew et al. 2016). Other studies in Morocco, South Africa, and Nigeria reported aflatoxins in poultry feeds, sometimes in combination with other mycotoxins (Zinedine et al. 2007; Mngadi, Govinden, and Odhav 2008; Ezekiel et al. 2012). Although aflatoxins have not been studied or reported in feeds in many countries, presence of aflatoxins in crops for human consumption or in milk is indicative of aflatoxins in feeds.

Commercial concentrates are important for productivity in Africa's increasingly intense farming systems; therefore, aflatoxins may cause a major hindrance to this development. In addition, it is a common practice for smallholders to feed moldy household food, which may be heavily contaminated, to animals—often to poultry or cows (Kiama et al. 2016; Nyangi et al. 2016). Considering the negative effects of aflatoxins on animal health and productivity, the exposure in livestock is likely to have effects on the availability of nutritious animal-source food, which, in turn, will affect food security.

Mycotoxins in Animal-Source Foods

Although the contamination of milk is the highest concern for public health, other categories of animal-source foods can contain aflatoxins after animals ingest contaminated feed; especially high concentrations can be found in liver and kidneys. In Cameroon, between 25 and 52 percent of eggs contained aflatoxins (max: 7.2 ppb; mean: 0.8 ppb) (Tchana, Moundipa, and Tchouanguep 2010). Because milk is often consumed by infants, young children, and pregnant and nursing mothers, who may be more vulnerable to toxic effects, the recommended levels are lower for milk than for most other commodities, even though AFM1 is considered less toxic and carcinogenic than AFB1, based on animal experiments (Cullen et al. 1987).

Aflatoxin contamination in milk is a worldwide occurrence. A recent review included reports of positive samples from Egypt, Libya, Syria, South Africa, Lebanon, Morocco, Nigeria, and Sudan (Mulund et al. 2013). Table 8.1 shows the results of some additional recent studies.

TABLE 8.1—RECENT STUDIES SHOWING AFLATOXIN M1 IN DAIRY PRODUCTS IN SOME AFRICAN COUNTRIES

Location	Samples	Positive	> 50 ppt	> 500 ppt	Max. level detected
Dar es Salaam, Tanzania[a]	37	92%		24%	855 ppt
Nairobi, Kenya[b]	128	100%	63%		2,560 ppt
Rural Kenya (4 AEZs)[c]	512	40%	10%	0.6%	6,999 ppt
Libya[d]	49	71%			3,130 ppt
Addis Ababa, Ethiopia[e]	110	100%	92%	26%	4,980 ppt
Cameroon[f]	63	16%	9.5%		527 ppt

Source: [a] Urio et al. (2006); [b] Kiarie et al. 2016; [c] Senerwa et al. (2016); [d] (Elgerbi et al. 2004); [e] Gizachew et al. (2016); [f] Tchana et al. (2010).

Managing Aflatoxins

Pre- and Postharvest Risk Factors

Aflatoxins are a worldwide problem because of the movement of contaminated produce in global trade. However, the problem is worse in Africa, and the burden to smallholder farmers is far more pressing for a number of reasons that increase the risk of aflatoxin occurrence and exposure (Figure 8.1). First, the prevalence of the toxin is higher in Africa and Southeast Asia due to conducive climatic conditions. Second, subsistence farmers cannot afford to diversify their diet and are often heavily dependent on high-aflatoxin-risk staple crops such as maize and groundnuts. These farmers consume 70 percent of what they produce, selling the better-quality produce for income (Crean and Ayalew 2016). Third, weak policy and institutional capacity, as well as limited awareness for aflatoxin control and for protecting the public health, aggravate the problem. Aflatoxin is the only mycotoxin known to contaminate crops both pre- and postharvest (potentially occurring along the entire value chain), which makes it difficult to target interventions for preventing or controlling contamination. Preharvest occurrence of aflatoxin increases with crop stress, including drought and pest attack.

FIGURE 8.1—RISK FACTORS CONTRIBUTING TO THE AFLATOXIN PROBLEM IN AFRICA

Source: Crean and Ayalew 2016.

Aflatoxin Risk Management

Managing the complex problem of aflatoxin contamination of food and feed requires systemic thinking and an integrated multidisciplinary and multistakeholder approach. This section discusses measures known to reduce aflatoxin contamination and offers options for an integrated aflatoxin control program. In the field, proper agronomic and crop management practices that improve plant vigor or reduce plant stress, such as that created by pest attack or drought, are known to reduce risk of aflatoxin contamination. Moreover, competitive biological control using non-aflatoxin-producing strains of A. flavus is known to reduce toxin levels by 80–90 percent at harvest, with reported effects of further preventing postharvest toxin accumulation (Atehnkeng et al. 2014). Resistance in maize and groundnuts to

A. flavus or subsequent accumulation of aflatoxins has been the subject of rigorous research for decades. Such resistance is a complex quantitative trait governed by multiple genes and is highly associated with stress tolerance such as drought stress adaptation, which is also a complex trait (Fountain et al. 2015); no commercial lines with resistance to address aflatoxin contamination have been marketed (Brown et al. 2013). Given the familiarity of improved varieties and the ease of adoption, resistant varieties, if available, potentially offer the easiest means of aflatoxin management. Thus, recent advances in plant breeding may be explored to develop stable resistance against aflatoxin accumulation.

Postharvest aflatoxin control can be reasonably achieved by properly drying to safe moisture levels (approximately 12.5–13.5 percent seed moisture content in starchy cereal grains, such as maize, or 8–9 percent seed moisture content for oilseeds, such as groundnuts), followed by clean, dry storage. Protecting stored grain from insect pests and weather factors—in particular, preventing any increase in moisture content during storage—will go a long way toward mitigating grain spoilage and aflatoxin contamination. Hermetic storage solutions are increasingly recognized as providing effective control of mold growth and toxin levels.

The developed world managed to prevent exposure of the public to aflatoxins through effective inspection of food supplies and by enforcing maximum limits for aflatoxins. Developing countries apply regulatory measures for produce destined for export markets. In domestic markets in Africa, trade-offs between food safety and availability cannot be ignored and should be taken into account in setting appropriate standards and in designing regulatory enforcement strategies. African countries cannot continue with the status quo of enforcing regulations only in produce destined for export markets, leaving the lesser quality contaminated produce to local consumers. Improving policy and institutions is also important for creating an enabling environment for research and technology solutions or for creating awareness campaigns. Effective aflatoxin control at scale calls for making suitable options readily available and embedding aflatoxin-control messages in agricultural and community health extension systems for wider adoption by smallholder farmers and other value-chain actors. Aflatoxin-control measures should be linked to outcomes that are visible to farmers, such as premium price, improved quality, or reduced losses for easier uptake. Studies have also shown that farmers are willing to invest, to some extent, in technologies to improve the health of their family (Hoffmann et al., 2016). Like most food safety burdens, aflatoxin contamination can be reduced and managed if adequate resources are made available.

Potential and Limitations of Market-Based Approaches

To the extent that markets reward aflatoxin safety, premium prices can be an important driver for the adoption of aflatoxin-control strategies at all stages of the value chain. Although explicit labeling for aflatoxin safety has not been adopted outside of pilot programs, a negative association between price and the probability that maize flour is contaminated above the regulated limit has been observed in Kenya (Moser and Hoffmann 2015). According to interviews with millers conducted by one of this chapter's authors, those producing the most expensive flour in this market pay significantly higher prices for raw materials than other mills; they also test for aflatoxin prior to purchase. This practice is likely driven by reputational considerations, as the impact of a food safety incident on a company's brand equity can be severe.

Although setting higher prices for uncontaminated grain may lead to better handling practices by traders, it is likely to concentrate aflatoxin contamination in lower-priced maize products and in the informal market if premium buyers simply reject contaminated maize at the mill gate. Moreover, the long value chains typical of African agricultural markets mean that even if a quality premium is paid by the ultimate processors or consumers, farmers are unlikely to receive higher prices, particularly because aflatoxin contamination is an unobservable trait (Fafchamps, Hill, and Minten 2008). Establishing direct procurement relationships between farmers or farmer associations and processors will likely be necessary for farmers to benefit from higher prices (and thus for them to be motivated to improve their management of aflatoxin on-farm, where contamination typically begins). A recent study in Kenya indicated that both subsidies and a price premium for aflatoxin-safe maize significantly increased adoption of an aflatoxin-mitigation technology (Hoffmann et al., 2016). Results from a separate study in Ghana echo this finding, though the impact of the market premium was weaker in this setting (ibid.).

Regulatory Successes and Opportunities

Principles of Regulatory Enforcement

Balancing trade-offs: An important principle of both setting and enforcing regulations is to balance social and economic impacts, including impacts on food security, with the protection of public health. This issue is reflected in the wide variation in aflatoxin limits across countries, which range from 4 ppb in the EU to 35 ppb in Malaysia (ASEAN 2015). Even within a single country, a flexible approach to enforcement may be appropriate given variation over time in both contamination and economic conditions. For example, blending of contaminated commodities to reduce aflatoxin levels is typically prohibited in the United States, but in years of particularly high aflatoxin contamination, the US Food and Drug Administration (FDA) has allowed maize containing up to 500 ppb aflatoxin to be blended with cleaner maize and used for cattle feed (Njapau et al. 2015).

Surveillance: A second key principle is that what cannot be measured cannot be managed. Routine surveillance of aflatoxin levels in both marketed foods and that stored by farmers, along with timely availability of data, is essential. Such data will allow for rapid interventions to avert outbreaks of acute aflatoxicosis and will enable tracking of contamination levels over time. This, in turn, will allow for the evaluation of control efforts and the development of climate-based models to enable better prediction of aflatoxin levels ahead of time.

Challenges of Enforcement in the Domestic Market

The presence of a large informal sector, as is typical in agricultural and food markets in developing countries, presents several challenges to the enforcement of aflatoxin regulations. First, it means that most market actors are not affected by the threat of enforcement. Second, the anonymity of informal market actors beyond their immediate suppliers and customers implies that food safety incidents have little impact on reputation; thus, the value-chain players have little private incentive to invest in improving food safety. Third, informal competitors put pressure on formal-sector firms, which must comply with regulations—to the extent these are enforced—while remaining price-competitive. Meanwhile, the informal sector is both a major employer and an important source of affordable food for the poor (Grace 2010). Enforcement of aflatoxin standards should thus be implemented in an inclusive and enabling manner, as opposed to one that penalizes those in either the informal or formal sector. This type of

enforcement implies capacity building for producers on farm-level aflatoxin management, for traders and warehouse operators on screening for food safety and handling to maintain it, and for food-processing firms on all relevant aspects of compliance with regulations.

Alternative Uses and Disposal Systems

Because such a large proportion of Africa's food supply is contaminated and because the majority of food is transacted through informal markets, developing legal uses and markets for contaminated grains is a critical component of aflatoxin management in this context. This approach is also used in the management of aflatoxin in developed countries. For example, in the United States and the EU, groundnuts contaminated in excess of the regulatory limit may be processed into oil, which meets standards for human consumption. The groundnut cake that remains as a by-product after oil extraction can then be used for livestock feed, for which allowable levels of aflatoxin are higher. This is because certain livestock (such as beef cattle) are able to tolerate relatively high levels of aflatoxin without serious impacts on productivity; in addition, aflatoxin residues in edible muscle tissue constitute only 0.2–0.5 percent of that in the feed (Jacobsen et al. 1978 and Shreeve et al. 1979, both cited in Njapau et al. 2015). Mycotoxin binders can also be used to prevent uptake of aflatoxin by livestock. Several different organic and inorganic substances can bind aflatoxins, as well as other mycotoxins; the different types of binders have been reviewed (Huwig et al. 2001; Kolosova and Stroka 2011; Binder 2007). In this way, the economic costs and the associated social trade-offs of regulatory enforcement are minimized. For example, in the United States, despite strict enforcement of a 10 ppb aflatoxin limit in peanuts for human consumption, the estimated loss due to aflatoxin is only 2 percent (Njapau et al. 2015).

Other potential alternative uses of contaminated commodities include production of ethanol. In many cases, the by-products of such alternative uses may contain a higher concentration of the original contaminated commodity and may need to be disposed of. Njapau et al. (2015) described options for safe disposal.

Relevance of Mycotoxin Control to Meeting Malabo Declaration Commitments and Sustainable Development Goals

The Malabo Declaration by African Heads of State and Government made nine specific commitments to achieve accelerated agricultural growth and transformation for shared prosperity and improved livelihoods. Addressing the pervasive food safety challenge from mycotoxins will contribute toward attainment of Malabo Declaration Commitment 3 (ending hunger in Africa by 2025), commitment 4 (poverty reduction), and commitment 5 (tripling intra-African trade in agricultural commodities and services). Mycotoxin control is also relevant to Malabo Declaration Commitment 6 (enhancing resilience of livelihoods and production systems to climate variability and related risks). Mycotoxins—notably, aflatoxins—increase when plants are stressed, such as by drought or pests, or when harvested crops are left in hot, humid conditions. With climate change, crops will be subjected to more stress from drought and erratic rainfall, pest infestations will evolve, and storage conditions are more likely to be hot and humid. Addressing aflatoxins is critical for mitigating climate change impacts on human health and agricultural markets and trade. From the foregoing discussion, mycotoxin control is also pivotal for achieving the Sustainable Development Goal on ending poverty and hunger.

Role of the Partnership for Aflatoxin Control in Africa

The Partnership for Aflatoxin Control in Africa (PACA) recognizes the wide sphere of influence and the central role of governments in driving wholesale change in aflatoxin control. With its unique position at the African Union (AU), PACA directly supports governments and Regional Economic Communities, while also forging strong partnerships with diverse stakeholders. PACA supports transformative efforts at making African agriculture competitive. The Implementation Strategy and Roadmap for translating the Malabo Declaration into concrete actions has a set of 11 strategic action areas (SAAs). PACA will contribute directly to the following SAAs:

SAA 1a: Sustainable agricultural production and productivity in an inclusive manner, particularly the subaction on "supporting postharvest loss management"

SAA 1b: Market infrastructure, regional trade and integration, and value-chain development—in particular, contributing to the subtheme to "harmonize trade regimes, measures and standards, and remove nontariff barriers (NTBs) within and across regional trade blocs (RECs), and domesticate and implement regional and continental trade agreements at national level"

SAA 1c: Increased resilience of livelihoods and production systems to climate variability and change and other shocks, specifically by promoting increased actions to address the pervasive aflatoxin problem that is aggravated by climate change, especially as a result of recurrent droughts and increased temperatures

SAA 2a: Building and strengthening the capacity for evidence-based planning, review, and documentation though the pioneer food safety database—the Africa Aflatoxin Information Management System (AfricaAIMS).

Proposed Interventions for Addressing Nutrition and Health Impacts of Mycotoxins

Participants of the regional workshop, "Engaging the Health and Nutrition Sectors in Aflatoxin Control in Africa," held at the AU Commission on March 23–24, 2016, recognized the need to holistically address the impacts of aflatoxins on health and nutrition and proposed an action plan to be implemented over a five-year period by various stakeholders in Africa (PACA 2016). The action plan, which includes 4 thematic areas and 13 action areas (AAs) as indicated below, could guide informed actions:

- **Thematic area 1: Health** *Targeting hepatitis B virus vaccination and other control options; health-targeted actions: surveillance and biomonitoring and actions targeting occupational exposure/risks and animal health aflatoxins and health policies*
  - **AA 1:** Surveillance to identify high-risk zones
  - **AA 2:** Biomonitoring to provide prevalence data on aflatoxin exposure in humans
  - **AA 3:** Animal health studies to provide prevalence data and raise awareness of effects of aflatoxins on animals
  - **AA 4:** Public health policy on aflatoxin in Africa
- **Thematic area 2: Agriculture** *Preharvest practices, postharvest interventions for reducing aflatoxin contamination and consequent human exposures*
  - **AA 5:** Market demand–driven technology adoption
  - **AA 6:** Alternative uses of contaminated crops

  - **AA 7:** Subsistence farmer adoption of practices to control aflatoxin and improve food safety
- **Thematic area 3: Nutrition** *Mitigating aflatoxins in food fortification supply chains for reducing human exposure, including household-targeted interventions (dietary diversification), food processing, and food quality and safety*
  - **AA 8:** Strengthen collaboration with relevant stakeholders to generate solutions to existing problems
  - **AA 9:** Ensure adequate food safety and nutrition legislative framework, including monitoring
  - **AA 10:** Establish research and development centers to promote use of traditional and indigenous foods into new products for dietary diversification
- **Thematic area 4: Awareness** *Role of awareness creation in minimizing aflatoxin exposure and consequent impacts; actions toward targeted health and nutrition awareness: education and medical consultations*
  - **AA 11:** Advocacy of aflatoxin management at high-level meetings
  - **AA 12:** Education and in-service training for increased awareness of the presence of aflatoxins in foodstuffs that are widely consumed
  - **AA 13:** Communication on the impacts of aflatoxin

BOX 8.1—KEY ACTION ITEMS TO ADDRESS THE PROBLEM OF MYCOTOXINS IN AFRICA

The following key intervention areas should be addressed to ensure that mycotoxins do not hold back progress on nutrition, trade, and economic growth in Africa.

1. Create markets for safe alternative uses of aflatoxin-contaminated crops through differentiated standards by use and development of markets for high-quality binders to be used in feed.
2. Ensure that attainable aflatoxin standards are enforced in school feeding programs and other public food-procurement activities, from procurement to provision.
3. Create mechanisms through which smallholder farmers are linked to premium markets for aflatoxin safe foods (World Food Programme, private sector, school feeding programs) as suppliers and are provided with training, access to technologies to ensure aflatoxin safety of the food they produce, and financing to enable the use of these technologies.
4. As appropriate based on ex ante cost-effectiveness analysis, deploy subsidies for aflatoxin control targeted to families with young children in high-risk areas.
5. Conduct rigorous evaluations of all of the above measures so that lessons are learned from both successes and failures.
6. Build capacities for aflatoxin monitoring and provide rapid test kits for increased surveillance and on-the-spot determination of aflatoxins in the food chain.
7. Use consumer education and agricultural tax incentives to create market conditions such that farmers find it optimal to grow underutilized crops or crops less susceptible to aflatoxins.
8. Identify and map aflatoxin high-risk zones in countries using food and human body fluid exposure data, as well as data from animal feed, to enable rapid response to aflatoxicosis outbreaks and to target efforts for promotion of aflatoxin-control technologies.
9. Develop an effective communication strategy or mechanism for reaching local farmers in local languages and build the media's capacity for communicating responsibly.

Source: Authors

Stakeholder Roles for Addressing Mycotoxins

PACA works with national governments in its six pilot countries in Africa (The Gambia, Malawi, Nigeria, Senegal, Tanzania, and Uganda), as well as with Regional Economic Communities and other stakeholders, to coordinate actions for effective aflatoxin control in Africa. For the past two years, PACA generated empirical evidence on the nature and impact of aflatoxin contamination; it developed comprehensive, ambitious, yet realistic national and regional aflatoxin-control plans, one of which was generated during the recently concluded health and nutrition workshop. In view of this action plan's multisectoral approach, PACA engages with such partners as health- and nutrition-based technical institutions and agencies, including Amref Health Africa, the US Centers for Disease Control and Prevention, the Food and Agriculture Organization of the United Nations, the World Health Organization–International Agency for Research on Cancer, and the Global Alliance for Improved Nutrition. It also works with private-sector actors and the appropriate ministries in countries to drive the action plans developed. Critical steps toward boosting consumer health and economic growth on the continent include harmonization of health-intervention efforts, especially those that link agriculture- and food processing-related interventions that affect public health (for example, such technical solutions as biocontrol, aflatoxin-resistant varieties, and alternative uses for contaminated), as well as creation of health advocacies and awareness. Thus, there is a need to foster and reinforce multisectoral linkages on the control of aflatoxins in Africa.

Summary and Conclusions

Aflatoxins, which are potent carcinogens in human and animals, mainly get into the biological system via diets. The human health impacts resulting from acute and chronic aflatoxin exposure add losses in productive years and cost of illness, contributing to the cycle of poverty, which may, in turn, contribute to further ill health. Several interventions are available for reducing the adverse impacts of aflatoxins on the economy. However, the complexity and cost of implementing the available strategies (Wu and Khlangwiset 2010) require effective partnerships.

CHAPTER 9

The Challenges, Opportunities, and Lessons Learned in Evidence-Informed Decision Making in Africa

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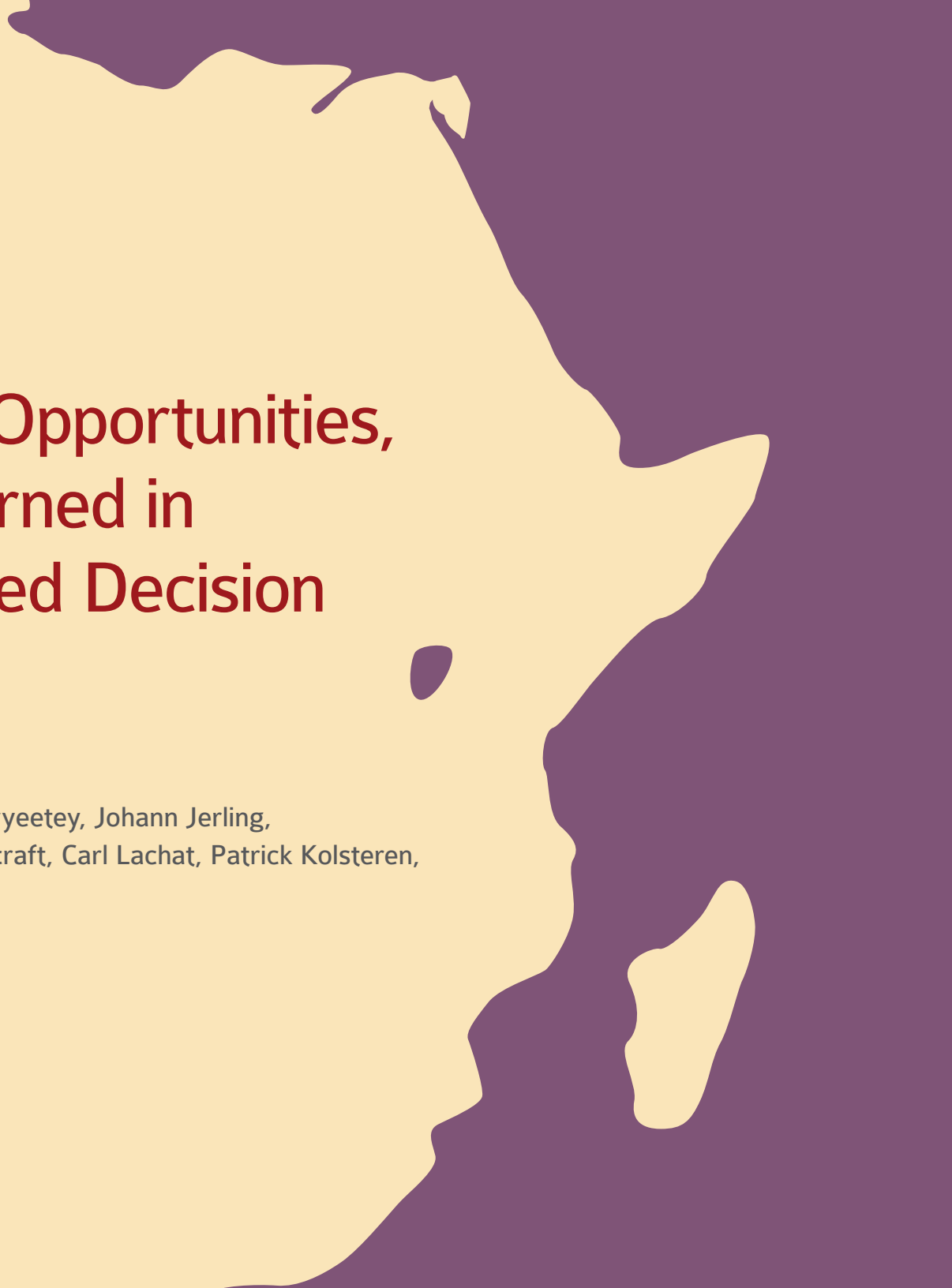


This chapter explores how evidence-informed decision making related to nutrition can be enhanced in Africa. It highlights the opportunities evidence presents to contribute more effectively to addressing the nutritional challenges on the continent by drawing on lessons learned so far about evidence-informed decision making in Africa.

Hence, it is imperative that countries design policies and programs that will not only enable them to sustain and accelerate the current recovery process but also generate high economic growth that is inclusive and creates significant employment opportunities in order to lift millions out of poverty. Africa's ability to sustain and accelerate its current growth will be determined by the effectiveness of its response to the challenges and opportunities it faces resulting from a deepening globalization, a rapid pace of urbanization, a rising middle class, a growing young population, rapidly transforming food systems, a changing climate, and more volatile global food and energy prices.

Why Is Evidence-Informed Decision Making in Nutrition Needed?

The 2016 Global Nutrition Report indicates that although the world is off-track regarding nutrition targets, modest progress in selected countries gives hope for turning the tide (IFPRI 2016). To realize this hope, however, the report calls for actions to address the persisting gaps in knowledge and to help explain why we already have effective tools and yet move too slowly toward targets. Because countries are likely to make faster progress if they prioritize nutrition in their policies, plugging the knowledge gaps and championing nutrition helps them make informed policies and plans for addressing malnutrition.

Evidence-based nutrition policies and research programs, when rolled out on a national scale, have the potential to deliver improved nutrition at the population level and contribute to sustainable development outcomes. Ideally, research in the field of nutrition should respond to critical needs identified by national and regional decision makers and other enablers. In this way, such research is more likely to translate into action and enhance impact, particularly in the world's poorest settings (COHRED 2007). The enhancement of evidence-informed decision making (EIDM) and policy-driven nutrition research in resource-limited settings is thus increasingly recognized as essential for maximizing public health benefits and resources (Ioannidis et al. 2014).

The conceptualization of evidence in this chapter encompasses both empirical (research based) and colloquial (experiential/subjective) information; "evidence informed" is considered in an iterative, rather than a strict evidence-based, sense. In Africa, where needs are plenty and resources scarce, high-quality research evidence in nutrition can help guide decision makers (such as policy makers, civil society, nongovernmental organizations, clinicians, and researchers) toward the best use of resources. However, this process is not as straightforward as it sounds. First, although there is a relatively large volume of published nutrition research in Africa, it is mainly descriptive and thus provides little of the critical intervention-related evidence needed to support policy development (Lachat et al. 2015). Second, the existing evidence is often not adapted to the priorities and conditions of national and subnational contexts (Morris, Cogill, and Uauy 2008; Holdsworth et al. 2014; Verstraeten et al. 2012) or to low- and middle-income countries (LMICs) (Resnick et al. 2015). Furthermore, insufficient effort is invested in championing use of existing nutrition

research by policy makers (Gillespie et al. 2016). What use is research to inform decision making if no decision maker ever knows about it?

Several reasons underlie the contradiction between existing research priorities and actual needs. On one hand, too many nutrition studies go unread—for example, several publications are inaccessible behind journal paywalls; locally published evidence is sometimes difficult to locate in the gray literature; and some research findings are promoted in academic circles only, remaining inaccessible to decision makers. In some cases, research that is accessible may have limitations, involve reporting bias, or be of low quality. On the other hand, decisions by policy makers are often not well supported by the appropriate evidence. Evidence for how to improve nutrition is particularly needed (Gillespie et al. 2016; Lachat et al. 2014), and evidence that is used is often less robust than decision makers may think. In addition, decision makers sometimes use anecdotal "evidence" alone to support decisions. Such evidence ranks low on the evidence-appraisal scale because it is based on only a few, and often unrepresentative, case reports. However, anecdotal evidence is often used because there is insufficient time, resources, or capacity to obtain robust evidence. There is also a risk of using evidence incorrectly. In the worst-case scenario, available evidence is simply not consulted.

A first illustration of these challenges was demonstrated by Doemeland and Trevino, who reported that about one-third of the policy reports produced by the World Bank were never downloaded, and 87 percent of these were never cited, even though a quarter of the budget for country services is invested in these knowledge products (Doemeland and Trevino 2014). A second example is the dearth of evidence on specific effective actions in LMICs to tackle noncommunicable diseases (NCDs), notwithstanding the magnitude of nutrition-related NCDs and their impact on health systems and quality of life in these settings (Alwan et al. 2010; Lachat et al. 2013). These examples illustrate some of the challenges that can arise when there is inadequate matching of evidence to identified policy needs.

Evidence Can Be Lost in Translation

There are also important systemic challenges regarding interactions in the collaboration among donors, policy makers, civil society, nongovernmental organizations, and researchers in LMICs. Multifinanced initiatives often face the risk of imposing the priorities of donors, lobbyists, and researchers; this often leads to neglect of national priorities as determined by decision makers (Van Royen et al. 2013; Sridhar 2012), which subsequently undermines resources spent on investments in research (Lachat et al. 2014, Sridhar 2012). In resource-poor countries, the nutrition policy and programming agendas are often set based on the availability of funding for particular intervention programs prioritized by development partners, rather than on what beneficiary governments may consider the priority. In addition, studies published from donor-driven research typically focus on quick-fix technical solutions and not on longer-term preventive or sustainable solutions (Lachat et al. 2014). Finally, critical decisions that need to be made along the policy, program development, and implementation continuum require the capacity to use, demand, and act upon relevant evidence. These decisions are prone to economic constraints, influence (lobbyists), values, traditions, and conflict due to competing interests that policy makers face in establishing and implementing a sustainable agenda. This, in turn, results in

the policy-implementation nexus (often referred to as the "know-do gap" or the "missing middle").

The recently developed kaleidoscope model of food security policy change (Resnick et al. 2015) acknowledges that the role of evidence is only one contributor to the decision-making process. Enabling environments are also key to policy change (Gillespie et al. 2016). The kaleidoscope model focuses on five key elements of the policy cycle—agenda setting, design, adoption, implementation, and evaluation and reform. This model acknowledges the role of power and conflict much more than existing approaches and recognizes the importance of external actors and the influence of their interests, ideas, and institutions (Resnick et al. 2015). The model particularly draws attention to the need for research evidence in the design and evaluation steps of the decision-making process. Indeed, the authors illustrate how much nutrition policy research assumes that improving the quality of empirical evidence will be enough to lead to evidence-informed policy making, assuming that "altruistic decision makers can be convinced to change their course when credible new evidence comes to light" (Resnick et al. 2015, 10).

It is no surprise that most LMICs are struggling to reach vulnerable and malnourished population groups with appropriate policies and effective interventions (Bryce et al. 2008). In countries where nutrition policies and programs have been formulated, the current challenge is failure to translate this idea into tangible action on the ground due to limited resources and capacity. This makes it even more pertinent to harness opportunities and have systems in place that can generate evidence to inform processes that could be adopted to more effectively implement nutrition action within the prevailing resource-constrained settings.

What Kind of Solution Do We Need?

New approaches to prioritize efforts in EIDM are needed. Action needs to be taken at different fronts by different actors. The EU-funded project SUNRAY (Sustainable Nutrition Research for Africa in the Years to Come; Lachat et al. 2014) demonstrated a need to strengthen, formalize, share, and use knowledge and evidence to (1) serve as the basis for setting research and policy priorities for nutrition and (2) align the production of scientific knowledge and evidence with the information needs of decision makers in Africa.

Accessibility of information is a key condition to enable informed decision making. Although progress has been made in facilitating access to academic publications in LMICs, practical constraints, such as poor Internet connectivity and language barriers, persist. Although international consensus favors the need to make published research evidence and data accessible, most shared data are isolated and stored in formats that do not enable reuse (Wilkinson et al. 2016). A culture of data stewardship and long-term commitment needs to be fostered in the nutrition research community. Not only do we need to ensure access to data, we also need to synthesize evidence to drive an evidence-informed agenda. Evidence synthesis tools, such as evidence maps,[22] systematic reviews, rapid reviews, and health technology assessments, are useful and appropriate tools that allow policy makers to make informed decisions on the selection of policies

22 The tool can be accessed at www.ifpri.org/tools/bpimappingtool.

to invest in. Evidence synthesis, however, should be tailored to identify and prioritize needs by addressing relevant questions to reduce the risk of epidemiological research waste.

Having good-quality evidence, however, is far from the only factor in decision making. Before evidence can be translated into action (such as new policy, programs, or decisions), other factors like economic constraints, lobbyists, habits, traditions, and values will come into play. Using evidence to inform decisions requires leadership, capacity, and concerted action (Resnick et al. 2015). Both technical capacity and leadership are critical (Gillespie et al. 2016) for harnessing the opportunity to use evidence to inform policies and programs, leading to better decisions; both are required at all stages of the process, from articulating demand, generating data, conducting evidence synthesis, and mobilizing knowledge from multisectoral research to translating knowledge from research to the local context. This is not only about strengthening individual capacity but also about building operational and institutional capacity and increasing the sustainability and resilience of the systematic evidence-informed processes and partners. In addition to technical capacity, leadership for nutrition in all government agencies (such as agriculture, water and sanitation, and social protection), civil society, the United Nations, academia, bilateral donors, and the private sector is recognized as a fundamental aspect of translating evidence of the effectiveness of multisectoral nutrition programs and policies into action on the ground. The Scaling Up Nutrition (SUN) movement is using a similar infrastructure (SUN 2014). Before we can use evidence to its full extent, we need to understand how to engage with civil society, what the private sector's role is, and how to create synergies with other sectors. Initiatives that include the promotion of leadership, such as Leveraging Agriculture for Nutrition in South Asia (LANSA) and Leveraging Agriculture for Nutrition in East Africa (LANEA), show promising solutions for addressing such challenges. The technical capacity to generate data (general capacity issues are dealt with in another chapter of this report) is also needed.

The inevitable tension between researchers and decision makers needs to be overcome; doing so requires capacity strengthening on both sides. The policy development and implementation process is, by its very nature, a process of change that requires leadership. We need to be equipped with the appropriate orientations and capabilities to effectively lead transformational change in LMIC settings. There is a need to foster concerted action within and across actors and countries to accelerate and sustain progress in scaling up nutrition. The multipartner collaboration provides important networks through which outputs and knowledge products can be disseminated and shared, thus accelerating the process by which evidence is taken up and translated into policy. This process should stimulate cross-country and cross-sector learning in every stage of the systematic processes of EIDM in nutrition. In addition, such collaboration will multiply opportunities for sharing lessons and learning, while recognizing that the contexts may be dissimilar. Even when all the above considerations have been accounted for, further issues remain which must be addressed. In many LMIC settings, a primary concern is insufficient funding of policies and programs, as well as limited integration across government ministries and sectors, in part because the sectors are funded vertically.

A Story of Change for Evidence-Informed Decision Making for Nutrition in Africa

Even though it is challenging to apply EIDM in the context described above, some change is already underway. Research funders and international agencies, such as CGIAR, have made important commitments to make data accessible.[23] A key barrier for the nutrition community in sharing data is the availability of appropriate infrastructure to host and manage nutrition research data within ethical and legal limits (Tenopir et al. 2011). The European Commission has pledged substantial funding to build national information platforms for nutrition in several African countries, aiming to unlock data on nutrition and nutrition-sensitive programs for better decision making.[24] Other initiatives, such as the World Health Organization/Food and Agriculture Organization's Global Dietary Database,[25] will collate data from food-intake studies.The European Nutritional Phenotype Assessment and Data Sharing Initiative will provide open-access facilities to share both observational and experimental studies in the area of nutrition and health. Tangible progress has been made at the technical level (for example, database structure, ontologies, and data standards). At the same time, however, there is surprisingly little understanding of users' needs and how such database systems will translate into actionable guidance for policy makers or how it will support Africa's nutrition research community.

Morris, Cogill, and Uauy (2008) reported an ineffective system of actors at both the national and international level, which, at the time, resulted in insufficient action on nutrition in Africa, leading to weak and fragmented capacity to improve nutrition. Since then, with the advent of the SUN movement and related efforts for a more coordinated effort at the national and international level, some improvements have been made, especially in the formulation of nutrition policies and programs, with countries showing different levels of progress. A number of resources and initiatives are strengthening leadership and capacity for EIDM in Africa with a broader health focus (see Box 9.1). The development of these initiatives highlights the importance of and need for addressing these challenges. Creating synergies among them could enhance their overall impact on the EIDM process.

The Agriculture for Nutrition and Health Research (A4NH) initiative is one example of how intersectoral collaboration and synergies could work to bridge the gap between agriculture and nutrition. This program aims to understand why the gap remains and how agriculture can be turned into a powerful lever for raising people's health and nutritional status, while at the same time contributing to other outcomes such as food security, income, equity, and sustainability. The VakaYiko Consortium (see Box 9.1) is an initiative involving building capacity to use research evidence. The consortium succeeded in strengthening the capacity of policy-making actors in several countries by developing an evidence-informed policy making (EIPM) toolkit to support the use of evidence in policy making in LMICs—for example, embedding EIPMs in civil-service training centers in Ghana and Nigeria and supporting local brokering organizations in Ghana and Zimbabwe. The LANSA initiative includes understanding and creating enabling environments for nutrition-sensitive agriculture. Gillespie et al. (2015) proposed the need for more and better evidence of

23 For more information: http://www.cgiar.org/resources/open/data-management-system/.

24 For more information: http://www.agropolis.org/project-management/NIPN-project.php.

25 For more information: http://www.fao.org/nutrition/assessment/food-consumption-database.

BOX 9.1—SOME INITIATIVES TO ADVANCE EVIDENCE-INFORMED DECISION MAKING IN AFRICA

Agriculture for Nutrition and Health (A4NH): This CGIAR Research Program, through its global network of partnerships, promotes actions of agricultural researchers, value-chain actors, program implementers, and policy makers to contribute more effectively to nutrition and health outcomes and impacts. a4nh.cgiar.org/

African Evidence Network: This network of researchers, practitioners, and policy makers working in research, civil society, and government agencies in Africa seeks to promote evidence production and use in decision making. The network's activities span a range of sectors, including education, health, and technology. www.africaevidencenetwork.org/about-us/

Building Capacity to Use Research Evidence (BCURE): BCURE is a mechanism that brings together various EIDM projects designed to promote EIDM in developing countries. These projects and the BCURE initiative constitute a response to the poor uptake of high-quality research evidence in developing-country settings. As a collaborative, it seeks to build capacity on EIDM and high levels of governance thought skills training in EIDM, as well as creation of dialogue opportunities across development partners. bcureglobal.wordpress.com/

EVIDENT: This global partnership involves partners from the north and south of Africa. EVIDENT is aimed at strengthening the capacity for addressing the disparity between research activities and local evidence needs in nutrition and health in Africa. Unlike other initiatives that aim to improve the use of evidence in decision making in health, EVIDENT focuses on nutrition. EVIDENT encompasses all issues that are at the forefront of global nutrition and health policy, including stunting, infant and young child feeding, maternal and child health, micronutrient deficiencies, obesity, and diet-related noncommunicable diseases. www.evident-network.org

Leveraging Agriculture for Nutrition in South Asia (LANSA) and Leveraging Agriculture for Nutrition in East Africa (LANEA): These are two linked international research consortia that study how agriculture and related food policies and interventions can be developed and implemented to enhance their impacts on nutrition. lansasouthasia.org/ and www.fao.org/3/a-i4550e.pdf

Supporting the Use of Research Evidence (SURE): This collaborative project is designed to support the strengthening of evidence-informed policy making in Africa. It seeks to achieve this goal through production of evidence products, increasing access to research evidence, and fostering capacity development and partnerships for EIDM in Africa—in particular, in seven focus countries (Burkina Faso, Cameroon, Central African Republic, Ethiopia, Mozambique, Uganda, and Zambia). www.who.int/evidence/sure/en/

The SECURE Health Programme: This initiative of the African Institute for Development Policy aims to improve and optimize individual and institutional capacity in accessing and using data and research evidence in decision making for health. To achieve this, the program works with governments in Africa (including Malawi and Kenya) to enhance leadership and competence in the use of evidence for decision making in policy and legislation. Specific interventions include bottleneck assessments, internships, science and policy forums, and institutional support mechanisms. The current focus of SECURE is in health and science and technology. www.afidep.org/?p=1364

VakaYiko Consortium: This three-year program of the International Network for the Availability of Scientific Publications recognizes that the use of research to inform policy requires capacity building of the following three levels: (1) individuals (enhancing their skills to access, evaluate, and use research evidence), (2) processes for handling research evidence in policy-making departments, and (3) a wider enabling environment. www.inasp.info/en/work/vakayiko/

Source: Authors

the relation between agriculture and nutrition to strengthen both horizontal and vertical coherence with regard to policy and program implementation and for capacity building at different levels to establish and sustain positive change. By focusing attention on these barriers, LANSA and LANEA have contributed to raising awareness of the need for capacity development for EIDM in both South Asia and East Africa.

However, the ability of countries to produce evidence to inform policy and program decisions has remained a challenge. Where evidence has been generated, it has mostly been through external academic institutions with limited involvement at the national level. Insufficient attention is also given to national prioritization processes, even where these have been previously identified (Morris, Cogill, and Uauy 2008). Meanwhile the prevailing decision-making processes on the African continent need exploring and documenting so that lessons can be learned for EIDM.

Case Studies

EVIDENT: Insights on Evidence-Informed Decision Making in African Country Processes and Strengthening Capacity

Committed to maintaining the momentum that was created during the SUNRAY initiative, a collaborative effort on evidence-informed decision-making for nutrition and health (EVIDENT) was initiated in 2014. This international collaboration of partners from the north and south aims to strengthen the capacity to address the disparity between research activities and local evidence needs in nutrition and health in Africa. Hence, EVIDENT has the fundamental goal of bridging the gap between academic research and nutrition policies and programs. Unlike other initiatives that aim to improve the use of evidence in decision making in health, EVIDENT focuses primarily on nutrition. Nutrition is fundamental to human development, as it plays a critical role in an individual's overall health throughout the life cycle and affects economic development at the national level. EVIDENT, therefore, encompasses all issues that are at the forefront of global nutrition and health policy: stunting, infant and young child feeding, maternal and child health, micronutrient deficiencies, obesity, and diet-related NCDs. EVIDENT's approach is to provide evidence tailored to the expressed needs of decision makers.

EVIDENT aims to document and share possible methods to make better decisions, bridging the gap between researchers and policy makers,

BOX 9.2—SUMMARY OF THE AIMS OF EVIDENT

- Enhance capacity and leadership of African researchers and decision makers in knowledge management and translation by providing high-quality methodological training and support
- Create in-country collaboration between decision makers and scientists to improve their ability to both articulate their research needs and appropriately use evidence
- Address nutrition- and health-related questions posed by African stakeholders in a timely and transparent manner
- Create a global collaboration of scientists and decision makers who have committed to working together and sharing experience in the application of the principles and processes of EIDM in nutrition
- Foster global collaborations to share existing knowledge and generate new knowledge and competencies, where necessary, to inform national and regional nutrition policy

Source: www.evident-network.org

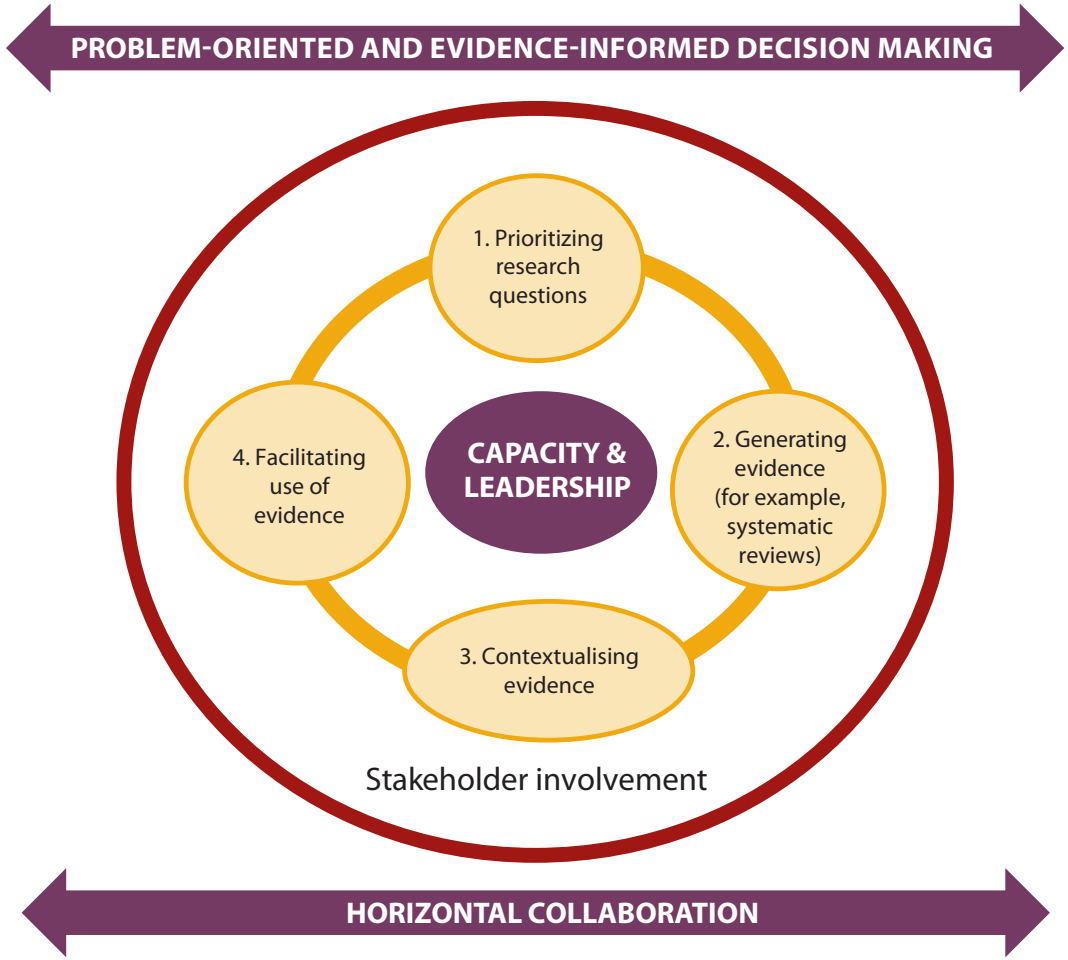
articulating questions based on needs, and translating the best available evidence into actionable policy recommendations. This process has entailed developing an organizational structure to share country learning experiences, actively consolidate the possibilities for scaling up solutions to common problems when appropriately contextualized, and forge equitable global collaborations. See Box 9.2 for a summary of EVIDENT's aims.

Strengthening Country Efforts for Evidence-Informed Decision Making

The pathway in responding to expressed needs entails a variety of complex processes, such as identifying priority policy- and program-related issues, performing evidence synthesis, adapting the best available evidence to the local context and needs, and creating an enabling environment to drive a policy process (Black et al. 2013) based on contextual recommendations. EVIDENT aims to increase impact by strengthening this evidence-policy pathway by translating local needs into recommendations that are specific, actionable, and informed by the best available evidence, while being adapted to aligned priorities of stakeholders. Its three main pillars anchored at the country level (including private sector, public sector, and civil society) along this pathway are (1) problem oriented and EIDM, (2) capacity strengthening and leadership, and (3) horizontal collaboration. Figure 9.1 presents EVIDENT's overall conceptual framework.

Through activities within each pillar, EVIDENT aims to investigate whether such a stepwise process for identifying and using evidence actually leads to better decision making and better nutrition policies in countries

FIGURE 9.1—EVIDENT CONCEPTUAL FRAMEWORK FOR EVIDENCE-INFORMED DECISION MAKING



Source: The EVIDENT Partnership (http://www.evident-network.org/).

with a high burden of malnutrition in all its forms. EVIDENT also explores the best conceptual representation of how these processes work across countries and will learn whether this a priori framework applies in a linear way, as proposed in Figure 9.1, or whether it is a more iterative process. The close involvement of decision makers in the entire process is an important and unique aspect. A first step involves effective articulation of subnational and national priority questions as expressed by decision makers, followed by prioritization and translation of these questions to inform demand-driven evidence generation. Generating evidence using high-quality evidence synthesis products (such as systematic review, rapid review, scoping review, and health technology assessment) is the second step. Third, although high-quality evidence is necessary, evidence of effective nutrition interventions needs to be translated to the country-specific context to allow relevant strategies and pathways to be chosen to facilitate change. This contextualization process includes a number of elements, such as economic evaluation of nutrition programs; local epidemiological evidence; and information on (dis)incentives, trade-offs, constraints, and opportunities for implementation. Finally, as a fourth step, generating policy recommendations tailored to the specific country context and framing relevant policy dialogue allow stakeholders to make decisions about how to best intervene in their context.

Within this conceptual framework, four pilot countries—Benin, Ethiopia, Ghana, and South Africa—are implementing case studies in which the current EIDM processes are mapped and explored for a better understanding of how they may or may not relate to the proposed pathway in Figure 9.1. EVIDENT will capitalize on the identified knowledge, capacity, and leadership gaps resulting from the case studies to inform developments toward effective EIDM in nutrition. As an output of these activities, EVIDENT will generate recommendations that are specific, actionable, and informed by the best available evidence for each country, while also adapting it to the priorities and conditions of national and subnational contexts. This process will forge links between actors from different sectors working at different scales within countries (regional, subnational, and national) and across countries. This, in turn, will provide the structural context and necessary leadership for scaling up evidence-informed recommendations in nutrition. Table 9.1 outlines the achievements of EVIDENT to date.

Lessons Learned So Far in the EVIDENT Partnership

Gathering evidence to inform decision making is neither cheap nor easy, but it has major advantages. The following ten key lessons have been learned so far:

- Lesson 1: Relationship building is important at every stage and at every level within EVIDENT and with other decision makers. Building and maintaining personal trust and nurturing such a relationship is time consuming. Such relationships create dialogue between scientists and policy makers—or at least between key people in the policy-making process. Greater awareness of national priorities and capacity needs is being generated, and south-south collaborations have been created in addition to national networks that did not exist before. Although the financial investment has been low so far, the buy-in from academic partners is high.
- Lesson 2: Clear and concise communication is important. Communication is often a catchall term that requires capacity and leadership to translate knowledge and work with different stakeholders.

TABLE 9.1—EVIDENT ACHIEVEMENTS TO DATE (SEPTEMBER 2016)

Activities	Outputs
Training in health technology assessment and evidence-informed decision making	EVIDENT has developed specialized training courses on systematic review techniques and contextualization of synthesized evidence. Training follows a stepwise strategy from the formulation of the review question to the communication plan of the policy brief to provide answers to stakeholders' questions. More than 60 Stakeholders and researchers have been trained over the past two years in four settings (Belgium: 10; Benin: 17; Ethiopia: 20; South Africa: 15). In 2015, two training workshops were organized. **Module 1** on systematic reviews was implemented and organized by South African partners. **Module 2** on contextualization and cost-effectiveness analysis was organized by the Ethiopian partner. Participants had a one-to-one male-to-female ratio. In addition, the Beninese team took the initiative (without financial support) to implement the course locally. EVIDENT linked up with the Leverulme Centre for Integrative Research on Agriculture and Health conference and Agriculture, Nutrition, and Health (ANH) Academy week (www.lcirah.ac.uk/news-events/events/anh-academy-week) and provided a training session at the ANH Academy in Addis Ababa, Ethiopia, on June 20–24, 2015.
Methodological tools and processes produced	The primary purpose was to develop hands-on guidelines and practical technical guidance on evidence-informed decision making, to be used within the ongoing pilot studies in Benin, Ethiopia, Ghana, and South Africa.
Evidence products generated and contextualized	Training in South Africa generated nine review questions; five protocols were subsequently registered on the PROSPERO database. An additional two systematic reviews were published following methods training from participants on the courses.
Case studies	Four case studies with a public health nutrition focus are in the process of being conducted in Benin, Ethiopia, Ghana, and South Africa. The case studies are also a way to assess the validity of the conceptual framework and thus serve as a starting point for developing an integrated approach to public health nutrition policy development in each country. Activities: Stakeholder mapping, stakeholder interviews, learning how the process works to see how one could best incorporate EIDM capability into the current process, regardless of what it is

Source: *The EVIDENT Partnership* (http://www.evident-network.org/).

- Lesson 3: Leadership transition to African partners is important. Coordination was initially led by the Belgian partner, but in its future development, EVIDENT will be led from within Africa (Ghana and South Africa). In addition, the importance of long-term continuity across staffing changes in key positions—both in academia and other for decision makers—is key; otherwise, there could be a lack of institutional memory and commitment.
- Lesson 4: There can likely be different EIDM processes in different countries and for different situations within countries. Preliminary findings from the EVIDENT country case studies found that although the underlying principles for EIDM may be shared, its application must respond to contextual differences and nuances. What works in one setting to enhance EIDM may not necessarily work well in another.
- Lesson 5: In all the case study countries, there is interest in fostering cross-talk between research and decision-making sectors. Both groups recognize the benefit of evidence in a situation where there are often inadequate resources; hence, making the most appropriate decisions is imperative. For this reason, there is a need to build both individual and institutional capacity to establish mutually beneficial links between research and decision making.

- Lesson 6: In the implementation of the case studies in Africa so far, the experience has varied across countries. In one case country, in particular, there were challenges in setting up meetings with stakeholders due to long-standing mistrust between decision makers and scientists. In another, it was difficult to get engagement from stakeholders; they were so busy, it was difficult to even engage them in discussions on EIDM. What was common in all country case studies, however, was that engaging with stakeholders takes time and cannot be rushed.
- Lesson 7: A paradigm shift was experienced on how the nutrition researchers felt toward knowledge generation and the knowledge translation skills and networks that this required. This finding reinforced the need for training.
- Lesson 8: Impact pathways are needed to clarify needs and enhance impact in the EIDM cycle.
- Lesson 9: Good-quality data and monitoring are needed for EIDM. The absence of policy or program stakeholders in the EVIDENT partnership has also been a lesson learned—not just collaborating with them but also involving them as an active partner to bridge the gap between producers and users of evidence. There are plans to include these stakeholders in the future at all stages.
- Lesson 10: Collaboration between EVIDENT and SUN and other UN projects will strengthen the impact that EVIDENT can have.

The Future of EVIDENT

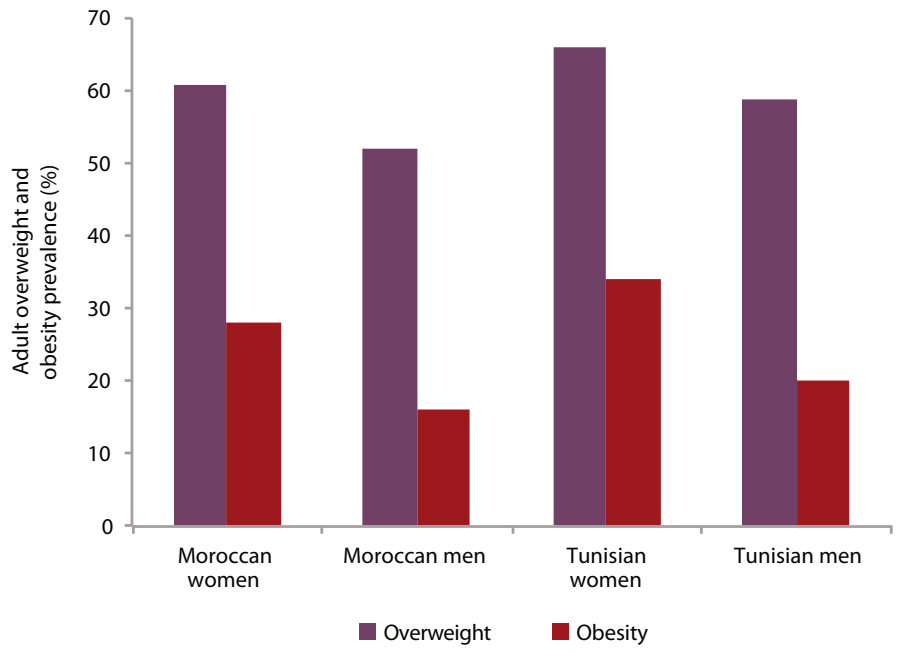
Looking forward to EVIDENT 2.0, the partnership will link up with other organizations, such as the SUN movement and the A4NH research program of the International Food Policy Research Institute, to extend the reach of the initiatives in Africa. Future work will investigate the EVIDENT conceptual framework as a theoretical process, assessing how decision-making processes were experienced in each country case study. EVIDENT will also identify what types of evidence are missing and therefore needed, such as nutrition epidemiological data, stakeholder opinions, and so on. The conceptual framework will therefore evolve in practice and will reflect on how evidence and the political context can be integrated.

Contextualizing EIDM in the Development of Preventive Obesity Policy: Key Lessons Learned from Morocco and Tunisia

The findings of a case study in North Africa (Morocco and Tunisia) is presented as an example of contextualization and use of evidence, or steps 3 and 4 of the EVIDENT framework (Holdsworth et al. 2012). The prevalence of overweight and obesity is a rapidly growing public health challenge in North Africa, where it has reached similar levels to those found in high-income countries. As Figure 9.2 shows, the 2016 Global Nutrition Report has presented high overweight and obesity prevalence for both countries (IFPRI 2016). Even so, there was uncertainty about what the political landscape was in each country to implement policy, despite international consensus that multisectoral public health policy is needed to prevent obesity (see, for example, WHO 2008 and Morris 2010).

However useful, the range of international interventions proposed (see, for example, WHO 2004, 2010) must also account for social acceptability and the cultural context in which those interventions would be implemented. The aim of this case study, therefore, was to explore the

FIGURE 9.2—ADULT OVERWEIGHT AND OBESITY PREVALENCE FOR MOROCCO AND TUNISIA



Source: IFPRI (2016).

views of a range of national-level stakeholders toward policies for preventing obesity as a means to map the political landscape, thereby guiding policy makers in the decision-making process (Figure 9.1, step 4).

The required coordination for effective obesity-prevention programs is complex given the multisectoral nature of the problem. Therefore, it is important that governments have colloquial evidence on which combination of policies may initially meet with least resistance, in addition to information on the cost-effectiveness of different policies. It is crucial to understand not only the need to understand the policy-making process (Catford 2006) but also what is actually proposed in the content of the policy.

Using a multicriteria mapping (MCM) technique (Stirling 2006), data were gathered from 82 stakeholders in Morocco and Tunisia coming from more than 30 different sectors. Stakeholders appraised 12 obesity policy options. MCM is a tool to assess stakeholders' views, which is useful in developing public health policies, recognizing that uncertainty, complexity, and varying conditions influence the implementation (Figure 9.1, step 4) of public health policy (Stirling 2010). Step 4 of Figure 9.1 helps shed light on how the wider context influences stakeholder views, thereby mapping views on individual policy as well as the wider political landscape in which policy would be implemented. The feasibility of policies in practical or political terms and their cost were perceived as being more important than how effective they would be in reducing obesity. Although stakeholders were interested in a range of policies, the political, social, economic, and cultural contexts of countries were important when prioritizing obesity policy. Stakeholders did not acknowledge that obesity was a public health priority, despite the compelling epidemiological evidence; therefore, convincing policy makers about the health consequences of obesity may be a crucial first challenge. One lesson learned is that more evidence on the extent and cost of managing the consequences of obesity in their countries may have strengthened the consultation process, suggesting that step 2 of the decision-making process (Figure 9.1) needed strengthening, thus providing an opportunity for researchers to undertake research to fill these gaps.

Unlike similar decision analysis approaches, MCM allows "opening up" of decision-making processes (Stirling 2006); by producing evidence concerning the context (Figure 9.1, step 3), it gives policy makers clearer guidance on the circumstances needed for a broad consensus to be reached. The MCM method also allows insight into how different policies may interact with or depend on each other, as well as how social and physical environments may shape effectiveness of policies. The latter requires greater evidence generation in Africa to inform the development of context-appropriate policies and interventions, as was suggested by the research prioritization arising from the SUNRAY project (Holdsworth et al. 2014).

A further lesson learned from this case study was that creating political will is fundamental to improving nutrition policy (Catford 2006; Pelletier et al. 2012); thus, researchers need to be proactive in translating their research findings (Figure 9.1, step 4) and creating personal contact with policy makers, which is a major facilitator of translating research into policy (Brownson et al. 2006). This case study also highlighted how priorities for developing nutrition-related policy will depend on the country's context (socioeconomic, cultural, political, and development), as one size does not fit all. Hence, the case study shed light on the need to integrate objective evidence of what works with contextualized colloquial evidence on the social and political landscape. This type of decision-making methodology has the advantage of providing qualitative and quantitative rankings of different policies that account for the complexity of the context in which policy may be developed and implemented. However, it has the limitation of not integrating objective evidence of what works and at what cost. Searching for the right kind of "objective" evidence to feed into decision-analytic models to fill this gap is an opportunity and a challenge. Better EIDM is required to integrate different bodies of evidence and ways in which more integrated methodologies and processes can be developed by drawing on all types of evidence.

Stepping Up the Game for EIDM in Africa: The Way Forward

There are two clear messages to take away from this chapter. First, there is need for EIDM in Africa that currently remains unmet; and second, even relatively small-scale actions like EVIDENT can generate significant demand for actions among decision makers and scientists. The next steps will be to encourage initiatives that aim to strengthen EIDM, linking with larger-scale projects as outlined. The chapter emphasizes that for research to become relevant, it should respond to an identified need so that the evidence can be translated into action. Who is being served by mapping evidence on a specific topic, by whom (messenger), how (medium), what (message), and who are you mapping it for all needs to be carefully evaluated. The process for institutionalizing EIDM in nutrition and health is especially relevant for a continent that hosts a significant proportion of high-burden countries and that makes up the bulk of the SUN countries. Recent research has illustrated how nutrition policy has transitioned "from obscurity to a global priority" since 2000 (Gillespie et al. 2013), which has increased the demand for evidence to inform policy development and the related program design and implementation.

EIDM is a possible powerful way to gauge the level of uncertainty of any given link between nutrition action and public health benefits. When developing sustainable priorities, emphasizing the importance of tailoring

evidence synthesis to expressed needs is indispensable. Ultimately, nutrition policies and programs will compete over resources—primarily, public budget and qualified staff—with other areas in the health and other sectors. This presents a challenge for nutrition researchers and advocates for raising awareness of the importance of good nutrition, the economic costs of inaction, and how to attract more resources to effectively reduce all forms of malnutrition.

Concerted effort—along with sufficient technical capacity, training, and contextualized evidence—has the potential to create dynamic country processes for EIDM that will enhance the relevance of the evidence generated and the likelihood of informing policies and programs. In this way, research in Africa could and would contribute more effectively to addressing the nutritional challenges on the continent.

CHAPTER 10

Evaluating Nutrition-Sensitive Programs: Challenges, Methods, and Opportunities

Jef L. Leroy, Deanna K. Olney, and Marie Ruel[26]

[26] This chapter draws from Olney, Leroy, and Ruel (forthcoming).

The *Lancet* series on Maternal and Child Nutrition called for greater investments in large-scale nutrition-sensitive programs to accelerate progress in improving the nutrition of vulnerable mothers and young children during the first 1,000 days—that is, from conception to the child's second birthday (Ruel and Alderman 2013). One of the key recommendations from the 2013 *Lancet* series was to use nutrition-sensitive programs from sectors such as agriculture, social protection, education, and early child development as platforms for improving the delivery, coverage, and scale of nutrition-specific interventions (Box 10.1). For example, agriculture development programs that target women and promote the production and consumption of nutrient-rich foods could also be used to deliver specially formulated micronutrient supplements for pregnant and lactating women or young children who have requirements that are difficult to meet with diet alone due to rapid growth and development. These types of integrated agriculture and nutrition programs have been shown to improve the diets of household members, mothers, and children (Girard et al. 2012; Ruel and Alderman 2013). A recent evaluation of a gender- and nutrition-sensitive homestead food production program that was used as a delivery platform for nutrition-specific interventions (such as behavior change communication (BCC) on health and nutrition practices) in Burkina Faso showed positive impacts on the nutritional status of both women and children (Olney et al. 2016).

Rigorous evidence on the effectiveness of nutrition-sensitive programs on nutrition outcomes, however, is scant. Recent reviews of the literature have attributed this lack of evidence to weaknesses in program design and implementation, and even more importantly to poor evaluation designs and methods (Webb-Girard et al. 2012; Leroy and Frongillo 2007; Leroy, Ruel, and Verhofstadt 2009). A consistent and strong recommendation provided in these reviews is the need for rigorous, theory-based impact evaluations that will generate credible evidence on the following:

- What works and what does not work to improve nutrition
- The pathways of impact
- What other development measures are improved with different nutrition-sensitive program models
- The cost and cost-effectiveness of achieving these improvements

This chapter reviews some of the key challenges in evaluating complex nutrition-sensitive programs. It describes a rigorous evaluation approach that has been used successfully to evaluate the impact, impact pathways, and cost of these programs in Africa and elsewhere. It also provides recommendations on how to address some of the key challenges of carrying out sound evaluations implemented under real-life conditions.

BOX 10.1—NUTRITION SPECIFIC AND NUTRITION SENSITIVE: WHAT'S THE DIFFERENCE?

Nutrition-*specific* programs address the immediate determinants of undernutrition, such as inadequate food and nutrient intake, suboptimal care and feeding practices, and poor health.

Nutrition-*sensitive* programs address the underlying causes of undernutrition, including poverty; food insecurity; poor maternal health; education; social status or empowerment; and limited access to water, sanitation, hygiene, and health services. They also incorporate specific nutrition goals and actions.

Source: Ruel and Alderman (2013).

Key Challenges in Evaluating Nutrition-Sensitive Programs

Although the need for rigorous, comprehensive program evaluations is recognized, carrying out high-quality evaluations of complex nutrition-sensitive programs with multiple inputs, goals, pathways of impacts, outcomes, and impacts is challenging. This section describes six of the key challenges of rigorously evaluating complex nutrition-sensitive programs.

Complexity of nutrition-sensitive programs: Nutrition-sensitive programs are, by definition, complex in design and implementation because they incorporate actions to address both the underlying causes of undernutrition (often several of them, such as poverty, food insecurity, and low women's status) and its direct causes (poor diet, health, and care). In addition, these types of programs often span different sectors (such as health, agriculture, and education), requiring coordination and integration. Within each program intervention, there is potential for variability in the delivery of the intervention by program implementers (both in terms of quantity and quality), use by program beneficiaries, and adherence to the specific protocol for each program intervention (for example, frequency of participation in program-related activities or dose of nutrition supplement consumed). This makes evaluation of the overall program impacts complex and attribution of impact to the different program components particularly difficult, unless multiple study arms (which increase cost) are used to disentangle their relative contribution.

Long impact pathways and time frames: A common constraint in the evaluation of nutrition-sensitive programs is the short time frame imposed by many donors (two to three years). Nutrition-sensitive programs integrate interventions from different sectors and thus take longer to get fully functional and well implemented. Program implementers are often pressured to start rolling out their program as soon as funding is received in order to reach their program targets. However, key components of nutrition-sensitive programs, such as the BCC strategy, require extensive adaptation of materials and staff training, which may take several months of planning and development. The complete development and smooth implementation of program components, as well as the adoption and optimal use of program inputs and services, can easily take more than one year, even with experienced program implementers and motivated program beneficiaries.

A second time-related challenge relates to the typically long pathways from program inputs to the biological effects on nutritional status in nutrition-sensitive programs. For example, a homestead food production program that includes home gardens and a BCC strategy requires a number of steps before an impact on nutritional status can be expected. These steps include installing garden beds, preparing the soil, and sowing, planting, and harvesting; setting up and implementing the BCC strategy, improving maternal knowledge through repeated BCC sessions, and achieving changes in practices from the BCC strategy. All of these steps are needed to improve children's diets and nutrition intakes, reduce infections and morbidity, and ultimately improve nutritional status (Webb-Girard et al. 2012; Olney, Rawat, and Ruel 2012; Ruel and Alderman 2013). A meaningful effect on biological outcomes, such as child anthropometry, may require as long as 1,000 days of program exposure.

Meanwhile, it also takes time to design a rigorous impact evaluation once the research questions are agreed upon. Preparations include building the program theory framework, developing the evaluation and sampling

design, designing and pre-testing the data collection instruments, training and standardizing enumerators, and planning the logistics of the fieldwork. Other aspects to be taken into account are time to prepare and conduct a rigorous baseline survey (which needs to happen before program implementation), the time necessary to enroll the necessary number of study participants, and seasonality. Both early and delayed program implementation affect the timing of the research components and can lead to significant disruptions or require changes in evaluation design and plans. The time frame for the comprehensive evaluation of a nutrition-sensitive program should be at least four to five years, which is typically shorter than the time frame imposed by funders.

Differing priorities, expectations, incentives, and perceptions among program implementers and evaluators: Program implementers and evaluators often have different mandates and reporting requirements, which are reflected in their differing priorities, expectations, and incentives. Implementers, on the one hand, are charged with delivering a high-quality program that meets the targets set out in the original proposed plan within the specified budget and time frame. Program evaluators, on the other hand, are responsible for rigorously evaluating the program and producing evidence of program impact (or lack thereof); they are also tasked with answering key questions related to why that impact was achieved (or not) and at what cost. An additional challenge is that evaluators are often wrongly perceived as evaluating the performance of the program implementers themselves, rather than generating evidence on the effectiveness of the program or approach. Likewise, collecting cost data frequently leads to the perception that evaluators are auditing the program's finances. These wrong perceptions easily undermine the trust necessary to conduct a rigorous program evaluation.

Independence of evaluators: Determining the right degree of independence between the program implementers and the evaluators is challenging. To ensure the objectivity and credibility of the evaluation, it is recommended to have an evaluation team that is independent of the institution implementing the program under evaluation. As shown in this chapter, complete separation is not possible nor desirable (Gertler et al. 2010).

Trade-offs between implementation constraints and evaluation rigor: Programmatic, logistical, and political factors that affect how programs are targeted, where they are implemented, and how they are rolled out add to the complexity of rigorously evaluating nutrition-sensitive programs. These factors often compromise the ability to establish a suitable, randomly assigned control group, which is desirable for establishing a proper counterfactual in assessing program impacts. Ideally, assignment to these arms is random at the lowest possible level of aggregation (that is, households rather than villages) to increase statistical power. For the program implementer, this ideal design makes implementation challenging (if not impossible) and may substantially increase costs. Another trade-off relates to the number of treatment groups that are needed to answer specific research questions. The more treatment groups, the more complex the logistics of implementing the program, because each treatment group comes with a different package, targeting, or modality of delivery, which requires a different implementation plan.

Assessing benefits beyond targeted beneficiaries: Lastly, nutrition-sensitive programs are generally aimed at improving multiple outcomes and have the potential to benefit people beyond the directly targeted

beneficiaries (such as pregnant and lactating women and young children). These beneficiaries could include other household members, future cohorts of children, and even other households or the community as a whole, depending on the types of interventions (Webb-Girard et al. 2012; Leroy, Ruel, and Verhofstadt 2009; Ruel and Alderman 2013). This potential "spillover" of benefits beyond the targeted beneficiaries is clearly a positive aspect of such programs and of their potential sustainability, but it adds even more complexity to evaluating and capturing all impacts of nutrition-sensitive programs. Related to this is the complexity of measuring the cost-effectiveness of programs that have multiple goals and benefits on multiple outcomes. A potential negative consequence of the spillover of benefits is that some of the nontargeted beneficiaries (or communities) may actually be part of the control group used to assess the program's impact. Although beneficial to households and communities in the control group, it may result in an underestimation of true impact because both targeted and nontargeted beneficiaries in the control group received the benefits.

Clearly, the evaluation of complex nutrition-sensitive programs brings about a series of challenges that need to be addressed before the work starts to ensure successful implementation and evaluation processes. The next section of this chapter describes how a comprehensive, well-designed, carefully implemented evaluation framework can be used to prevent or address some of the key challenges inherent to the rigorous evaluation of these programs. The final section discusses the key role of strong partnerships and solid communication and provides specific solutions to each evaluation challenge highlighted above.

A Comprehensive Evaluation Framework to Assess Program Impacts, Impact Pathways, and the Cost of Nutrition-Sensitive Programs

This section describes how to design and implement a comprehensive evaluation framework that allows researchers to assess what impact a nutrition-sensitive program has (impact evaluation), how and why the program has (or does not have) an impact (impact evaluation and process evaluation), and at what cost (cost study). As noted earlier, a clear evaluation framework is an essential element of successful evaluations and is critically important to prevent or address many of the challenges associated with evaluating complex nutrition-sensitive programs.

What Is the Program's Impact?

A rigorous impact evaluation allows attribution of changes in outcome and impact measures to the program and requires a probability design (Habicht, Pelto, and Lapp 1999). Several factors need to be taken into consideration when designing rigorous impact evaluations of nutrition-sensitive programs. These include aspects related to the selection of a valid comparison group (counterfactual), the trade-offs between experimental and nonexperimental designs, issues of timing and duration of the evaluation, sample sizes, and choice of impact measures.

The challenge of finding a valid counterfactual: As an example, this section considers a program aimed at improving women's nutritional status. The objective is to estimate the impact of the program on women's nutritional status (N)—that is, we want to know to what extent the program

caused a change in women's nutritional status. The impact of the program can be calculated as

Impact = (N | with program) – (N | without program).

In other words, the impact of the program is the difference between the nutritional status of a woman receiving the program and the nutritional status of the same woman at the same point in time had she not received the program. Comparing the same woman at the same point rules out the possibility that the difference is due to non-program-related differences between women or to changes over time. The problem with this approach is obvious: (N | with program) and (N | without program) are never both "observable"—that is, no woman can be in the program and not in the program at the same time. For a woman in the program, for example, her status if she were not in the program is unknown; conversely, for a woman who is not in the program, we do not know what her nutritional status would have been had she been receiving the program. The key challenge to impact evaluation is to determine what would have happened in the absence of the program, which is referred to as the "counterfactual." The counterfactual is constructed by finding a comparison group that is similar to the group receiving the program on all relevant characteristics, except for receiving the program (Gertler et al. 2010; Khandker, Koolwal, and Samad 2010; White 2013). The following subsection describes how different evaluation designs are used to generate valid counterfactuals.

Selecting an evaluation design: Experimental (or randomized) designs, in which the eligible population is randomly assigned to either a treatment or a control group, are considered the gold standard for impact evaluations. Randomization can be done at the individual or group (cluster) level. If the randomization is done well (and if the group to be randomized is sufficiently large), one can (reasonably) assume that both groups are comparable and that the only difference between the groups is the program. The control group thus provides a valid counterfactual for the intervention group exposed to the program. As a consequence, differences found in the outcome and impact measures of interest between groups can be attributed to the program.

Experimental designs, even though they are attractive from a design point of view, are often difficult to implement for practical, logistical, or political reasons. For example, it may be politically unacceptable to withhold a cash transfer program known to have had impacts on poverty in some contexts from households or communities that are as equally poor as those receiving the program. Some may even challenge the rationale for conducting an impact evaluation if the program has been previously shown to be efficacious or effective. There are many reasons that new impact evaluations may be justified. As an example, they may be used to assess impacts on other measures (such as nutrition, women's empowerment, domestic violence, and poverty) or in other contexts (such as testing a successful model implemented in a middle-income country from Latin America in a low-income country in Africa) or to test different modalities or packages of interventions. An important consideration when discussing the creation of a control group is that, given the usually limited resources that programs have available, only a certain percentage of the poor can be covered by the program. As such, the fairest way to select those included and those excluded is done by random allocation, giving all potential beneficiaries (either individuals or groups) the same probability of getting the program (as opposed to other less-fair approaches). Alternatively, a stepped-wedge design can be used in which program enrollment (group or individual) is

staggered over time, allowing those scheduled to start receiving benefits later to serve as a control until the time they become beneficiaries themselves.

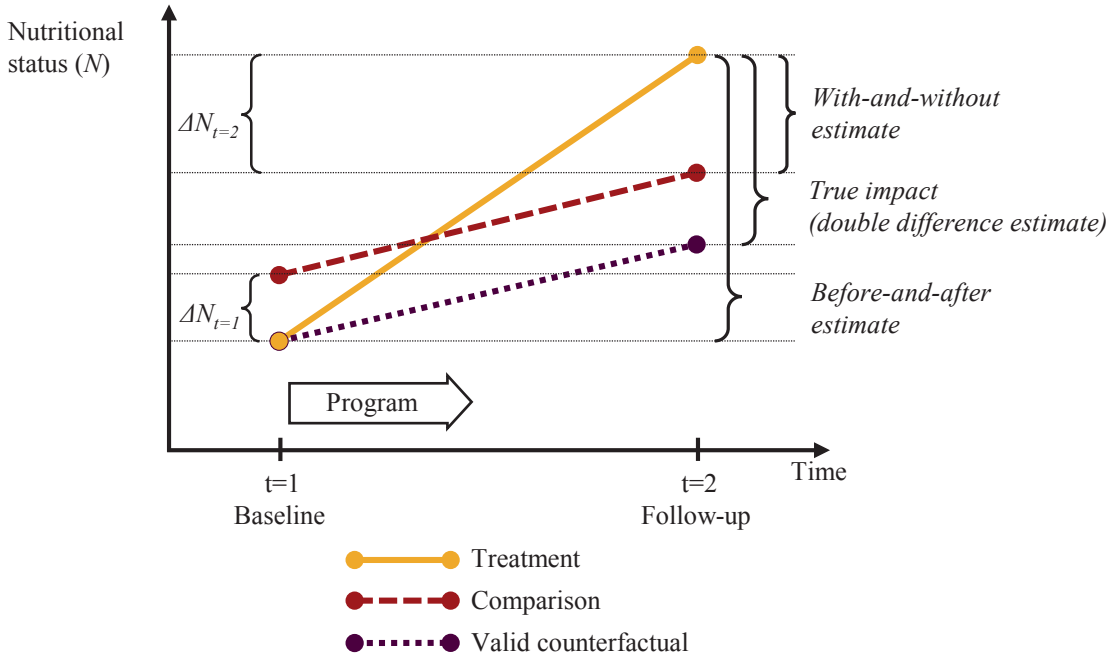
Nonetheless, experimental approaches are often not feasible in programmatic contexts; quasi-experimental designs are the next best alternative. Short of randomization, quasi-experimental designs use statistical techniques to create a valid comparison group or to address the differences between the treatment and the comparison group. Commonly used methods include propensity score matching, double difference (or difference-in-difference) approach, regression discontinuity, and instrumental variable regressions. Details on these methods can be found elsewhere (Gertler et al. 2010; Khandker, Koolwal, and Samad 2010; Baker 2000).

It is important to note two widely used evaluation designs that are likely to produce biased impact estimates due to inadequate counterfactuals: (1) designs that compare with-and-without intervention at follow-up only (no baseline), and (2) designs that compare program beneficiaries before and after the intervention (intervention group only, with no "control" or comparison group). In the first method, individuals who received the program are compared to (nonrandomly chosen) individuals who did not receive the program. Any difference between these two groups can thus be due either to the program or to pre-existing differences between the two groups. This is a particularly severe problem when individuals or households self-select into a program—that is, they are eligible to receive program benefits but can choose to participate or not. In this case, it is likely that those who choose to participate are different from those who choose not to in key aspects such as poverty, employment, education, and other factors that are difficult to measure (such as autonomy and commitment to improve the well-being of their children); these factors affect both the uptake and the impacts of the program. In the hypothetical example in Figure 10.1, the comparison group selected at follow-up actually had a higher nutritional status (N) at baseline than the treatment group. However, because baseline information is not available, the with-and-without estimate of the program's impact at follow-up underestimates the program's "true" impact.

With the before-and-after intervention group only method, which compares the outcomes in program beneficiaries before and after program participation, the problem is that no information is available on the potential influence of other factors, such as shocks (positive or negative) or other programs implemented in the study areas. These other factors may also affect the key outcomes and impacts of interest in the evaluation. Figure 10.1 shows a situation in which this approach overestimates the program's impact, simply because it does not consider the improvement in nutritional status that occurred in the area due to factors unrelated to the program (see improvements between baseline and follow-up in the hypothetical "valid counterfactural" group). In this case, because information on a valid (counterfactual) comparison group is unavailable, the impact attributed to the program (the before-and-after estimate) is larger than its real impact (true impact).

The importance of time, duration, and timing: The proper timing of the impact evaluation and the ideal length of time between baseline and follow-up depend on five time-related factors (the first four of which are lag times). The first lag time is the time it takes for the program to be fully rolled out and for program components to reach full coverage at the level of quality of implementation expected. The length of this lag time affects the time it will take after the baseline survey for the program to achieve detectable impacts; it thus determines the timing of the follow-up survey (Figure 10.1). The second lag time relates to the (biological) response time,

FIGURE 10.1—ESTIMATING PROGRAM IMPACT USING THE DOUBLE DIFFERENCE FOLLOW-UP WITH-AND-WITHOUT INTERVENTION AND THE BEFORE-AND-AFTER INTERVENTION GROUP ONLY APPROACHES



Source: Olney, Leroy, and Ruel (forthcoming).

which depends on the measure of interest. For example, it takes only a few days for vitamin A supplements to improve vitamin A status in deficient populations, but improving children's linear growth takes much longer. To improve children's height, it is important to consider not only the duration of the intervention but also its timing. It is now well recognized that the best time to improve children's height is during the critical first 1,000 days (from conception to the child's second birthday), which is considered the period of greatest potential for response to nutritional interventions targeted to mothers and children (Black et al. 2013). To achieve full impact, children should therefore be exposed to the program for almost three years (in utero during pregnancy and for at least their first 24 months of life). Because the effect on linear growth is cumulative, the impact should be evaluated after 24 months when the largest effect is expected to be observed. The impact on the behaviors leading to this impact (such as nutrition and health practices), however, should be assessed when they are most important—that is, before 24 months of age. The third lag time is the time it takes in cohort studies to enroll a sufficiently large number of study subjects in the required age group. Say, for example, that a program aims to enroll mothers during pregnancy and follow them until their child reaches two years of age. It will require several months to enroll the target sample of pregnant women, adding to the total time needed for full follow-up of each child until 24 months of age (Habicht, Pelto, and Lapp 2009). The fourth lag time relates to the often long pathways from program inputs to the biological effects on nutrition measures (for example, from installing garden beds to harvesting and feeding the crops to the child or from mothers receiving BCC to actually adopting recommended feeding practices and for these improvements to translate into improvements in nutritional status measures). The fifth time-related factor—seasonality—needs to be taken

into account when measuring outcomes known to vary by season, such as food availability, dietary intake, and child morbidity and wasting (Gibson 2005). The potential to benefit from interventions may also vary by season. For instance, the impact of an intervention aimed at alleviating acute malnutrition should be assessed during the lean season when its prevalence is highest. Seasonality is particularly challenging when evaluating the nutrition impact of agricultural interventions, as both the intervention and the impact measures may be sensitive to seasonal variation. To reduce the effect of seasonality, it is generally recommended to conduct the baseline and follow-up surveys at the same time (month) of each year.

Ensuring appropriate sample size: Sample size calculations are conducted to determine the minimal number of observations needed to detect a meaningful effect of the intervention on the impact measures of interest. Calculating the necessary sample size requires information on the hypothesized impact of the intervention, the natural variability in the impact measure of interest, the study design (including whether randomization is done at the individual or cluster level), and the level of type I and type II errors the evaluators are comfortable with. The first type of error reflects the possibility of concluding that there is an impact while the program had no effect. One minus the type II error equals the study's statistical power—that is, the probability of finding the impact if it were truly there (Gertler et al. 2010). Once the required sample size has been calculated, additional provisions need to be made for missing data, loss to follow-up, and other problems that might reduce the number of observations that can be analyzed.

Choosing indicators: Selecting appropriate indicators for the evaluation of complex nutrition-sensitive programs with multiple inputs, impact pathways, outcomes, and impacts is challenging and should be informed by the program theory framework. Because these programs integrate interventions from different sectors that often aim to address several underlying determinants of undernutrition (such as poverty, food insecurity, and women's empowerment), choosing the right indicators requires consulting with experts from a variety of fields. Indicators need to be selected carefully to ensure that they accurately reflect the phenomenon being measured.

BOX 10.2—EXAMPLES OF STANDARDIZED APPROACHES AVAILABLE FOR THE MEASUREMENT OF SELECT OUTCOMES IN NUTRITION-SENSITIVE PROGRAMS

Standardized approaches are available for the measurement of a wide variety of outcomes. Examples include the following:

- Household food security[27]: www.fantaproject.org/research/measuring-household-food-insecurity (Coates, Swindale, and Bilinsky 2007)
- Minimum Dietary Diversity for Women: www.fantaproject.org/monitoring-and-evaluation/minimum-dietary-diversity-women-indicator-mddw (FAO and IRD 2014; FAO and FHI360 2016)
- Women's Empowerment in Agriculture Index: www.ifpri.org/topic/weai-resource-center (Alkire et al. 2013)
- Infant and young child feeding practices: www.who.int/nutrition/publications/infantfeeding/9789241596664/en/ (WHO 2010)

The valid measurement of other outcomes, such as agricultural practices and health and nutrition knowledge, requires the careful development of data collection tools and analytic approaches that accurately capture the main outcomes and impacts of interest of a given evaluation.

[27] A new tool to measure food security developed by the FAO is the Food Insecurity Experience Scale (FIES): www.fao.org/fileadmin/templates/ess/voh/FIES_Technical_Paper_v1.1.pdf. Note that this approach has not been formally validated (Ballard et al. 2014).

Other challenges relate to different levels at which measures need to be taken (community, household, individual) and to the fact that the validity of many indicators depends on the degree or the level at which it will be assessed. For instance, the different stages in the development of iron deficiency require the use of different indicators (Gibson 2005). Standardized approaches are available for the measurement of a wide variety of outcomes (see Box 10.2 for examples).

How and Why Did the Program Have (Not Have) an Impact?

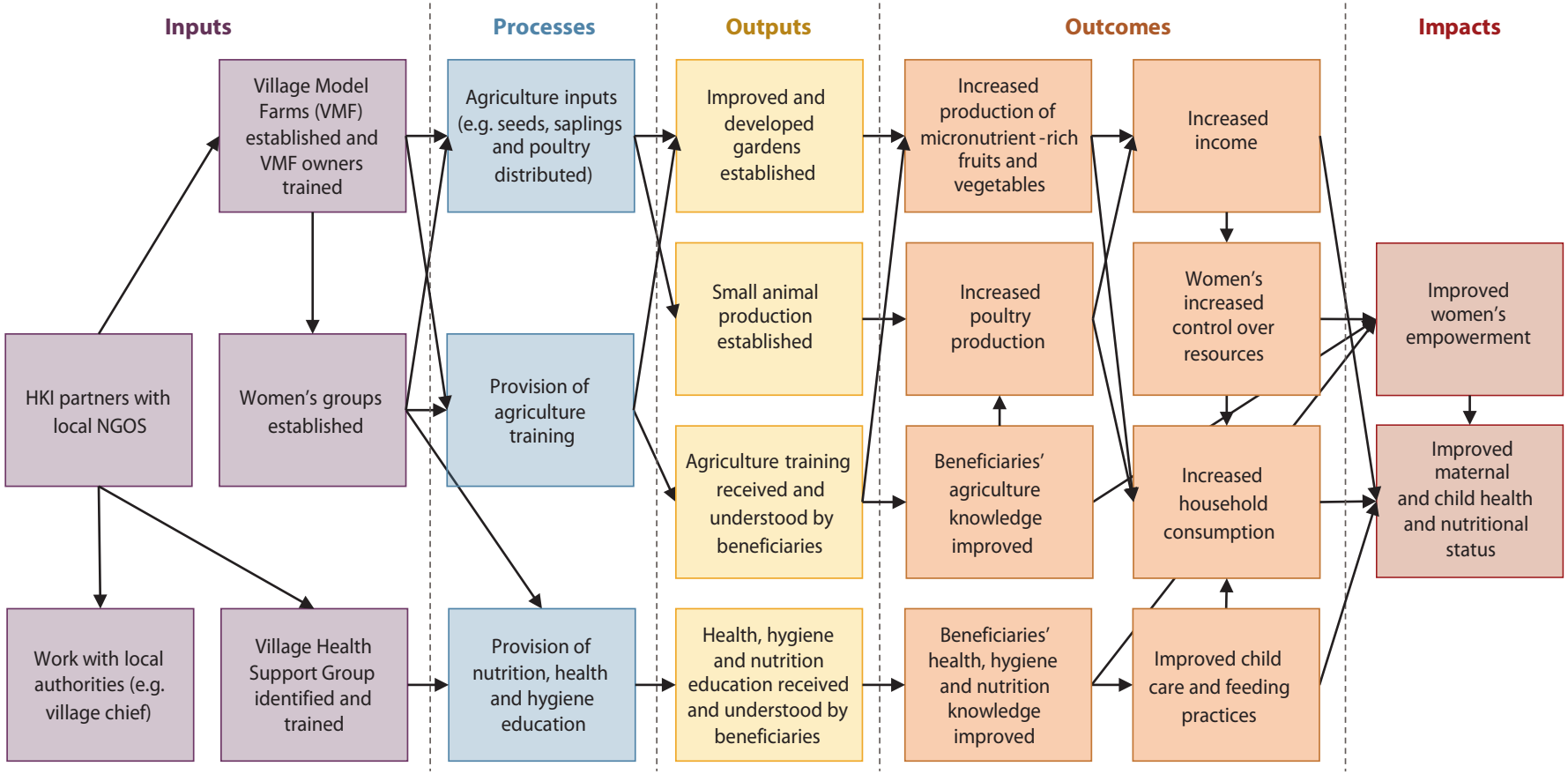
This section describes how to design and use a program theory framework for the analysis of pathways of impact of nutrition-sensitive programs. It also lays out the different steps involved in designing and implementing a process evaluation to collect data on how (and how well) different stakeholders implement, use, and perceive the program.

Designing a program theory framework: A program theory framework is used to identify the key components included in a program, the factors that may affect optimal delivery or use of each component, the assumptions associated with each of component, and how the components are expected to be linked in order to achieve impact (Rossi, Lipsey, and Freeman 2004). Ideally, program theory frameworks are designed by a group of key stakeholders including program implementers, evaluators, and other relevant stakeholders. Figure 10.2 provides an example of a program theory framework developed by evaluators from the International Food Policy Research Institute (IFPRI) and Helen Keller International (HKI) for the evaluation of HKI's homestead food production (HFP) program in Cambodia (see also Olney et al. 2013). Similar models have been developed for evaluations of HFP programs in Burkina Faso (Olney et al. 2015, 2016).

Understanding the pathways to impact: Understanding the pathways to impact is critical not only for improving program delivery and effectiveness (that is, for keeping and strengthening components that work and modify or discarding components that do not) but also for identifying what is needed to scale up and to adapt the program for implementation in other settings. Information on how impact is achieved is typically collected in two different ways. First, data on intermediary measures (outcomes along the impact pathway) are collected in the baseline and follow-up surveys. For example, the evaluation of HKI's HFP program in Burkina Faso assessed a set of intermediary outcomes that included changes in agriculture production; women's health- and nutrition-related knowledge; and household, women's, and children's dietary diversity. All of these outcomes lie along the hypothesized program impact pathways for HKI's HFP program (van den Bold et al. 2015; Olney et al. 2015, 2016). If no changes are observed in these intermediary outcomes, it is unlikely that improvements will be found in the final impact measures. Conversely, if positive changes that are attributable to the program are seen in both these intermediary outcomes and the final impact measures, then there is a higher plausibility that the final impacts are due to the program.

Second, a process evaluation study conducted while the program is being implemented helps identify what is working and what might be working less well in terms of fidelity of implementation and delivery and use of program services at different points along the program impact pathway. Process evaluations help identify bottlenecks in or facilitators of optimal program delivery and use. This information can be used to improve both ongoing programs and future programs. Note that process evaluation findings that are used to strengthen ongoing programs will not compromise the program evaluation as long as the changes are made uniformly

FIGURE 10.2—HYPOTHESIZED PATHWAYS THROUGH WHICH HOMESTEAD FOOD PRODUCTION PROGRAMS MAY IMPROVE MATERNAL AND CHILD HEALTH AND NUTRITION



Source: Adapted from Olney et al. 2013.
Note: HKI = Helen Keller International; NGO = nongovernmental organization

across all program areas. Process evaluation findings are also critically important to help understand why a program has (or has not) achieved its desired impacts.

Designing the process evaluation: The design of a rigorous process evaluation requires a solid understanding of the overall program theory framework and the associated program impact pathways. Ideally, a

BOX 10.3—DEFINITIONS OF PROGRAM INPUTS, PROCESSES, OUTPUTS, OUTCOMES, AND IMPACTS

1. Inputs: Resources and constraints applicable to the program (such as village health support group identified and trained)
2. Processes (or activities): The services the program is expected to provide (such as provision of health, hygiene, and nutrition education)
3. Outputs: Receipt of program services or service use (such as health, hygiene, and nutrition education received by beneficiaries)
4. Outcomes: The state of the target population or the social conditions that a program is expected to change (such as childcare and feeding practices)
5. Impacts: The portion of changes in the final measures along the hypothesized program impact pathways that can be attributed uniquely to a program, with the influence of other sources controlled or removed (such as maternal and child health and nutritional status)

Source: Based on Rossi, Lipsey, and Friedman (2004).

process evaluation is designed to examine the primary inputs, processes, outputs, and outcomes along each primary program impact pathway (see Figure 10.2, Box 10.3) to obtain in-depth information to address five key questions:

1. Are program services being implemented and provided as planned and according to the program design (inputs and processes)?
2. Are program services being used as intended (outputs)?
3. What is the quality of the program's inputs and services (inputs, processes, and outputs)?
4. What are the barriers to and facilitators of optimal service delivery and use (inputs and processes)?
5. Is the program on track to have the desired effect on improving intermediary outputs and outcomes (such as improvements in knowledge in the example from HKI's HFP program)?

Answers to these these questions help assess the program's fidelity to its intended design; the adherence to intervention protocols, as well as barriers to and facilitators of optimal program delivery; the quality of the services being delivered by program implementers; and the level of use of program services by intended participants and their adoption of recommended practices. In addition, process evaluation results can provide information related to whether the program is likely to have its desired impacts by allowing researchers to examine early impacts on intermediary outcomes (Nguyen et al. 2014; Rawat et al. 2013).

The importance of timing and time frames: Ideally, a process evaluation is conducted once the program is fully up and running; this gives the fairest assessment of what is working well and which processes and services could be improved. With most nutrition-sensitive programs, which typically run from two to three years, the first process evaluation round should be carried out about one year after the program has started implementing its different intervention components. Depending on the program's duration, it can be useful to conduct a second round of process evaluation to document whether corrective measures implemented by the program team (if applicable) have improved implementation fidelity or successfully addressed previously identified bottlenecks. This round could also be used

to further study specific issues identified during the first round of the process evaluation (such as potential time constraints related to beneficiary participation in the program; use or sharing of donated commodities or products; and observation of potentially negative impacts of a program on household dynamics, such as domestic violence).

Selecting data collection methods and tools: Once the overall goals and the key questions to be answered by the process evaluation are determined, the next step is to select the program inputs, processes, outputs, and outcomes to be assessed and to identify the types of service delivery points and respondents (program implementers, program beneficiaries, and other household or community members) to include in the study. The choice of methods should take into account the program components to be evaluated, the measures (or indicators) to be used, the respondents to be interviewed, and the points of service delivery to be observed. Commonly used approaches include semi-structured interviews, structured/semi-structured observations, and focus group discussions. As noted earlier, all program inputs, processes, outputs, and outcomes along the hypothesized program impact pathways should be evaluated in a rigorous process evaluation. If there are time or resource constraints, however, implementers and evaluators should jointly prioritize which inputs, processes, outputs, and outcomes the research should focus on.

To assess whether program inputs, processes, outputs, and outcomes are working as expected requires the collection of data that are subsequently compared to the intended design of the program (as an example, beneficiaries should receive five different types of seeds and attend two trainings per month). In addition, measures of quality of service delivery should be included because this is critically important for uptake and impact. Quality can be assessed using direct (structured or semi-structured) observations at program delivery points and through interviews with program implementers and beneficiaries. Lastly, barriers to and facilitators of optimal program delivery or use should be assessed through the use of observations, interviews, and focus group discussions.

Drawing the sample: The goal of process evaluation is different from that of an impact evaluation; therefore, it requires a different sampling approach. In general, the primary respondents are program staff at various levels and program beneficiaries. Program staff are selected using a purposive sampling method whereby the implementer provides a list of staff and the program evaluators select some or all of them. If only a portion of the program staff are selected, this is done using a random sample or by selecting implementers who meet certain criteria (gender, age, skill level, and so on). Beneficiaries are either purposively or randomly selected with or without stratification on a few key variables (poverty, household size, location, and so on) to ensure that the sample includes a range of respondents.

Summarizing the results from the process evaluation: The mix of qualitative and quantitative data collected from a variety of key stakeholders requires a general framework of analysis to determine whether program inputs, processes, outputs, and outcomes are working as expected and which aspects of implementation might need strengthening. This is not meant to be an exact science; rather, it is a general framework that can be used to identify areas that may need attention. One way to do this is to consider the quantitative data related to the primary measure (or set of

measures) for a given program input, process, output, or outcome (as an example, beneficiaries established home gardens or attended training) and determine whether each input, process, output, or outcome is working as expected—and if not, why not and what could be done to improve them. For example, components with a positive response in more than 75 percent of the cases could be classified as "working well"; those with a positive response in 25–75 percent, as "needs improvement"; and those with a positive response in less than 25 percent, as "not working." After this initial classification, the qualitative data on the perceptions and opinions of program implementers and beneficiaries are used for triangulation; the categorization of that component can be changed as necessary. The final classification should consider the frequency with which problems were reported or the severity of the respective problems. For example, if BCC sessions are documented as being implemented according to plan but the majority of the beneficiaries interviewed mention that they do not remember anything from those sessions, then provision of BCC sessions would be changed from "working well" based on the quantitative assessment to either "needs improvement" or "not working."

Sharing and feeding the results back to program implementers: For program implementers to fully use the results from a process evaluation to improve ongoing and future programs and to identify what was working in the program that should be replicated in similar programs or be scaled up if appropriate, the results need to be fed back to them in a timely fashion. This feedback should occur in the context of a workshop in which the results are presented and program implementers, evaluators, and other key stakeholders knowledgeable about the type of program discuss the implications of the results. To make improvements in ongoing and future programs, these discussions should focus on what program inputs, processes, or outputs are feasible to improve and how these improvements could take place. Process evaluation data can also feed into efforts to replicate and scale up similar programs. In this case, discussions should include a reflection on what worked well in the program and how optimal program delivery and use can be maintained as the replication or scale-up process evolves.

What is the Cost of the Program?

The objective of the cost study is to estimate the program's overall cost, the cost of the main program components, and the program's cost-effectiveness. A well-conducted cost study allows for estimation of the savings or cost associated with adding, changing, or dropping program components; adding beneficiaries; or scaling up the program. A preferred method for detailed cost analysis in the context of a theory-driven impact evaluation is the activity-based costing ingredients (ABC-I) approach (Fiedler, Villalobos, and De Mattos 2008). Using the program impact pathways, the first step of the ABC-I approach is to conduct a detailed description of all program activities. The description is used to identify the program's main activities. The next step is to define the unit cost algorithms—that is, the different types, quantities, and costs of the "ingredients" necessary for each activity. Once the unit cost for each ingredient is determined, the total cost for each program activity and for the full program can be determined. This method has been used in several contexts and with a variety of programs (Fiedler, Villalobos, and De Mattos 2008; Margolies and Hoddinott 2015).

Solid Evaluation Frameworks and Strong Partnerships and Coordination: Key Success Factors in Evaluations of Complex Nutrition-Sensitive Programs

The previous two sections of this chapter showed how a comprehensive, well-designed, carefully implemented evaluation framework can be used to prevent and address many of the key challenges inherent to the rigorous evaluation of these programs. This section highlights the importance of strong partnerships and solid communication between program implementers and evaluators for the success of impact evaluations. It also illustrates how these factors, combined with a solid evaluation framework, can help address the challenges laid out at the beginning of this chapter.

Strong Partnership and Collaboration between Program Implementers and Evaluators

Evaluations of complex nutrition-sensitive programs require close, continuous collaboration between program implementers and the external evaluation team (Rawat and Alderman 2013). This collaboration should be established at the program design phase. Evaluators are often brought in late, sometimes when program implementation is well underway, which seriously compromises the ability to conduct a rigorous evaluation. Once the partnership is established, it needs to be maintained throughout. The objective of the close collaboration is to align potentially differing priorities, expectations, incentives, and time frames and to ensure that, on the one hand, the program implementers share updates and challenges on program rollout and service delivery and, on the other hand, the evaluators provide regular updates on goals, methods, and findings from their evaluation activities. This collaboration is also useful for aligning program monitoring and evaluation activities.

Addressing the Six Challenges Inherent to the Evaluation of Nutrition-Sensitive Programs

Complexity of nutrition-sensitive programs: As noted earlier, designing an evaluation that captures a program's complexity requires a strong evaluation framework grounded in program theory. Depending on the complexity of the program, a program theory framework includes one or more program impact pathways. A clearly documented program theory framework, developed jointly by evaluators and program implementers, and a clear description of the hypothesized program impact pathways are indispensable for unraveling the complexity of nutrition-sensitive programs. These tools help identify which indicators to measure along the program impact pathways and when and how to measure them (such as who the respondent should be and what method should be used to measure the different types of indicators).

Long impact pathways and time frames: The time frame for program design and full program rollout and the required duration of exposure needed to achieve expected impacts have critical implications for the timing of the different evaluation components (for example, baseline, process evaluation, and follow-up surveys). The proper timing of these components requires an in-depth understanding of the program, which should be achieved through the use of a program theory framework and extensive discussions with a variety of staff members from the program implementation organization. To achieve an optimal alignment in time frames of program implementers and evaluators, the two groups need to work jointly and closely as early and often as possible throughout the program and evaluation process.

Differing priorities, expectations, incentives, and perceptions among program implementers and evaluators: To build the trust necessary for effective collaboration, it is important for each party to clearly explain its priorities and expectations. The evaluator must clearly lay out the objectives of the evaluation's different components (impact, process, cost); present examples of the types of information that will be generated; and discuss how this information can be used to strengthen, replicate, or scale up successful program models. Again, this requires continuous close collaboration and communication between implementers and evaluators and a high-level of coordination, negotiation, and endorsement at each step of the program cycle.

Independence of evaluators: The use of an external team is recommended to ensure the highest possible evaluation quality. Rigorous program evaluations require experts with specialized skills that the implementing organization is unlikely to have among its staff. A number of recent capacity-building initiatives targeted to development practitioners and policy makers have focused on making communication between implementers and expert evaluators easier. These initiatives include books (see, for instance, Gertler et al. 2010), initiatives such as MEASURE Evaluation (www.cpc.unc.edu/measure) and the International Initiative for Impact Evaluation (www.3ieimpact.org), and e-learning courses (www.fao.org/elearning/#/elc/en/course/IA). These efforts are likely to be much more valuable than trying to build the capacity of program implementers in conducting rigorous evaluations, just as it would make little sense to train evaluators in designing and implementing programs.

Trade-offs between implementation constraints and evaluation rigor: Agreeing on a workable evaluation design that meets both the evaluators' commitment to rigor and the implementers' mandate to deliver a high-quality program and achieve target coverage numbers within the budgetary limits requires in-depth, regular discussions, starting at the inception of the program and evaluation process and continuing until the final survey is complete. These discussions will help identify options, such as using cluster randomization (randomizing villages or other administrative units) instead of households or using individual-level randomization and holding a public lottery to assign clusters to intervention versus control groups to show transparency and obtain endorsement by community leaders and members. If a randomized design is not feasible, the strongest possible nonrandomized designs need to be considered and discussed with program implementers. Researchers and program staff also need to discuss key research questions, agree on the priority questions, and identify the ideal research design and set of study groups needed to best answer them.

Assessing benefits beyond targeted beneficiaries: Given that nutrition-sensitive programs have the potential to have impacts (both positive and negative) beyond the targeted beneficiaries, evaluators and program implementers need to work together to identify what those impacts may be, who they will likely affect, and how they can be assessed. The evaluators should take into account the full range of potential spillovers and include appropriate measures and samples of the nontargeted populations who may benefit from these spillovers. While these potential spillovers can sometimes come to light through communications from program implementers who have been told about such effects or who have seen them themselves in the households and communities in which they are working, formal assessment is essential for attribution to the program.

Using the Results from Evaluation Research

In order to be useful, evaluation results need to be shared widely in the appropriate fora and using the most effective and tailored communications approaches for different audiences. For example, program implementers need to know whether they are meeting their targets as agreed with the donors and which program components are working or need improvement. They generally need this information quickly so they can use it to report back to donors or to improve ongoing program delivery and use. This information is usually provided by evaluators in the form of reports, presentations, and extensive discussions of the results and their implications. Lessons learned from the synthesis of results from the different parts of the evaluation (that is, impact, process, and cost) can also be particularly useful for the wider community of program implementers; evaluators should use these rich data and work jointly with program implementers to prepare guidance documents on best practices for designing and implementing and evaluating successful nutrition-sensitive programs. Like program implementers, donors need to know whether targets are being met, but they also want to know what overall impact the programs they fund have and at what cost. Thus, widespread dissemination among the donor community of evaluation results and lessons learned is also critically important to inform future investments in nutrition-sensitive programs. Lastly, to contribute effectively to building the evidence base and to promote uptake of research methods and findings by the research and development community, results from comprehensive evaluations should be published in the scientific, peer-reviewed literature and disseminated widely at international, regional, and national conferences.

Conclusions

The current global evidence base regarding the nutritional impacts of nutrition-sensitive programs, including popular ones such as social safety nets and agriculture development programs, is generally limited due to poor targeting, design, and implementation of programs and, equally important, to suboptimal evaluation designs (Webb-Girard et al. 2012; Ruel and Alderman 2013; Leroy, Ruel, and Verhofstadt 2009). Although there is a consensus regarding the need to invest in nutrition-sensitive programs in order to address the underlying causes of undernutrition and to improve the effectiveness, reach, and scale of both nutrition-specific interventions and nutrition-sensitive programs, the evidence of what works, how, and at what cost is extremely limited. Thus, building a strong body of evidence from rigorous, theory-based comprehensive evaluations of different nutrition-sensitive program models that bring together interventions from a variety of sectors (health, education, agriculture, social protection, women's empowerment, water and sanitation, and so on) is essential to provide the needed guidance for future investments for improving nutrition. This chapter provides this type of guidance, focusing on how to design and carry out rigorous process, cost, and impact evaluations of complex nutrition-sensitive programs. It aims to demystify some of the perceived insurmountable challenges that have prevented investments in rigorous evaluations of such programs in the past. By doing so, we hope that the evidence gap in nutrition-sensitive programming, which has characterized the past decades of development, will quickly be filled and that future investments will benefit from a strong body of evidence on what works to improve nutrition, how it works, and at what cost.

CHAPTER 11

Supporting Multisectoral Action: Capacity and Nutrition Leadership Challenges Facing Africa

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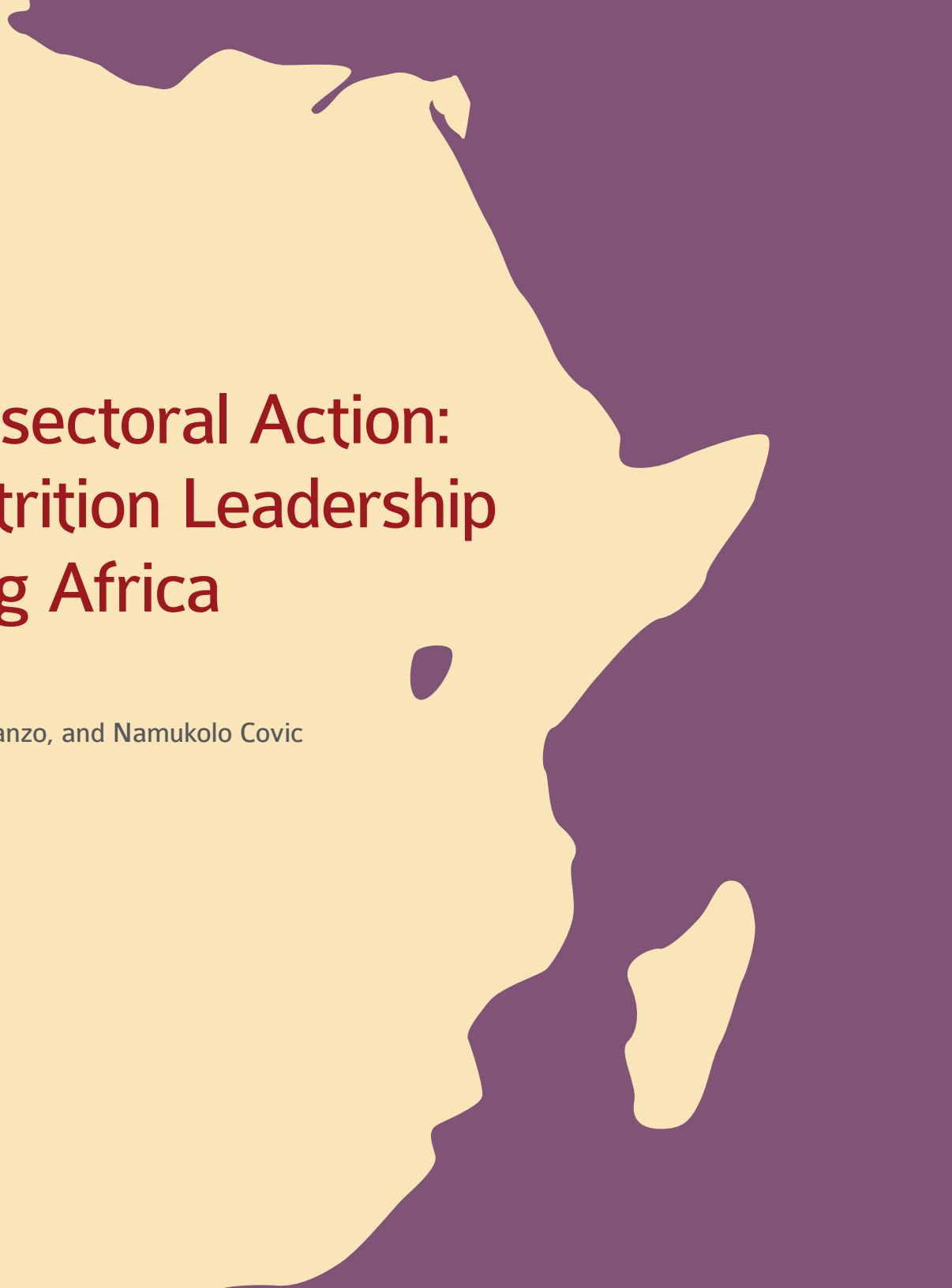


Of the 57 Scaling Up Nutrition (SUN) movement countries worldwide, 37 are African countries, demonstrating the commitment of these countries to improving nutrition. Despite much positive political will for nutrition action, however, many African countries are struggling to move effectively from policy development to implementation; in some cases, policy development and adoption take much longer than is warranted. Addressing nutrition comprehensively requires efforts from different sectors such as health, agriculture (including postharvest aspects and food value chains), water and sanitation, social protection, and so forth. This includes all sectors and stakeholders who in one way or another influence consumption patterns, nutrition quality and safety of what is consumed, and related environmental and economic factors that affect nutrition and health outcomes.

The multisectoral nature of nutrition requires individual, institutional, and system-level capacities to operationalize effective interventions through collaborative engagement across sectors and stakeholders. Effective implementation further requires coherence both vertically (within sectors and stakeholder institutions) and horizontally (across sectors and stakeholders). As noted, African countries are grappling with significant capacity limitations to effectively implement their nutrition policies and plans, even when those plans are well formulated. Countries need to design appropriate multisectoral nutrition (MSN) systems with structures that will vary according to country context. The MSN system in each country must be supported by a diverse nutrition workforce with the required technical, managerial, and leadership competencies to support sustained progress over time in a dynamic nutrition landscape.

Different definitions can be applied to the capacity areas addressed in this chapter; however, a detailed discussion of such definitions is not the goal here. For the purpose of this document, a, MSN system refers to a set of institutional nutrition coordination and implementation structures involving multiple sectors. Technical capacities refer to an adequate nutrition-related knowledge base, skills, and competencies to plan, implement, and monitor and evaluate (M&E) nutrition-specific and nutrition-sensitive interventions and research skills. Managerial capacities refer to the abilities and support for managing specific work processes, including reporting, accountability, and governance mechanisms. Leadership is not about leadership positions per se; rather, it refers to capabilities applied by individuals as individuals or collectively in teams to bring about change. It also involves the ability to align stakeholders to a common vision and value system, to recognize and leverage opportunities while also proactively creating opportunities for change, and to use strategic thinking and alignment to current and future opportunities. These capacities can be at varying levels of specialization or expertise as needed for different operational levels, from basic capacities for frontline staff to specialization at a postgraduate level for higher levels.

The aim of this chapter is to present a forward-looking analysis of need for MSN systems and the required three main capacity areas (technical, managerial, and leadership) for effective MSN action to bring about the desired nutrition outcomes for the continent in a sustained manner.

The chapter is structured as follows: First we discuss MSN systems, including MSN structures and the system requirements needed to address both nutrition-sensitive and nutrition-specific interventions for well-coordinated horizontal and vertical action in a multisectoral approach.

The information presented is based on experience in the Africa Nutrition Security Partnership (ANSP), an EU-funded project implemented from 2011–2015 through UNICEF's regional offices (Eastern and Southern Africa Region Office and West and Central Africa Regional Office) and UNICEF country offices in Burkina Faso, Ethiopia, Mali, and Uganda. These experiences, among many others, reveal the need for a competent, multifunctional nutrition workforce to carry out the work within the organized scaffolding of an MSN system. The relevant technical capacities and competencies for this MSN system are then discussed, including the necessary changes in the education systems to meet both short- and long-term needs. In addition, even in the presence of a well-designed MSN system and a technically competent workforce, there is a need for adequate managerial and leadership skills to align goals and galvanize efforts where multiple sectors and stakeholders face competing demands and limited resources. Therefore, the chapter also discusses managerial and leadership capacities and how these can be addressed. All three capacity areas are necessary for effective multisectoral action, and all three require significant investment in the years ahead to support the "nutrition revolution" called for by this report.

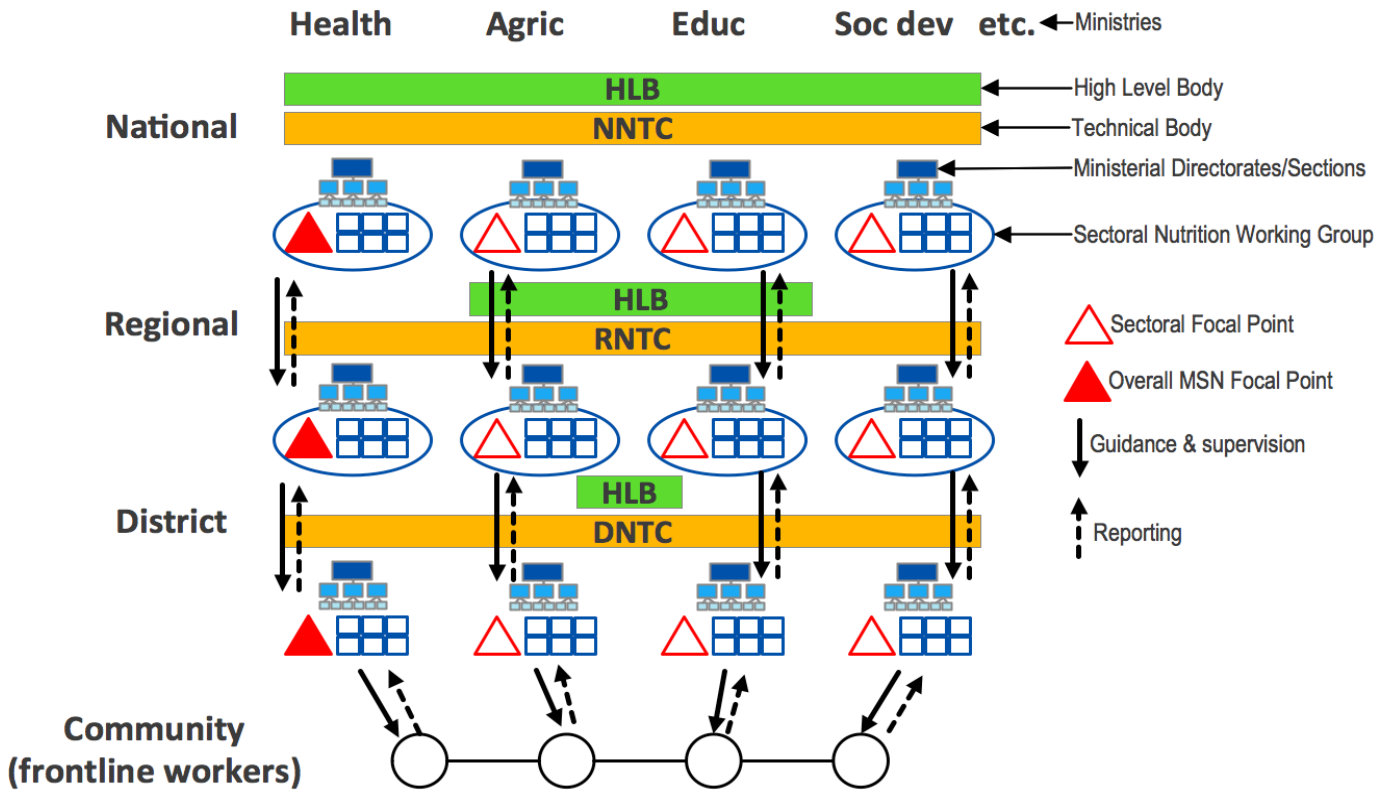
Multisectoral Nutrition Systems: The Basic Requirements

Currently, various African countries are at different stages of SUN implementation requiring operationalization of MSN systems. The "food, health, and care" framework for the causes of malnutrition reflected in the UNICEF Conceptual Framework of Malnutrition provides the basic rationale for taking a multisectoral approach (UNICEF 1991). However, the design of a multisectoral approach must also take into account three additional considerations. First, food, health, and care are interdependent rather than separate causes (Pelletier et al. 2003). Even at the household level, food security will not improve nutrition unless child-feeding practices are appropriate and infectious diseases do not deplete a child of nutrients. Improved water and sanitation infrastructure will not eliminate childhood diarrhea unless proper hygiene is practiced consistently. In addition, good-quality health services will not prevent or treat malnutrition unless children are brought to healthcare facilities in a timely manner. Even if all these aspects are taken care of, the desired nutrition outcomes will still not happen if food contamination with mycotoxins or other deleterious contaminants persists. Thus, improvements are necessary in all three—food, health, and care—and these must converge at the community and household level within a health-promoting environment. Second, specific factors that impair food, health, and care are contextual: they can and do differ widely across countries, districts, and communities, depending on agroecological, infrastructural, economic, and sociocultural conditions (Pelletier et al. 1995). For that reason, capacities must be developed for decentralized assessment, planning, and implementation, in addition to national policy development. Finally, unlike health, agriculture, education, and many other development domains, nutrition does not have a unique sectoral home. Nutrition, therefore, requires policy reform and other changes in various ministries, as well as special institutional arrangements for oversight, guidance, coordination, and accountability. The latter consideration is especially important because nutrition—and this multisectoral understanding of nutrition—is only recently being introduced to the nontraditional sectors, which may not yet have the

capacity or commitment to integrate it into their policies, programs, and practices.

The three considerations described above have important implications for the design of MSN systems. Figure 11.1 illustrates one version of the structures that would meet the three sets of considerations. In this scheme, adapted for illustration purposes from the Ethiopian approach (GoE 2013), the coordinating structures are created at the national, regional, and district levels, with a high-level coordinating body and a technical body at each level. The high-level body consists of state ministers or permanent secretaries at the national level and various arrangements at the subnational levels. The technical body consists of a technical focal point (staff member) for nutrition, assigned from each ministry. In various countries, the responsibility for coordination is located in one of the line ministries (typically health or agriculture) or in a supraministerial body, such as the prime minister's office or the planning ministry. The former meet once or twice yearly, and the latter meet monthly. In Ethiopia, an important innovation is that a sectoral working group is formed in some ministries, with representations from directorates or sections that may contribute to the ministries' nutrition efforts. These structures provide for horizontal coordination between sectors or ministries at each administrative level.

FIGURE 11.1—ONE VERSION OF A MULTISECTORAL NUTRITION STRUCTURE[a]



Source: Pelletier et al. (2015).

[a] There may be variations of this in different countries.

Vertical coordination between geographical and administrative divisions is provided in two ways: through the usual mechanisms within each ministry implementing nutrition action and through the coordinating structures at each level ensuring functioning and oversight of the overall MSN effort.

These structures enable horizontal coordination so that food, health, and care receive attention; decentralized assessment, planning, and implementation to address geographically context-specific causes of malnutrition; and vertical coordination to ensure oversight, guidance, and accountability within sectors and for the overall MSN system (in addition to that provided by the high-level body at each level). This is only one model of providing basic MSN requirements and is not offered as the preferred model. It is presented here to highlight some basic system requirements that stem from the multisectoral nature of malnutrition. Countries vary widely in structuring multisectoral efforts for a variety of political, administrative, and historical reasons. In early 2014, the SUN Movement documented that the MSN was coordinated by a supraministerial body in 20 countries, a line ministry in 12 countries, and an independent body in 4 countries, with 10 countries in the planning phase. In addition, roughly half of the 46 countries engaged civil society, UN agencies, or donors in their multistakeholder platforms (Scaling Up Nutrition Movement 2014). At that time, relatively few countries had established multisectoral structures at the subnational level, though that number was expanding.

It is important to note that the current interest in multisectoral nutrition stems from lessons learned from failed efforts in the 1970s. However, the current development context is different. The earlier efforts were largely donor driven, naive regarding the political and implementation realities, and lacking the scientific and experiential knowledge concerning effective nutrition actions. The current efforts, as embodied and supported by the SUN movement, are committed to a country-owned, country-led approach; harmonized support from development partners; the strengthening of functional capacities for multisectoral governance; and the use of a far stronger knowledge base (including evidence and experience) regarding interventions and strategies. This change is illustrated in the list of requirements for an effective and sustainable MSN system shown in Table 11.1. These requirements go well beyond the creation of national coordination structures and can serve as a guide for capacity strengthening at the individual, organizational, and system levels. The SUN movement has noted that all countries face challenges in meeting these requirements, yet all are also making progress and revealing useful strategies. Specific examples are described in the next section, along with some strategies for making progress, based on some recent experiences in four African countries.

Multisectoral Nutrition Systems: Challenges, Accomplishments, and Strategies

The ANSP in Burkina Faso, Ethiopia, Mali, and Uganda had four overall objectives: (1) upstream policy development and nutrition security awareness, (2) institutional development and capacity building, (3) data analysis and knowledge sharing, and (4) scaling up of interventions in selected regions of countries. At the country level, the proposed activities were designed to complement what was being done by the government and partners and to document and share experiences, best practices and, lessons learned within the countries. UNICEF contracted the Division of Nutritional Sciences at Cornell University to provide strategic guidance and support to the government officials and development partners in the nutrition

TABLE 11.1—REQUIREMENTS FOR AN EFFECTIVE AND SUSTAINABLE MULTISECTORAL NUTRITION (MSN) SYSTEM

1	**Strategic capacities and adaptive management at the national and subnational levels** The collective capacity of people and organizations should align around the requirements presented here. This requires formal and informal collaboration and a national core of leaders, champions, and supporters from many organizations.
2	**Common understanding and communication** Stakeholders from the national to the community level often have widely divergent views of nutrition problems and solutions. Diverse, frequent, and regular communication strategies are needed to promote and reinforce an integrated, balanced MSN multiview of nutrition determinants at all administrative levels.
3	**Coherent and authoritative policies, strategies, and guidelines** A coherent and authoritative set of policies and strategies is fundamental and enables all other issues in this list to be secured. Nutrition plans, programs, and guidelines are often intermediate steps; ultimately, legislative support is needed to ensure stable budgetary support and protection during political transitions.
4	**Consensus on actions** Disagreements on nutrition-specific, nutrition-sensitive policies and interventions and implementation strategies within and among sectors can greatly impede progress. Strong guidelines are needed, along with formal and informal mechanisms for forging consensus when disagreements arise and for adapting actions to local contexts as appropriate. Strong leadership qualities would be useful here.
5	**Common results framework (CRF)** This framework should detail objectives, roles and responsibilities, expected results, targets, indicators, and data sources. There is a need for technical research capacity across sectors to support monitoring and evaluation processes associated with the CRF and leadership capabilities to foster collaborative engagement with academic and research institutions to support the evidence-generation process.
6	**High-level commitment, system commitment, and leadership at all levels** High-level commitment and leadership are necessary but not sufficient. This must also exist at all levels within each sector, from managerial to the frontline, as well as in development partners, civil society, the private sector, and the government ("system commitment").
7	**Clear roles and responsibilities** Defining clear, well-understood roles and responsibilities for all sectors and focal points at all administrative levels would improve collaboration among team members within and across sectors.
8	**Consistent incentives and accountability** Roles and responsibilities at all levels in each sector and for the coordination structures must be communicated, incentivized, and enforced to be effective. This requires reconciling contradictions or inconsistencies between traditional sectoral roles and incentives versus nutrition-sensitive ones. It also requires revised job descriptions and performance metrics.
9	**Coordinated monitoring and evaluation (M&E) operations research and learning platforms** The CRF should be the basis for the M&E system within and across sectors. Major reforms in these systems may be needed. Attention and authority from the high-level coordination platform are essential. A system for efficiently tracking and resolving implementation bottlenecks is needed at all levels and in all sectors. A culture of routinely adjusting program implementation at each level in response to M&E, operations research, and learning is required.
10	**Community, nongovernmental organizations, partner, and private-sector alignment** The public sector cannot succeed alone. The given sectors and development partners have key roles to play and must be appropriately and constructively engaged across the system.
11	**Capacities, facilities, tools, and equipment** A strong capacity development plan with short-, medium-, and long-term objectives, financing, and results framework should be created as a high priority. Proper facilities, equipment, and tools should be in place.
12	**Consistent financing** As nutrition becomes mainstreamed in sectoral work plans at national and subnational levels, the financing must follow suit. Government and partner financing must be consistent, stable from year to year, and aligned with these plans and the CRF. The government share of funding must expand over time.
13	**Coordination** A high-level platform with a strong anchorage is needed, as are a technical platform, committed focal points from each sector, and effective working groups. Attendance and progress must be enforced from the high-level platform. Appropriate structures and mechanisms are needed at the subnational level. Essential, but not maximal, coordination is the objective.

Source: Pelletier et al. (2015).

policy community and to observe, document, and disseminate lessons from country experiences. Three Cornell staff members were posted to ANSP countries during the final two years of ANSP for this purpose. The following discussion is based on their observations through October 2015 and are described in greater detail elsewhere (Pelletier et al. 2015).

The Institutional Situation at Inception

Although the four ANSP countries differed in many respects, they did have some features in common at inception (June–December 2013). They differed in relation to existence of policies and plans authorizing and detailing the MSN design. Ethiopia and Uganda had formalized plans in place; Mali had just adopted the national nutrition policy and was in the process of developing its MSN action plan; and Burkina Faso had both a nutrition policy and strategic plan, though neither was multisectoral. The countries also differed in the status of multisectoral structures: Ethiopia and Uganda had established political and technical structures at the national level and had authorized (but not yet implemented) them at the subnational level, whereas Burkina Faso had a consultation platform at the national and subnational levels. Mali had coordination structures anticipated in the nutrition policy but not yet in place. MSN anchorage was in the Ministry of Health in Ethiopia, Mali, and Burkina Faso and in the prime minister's office in Uganda. Ethiopia had one successful working model of a district MSN for illustration and cascade training to other regions; there was nothing like this in the other countries. Government leadership on nutrition agenda was strong in Ethiopia and still emergent in Uganda. Development partners were exercising strong influence on the nutrition agenda in Uganda, Mali, and Burkina Faso, but much less so in Ethiopia. In addition to these differences, some commonalties existed:

- All countries had experienced various sectoral or bisectoral (health and agriculture) approaches for addressing malnutrition in the past, with varied success and without the benefit of government and partner interest seen currently.
- In all cases, development partners were active in nutrition but not well aligned with each other or the government.
- None of the countries possessed detailed implementation guidelines.
- All had placed responsibility for coordination of MSN on the shoulders of a small number of already-over-committed staff.
- The level of understanding or interpretation of "MSN" was generally weak or highly variable in all four countries.

Considered together, these differences mean that each country faced serious challenges in creating an effective, sustainable MSN system. These challenges have been aggregated across the four countries and are summarized below.

Challenges

Whereas the global discourse on MSN recognizes broad categories of challenges, such as political will, financing, and delivery capacity, the reality on the ground is far more varied, pervasive, and dynamic. At the individual level, it includes such factors as a weak understanding of nutrition, of MSN, and of how to operationalize MSN; weak staff capacity in key positions who nonetheless have large influence; gatekeepers who choose to impede progress for personal, professional, or political reasons; risk aversion and rule-bounded-ness; fear of losing control over the nutrition agenda; and resistance, micro-politics, and power struggles. At the organizational level,

it includes the following examples of lack of alignment between sectoral and MSN objectives:

- Unawareness by sectors of their contribution to nutrition
- Sectoral focal points that are low level, different from one meeting to another, and unable to influence their ministry
- Overreliance on sectoral focal points to stimulate nutrition sensitivity
- Lack of nutrition in job descriptions or poor specificity
- High staff turnover in key positions
- The levels, sources, dynamics, inflexibility, and unpredictability of funding
- Partner mandates that do not align with the government or each other
- Bureaucratic inefficiencies with funding and routine tasks like organizing small and large meetings

At the system level, the challenges include coordination structures that are weak or not in place; platform meetings with poor attendance, frequency, facilitation, and follow-up; lack of time required for structures to become functional; lack of clear roles and responsibilities for staff and structures; disagreements over anchorage; weak convening power and authority for MSN in the Ministry of Health; weak cascading approaches; lack of detailed implementation guidelines; lack of harmonized orientation guidelines for sectors and districts; weak reporting mechanisms for MSN from districts to the national level; disagreements within the nutrition policy community (at both the national and international level); scheduling conflicts, such as too many meetings or too few staff; weak partner alignment on priorities, strategies, funding, and implementation; lack of a shared long-term vision for MSN; and lack of a real commitment to a country-owned, country-led agenda. Deeper analysis of these challenges reveals that they are traceable to a relatively small set of root causes: human resource constraints for overall MSN coordination and management in the designated MSN anchorage institution; lack of a dedicated implementation team for cascading and supporting subnational efforts; and failure to engage high-level decision makers in addressing critical bottlenecks, supported by real-time progress markers.

Accomplishments

Each country made significant progress in advancing the MSN agenda and putting in place components of the system that will be needed. With the benefit of hindsight, and reflecting on the tasks that required the most attention during the two years of documentation, the major accomplishments can be placed into four categories: (1) strengthening the enabling environment, (2) cascading to subnational levels, (3) stakeholder alignment, and (4) learning and adaptive management (a crosscutting category). Table 11.2 provides an example from Mali.

A key insight from this work, as reflected in Table 11.2, is that each category contains "hard" and "soft" accomplishments; this distinction is important when planning, implementing, and evaluating progress in MSN. To illustrate, in the enabling environment category, some of the hard components are formal policies, common results frameworks, coordination structures, and so on. Some "soft" components include increased agreement buy-in from individual stakeholders for a systems perspective for MSN; awareness of and commitment to MSN among individual stakeholders; increased capacity of a few individuals for identifying and addressing bottlenecks; recognizing the need to create implementation teams (even if not yet created); and the need to create sectoral working groups (in addition to sectoral focal points) to promote nutrition sensitivity across sectors. The

TABLE 11.2—ILLUSTRATION OF THE ACCOMPLISHMENTS OF THE AFRICA NUTRITION SECURITY PARTNERSHIP, USING MALI AS AN EXAMPLE

1. Strengthening the Enabling Environment
– Multisectoral nutrition (MSN) action plan developed, launched, and disseminated
– National coordination platforms formed and operationalization in process
– Full-time coordination/implementation unit being created and staffed
– SUN civil society alliance created
– Funding gaps and government contribution to nutrition assessed
– Alignment of sectoral policies and programs in process
2. Cascading to Subnational Levels
– MSN platforms created and coordinating committees formed in Bankass and Yorosso (plus others ongoing)
– Local authorities in these districts committed to reinforce nutrition in the next local development plan
– Bankass and Yorosso identified as districts of convergence
– Subdistrict platforms formed
– National capacity for cascading down MSN strengthened as a result of experience in these districts
3. Stakeholder Alignment
– Civil society alliance created
– Convergence on policy implementation
– Reform of the coordinating mechanism
– Harmonization of nutrition objectives and indicators in sectoral policies and programs, in process
– Global Alliance for Resilience Initiative priorities adopted, with nutrition as one of the four strategic priorities
4. Learning and Adaptive Management (a crosscutting theme)
– MSN implementation bottlenecks identified and reflected back to stakeholder for timely actions
– Continuous collaborative assessment and adjustment in coordinating structures
– Participatory assessment of functionality of subnational platforms
– Documentation of the subnational experience to inform the cascading down

Source: Pelletier et al. (2015).

distinction between hard and soft components has important implications for sequencing and prioritizing efforts when building an MSN system; establishing progress markers for use by the government; evaluating MSN initiatives; and promoting realistic expectations within government and donor organizations concerning the time, effort, and resources required to establish functional MSN systems. It is also important to note that the identified components require technical, managerial, and leadership capacities, which are discussed in more detail later in this chapter.

Multisectoral Nutrition Systems: Suggestions for the Way Forward

Recognizing the many challenges from a systems perspective, and noting the functional connections among them, it is possible to identify a relatively small set of actions that could help overcome most of the challenges noted above. The suggestions made here are based on actions or practices already present or emergent in one or more of the ANSP countries but which appear to be relevant for all four countries, as well as for others.

1. Strengthen human resource capacities in the technical coordination body for strategic oversight and coordination: The task of operationalizing MSN at the national scale is a monumental undertaking that requires attention to many system components. The oversight and coordination of all the necessary activities—including involving interactions, advocacy, and negotiations with a large number of government and nongovernment stakeholders and organizations—require the full-time effort from an MSN coordinator located in an institution that enables effective oversight and coordination. In some cases, this may require hiring or acquiring a new staff member; in other cases, it might be achieved by reassigning responsibilities among existing staff.

2. *Create a full-time implementation team to support the national coordination and capacity-building mandate, cascading, and ongoing support to subnational levels:* Most countries have 10–20 regions or provinces and many more districts. The task of orienting and

training these subnational entities and supervising and supporting them in a responsive fashion over time requires a mobile implementation team dedicated to those functions. Currently, none of the ANSP countries has fully implemented such a team, though three of them have recognized the need and are moving in that direction. As with the MSN coordinator, this need could be met by hiring or acquiring new staff (including partner-supported staff as an interim measure) or by reassigning responsibilities among existing staff. The selection of such staff, however, requires adequate attention to the needed competencies for effectiveness.

3. *Engage with high-level decision makers in government and partner organizations to address critical bottlenecks through candid reporting from the technical anchorage, the use of real-time progress markers, and the establishment of clear lines of accountability:* Many of the individual, organizational, and system challenges documented in this report cannot be addressed by the technical and managerial staff (for example, the MSN coordinator, implementation team, or technical coordinating committee) because they do not have the requisite authority to do so. The ANSP experience demonstrates that the failure to report and address these challenges results in prolonged delays and dysfunctionality. Some ANSP experiences also demonstrate the enormous progress that can be made when such challenges are candidly reported and addressed. For this reason, a high priority is placed on ensuring candid reporting from the MSN coordinator to higher-level decision makers in government or in partner organizations. This, in turn, requires the development of progress markers that reflect the practical aspects of MSN implementation (such as the number of districts oriented, attendance at MSN committee meetings, and so on), updated as appropriate, along with clear lines of accountability that ensure corrective measures. It also requires a mind-set change to become more accepting of the need for candid reporting as an important element of promoting progress. There should be a clear signal from policy makers that they expect such reporting. Individual leadership capabilities are important for those reporting or receiving such reports and to adoptstrategic thinking toward the value and opportunities such reports present for accelerating progress. Leadership capabilities are covered in a later section of this chapter.

The rationale for singling out these three actions from the much larger set of challenges documented in this report is that all (or most) of the other challenges can be addressed by a dedicated staff and clear procedures. This scenario applies to all levels, from the African Union continental level to Regional Economic Communities to national, subnational, and community levels. Staff should receive ongoing capacity strengthening and support in the areas of leadership, strategic management, boundary-crossing work between sectors and stakeholders, monitoring and evaluation (M&E), strategic communications, and other important skills.

Technical Capacity and Needed Competencies to Support Nutrition Action and to Inform Policies and Programs

The requirements for an effective and sustainable MSN system are set out above. These requirements indicate a need to develop the capacities of the nutrition workforce not only to deal with the current situation but also to address the complexities of globalizing food systems, emerging

communicable and noncommunicable diseases, and economic, political, and social uncertainties that may not be conducive to the good nutrition and health of populations. Professionals must have competencies in several areas, including a greater understanding of policy processes and programs, leadership and advocacy, the relevant sciences, evidence-based decision making, metrics to help with evaluating programs, communication across different disciplines and sectors, and framing of evidence for different audiences, including policy makers and the public at large. This calls for different types of workforce capacities.

Types of Human Capacity

Capacity development goes beyond the training of individuals, requiring strengthening of support structures and systems. The capacity needs for nutrition are diverse and require a new generation of professionals to work across many dimensions to address the complexities that nutrition inherently presents. The MSN approach calls for varied and crucial skill sets to effectively deliver nutrition at scale for impactful, sustained change. Not just "more studies and more evidence" are needed but also improved capacity to successfully address nutritional needs under different contexts (Heikens et al. 2008). What type of nutrition workforce and related competencies are needed for Africa? The answer is complex because the needs are different, context specific, and country dependent. There are multiple ways to address the situation, involving policy formulation and advocacy, programmatic design and management, frontline effort that engages individuals or communities, and researchers and evaluators who can monitor and evaluate progress and generate evidence on "what works" and under what circumstances.

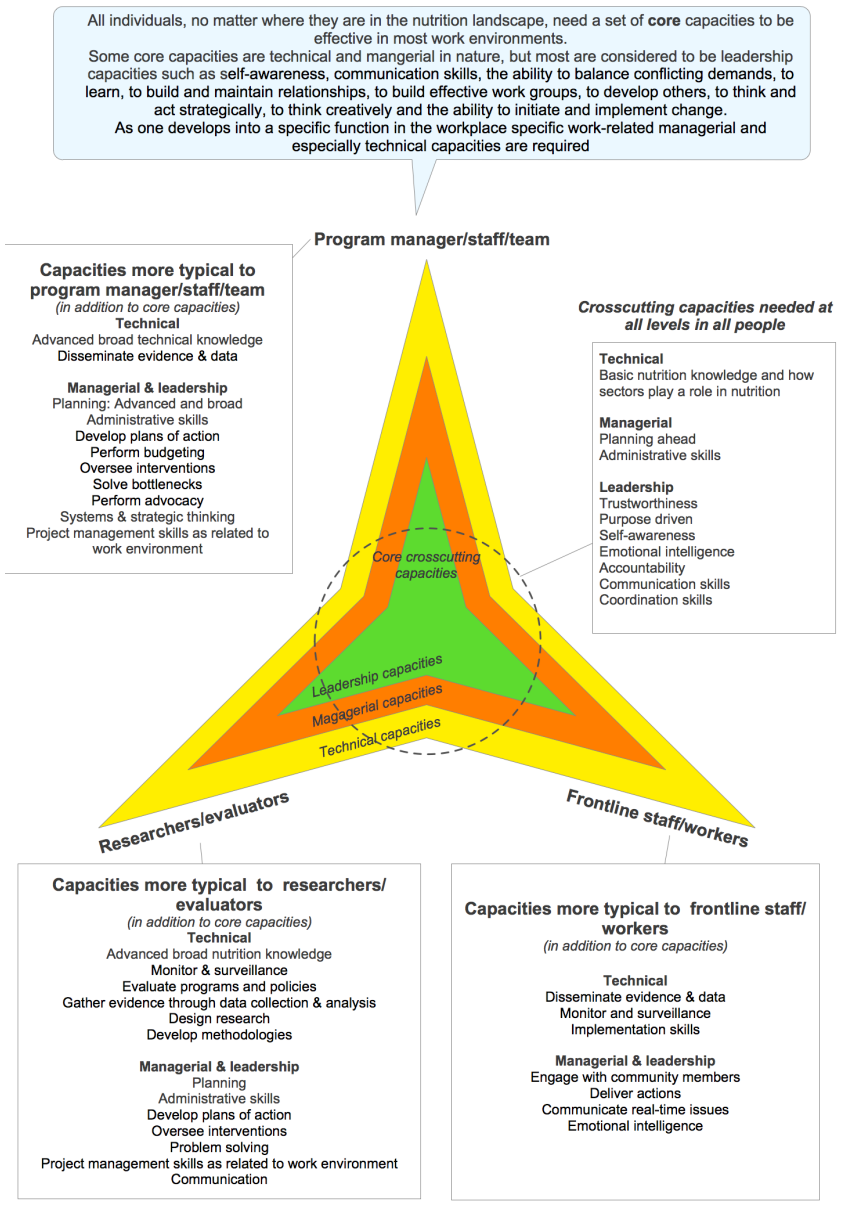
This section highlights capacities and competencies for three types of nutrition workforce: program staff (such as ministry staff or nongovernmental organization staff), frontline workers (such as community health workers or agriculture extension agents), and researchers or evaluators (who may sit in universities and research institutions). Leadership and management are crosscutting and are core to all three and are covered in a later section because they help navigate the dynamic landscape that characterizes nutrition action in a multisectoral approach. Figure 11.2 illustrates specific capacities of each type of workforce.

Program Staff

For program staff, technical competency needs to align with systems-based thinking that informs design, implementation, and M&E of nutrition policies and programs (see Table 11.1 and Figure 11.1). At the least, program staff should have a good basic understanding of the links between the food system and the health system, as well as the capacity to design appropriate mechanisms to deliver interventions through entry points of these systems. These systems are interconnected, especially in rural Africa, where the health of farming families is directly tied to the productivity of the land and their food security. Therefore, program staff must have an understanding of how populations interact within these systems and how they reap their benefits, including attention to markets, social protection programs, and so on. They also must use the right language to frame the MSN issues to diverse audiences.

In Africa south of the Sahara, understanding the food–care–health causal pathways and barriers that influence undernutrition, the complex food and health environments linked to overweight and obesity, and noncommunicable disease risks is essential for building a more comprehensive

FIGURE 11.2—A FRAMEWORK FOR TECHNICAL, MANAGERIAL, AND LEADERSHIP CAPACITIES NEEDED FOR THE DYNAMIC NUTRITION LANDSCAPE



Source: Authors.

knowledge base. An individual is not expected to have expertise in all areas, but it is important to have a good theoretical understanding of the causes and consequences of poor nutrition and how different aspects of the food system may influence this. Managers of program staff must have adequate leadership capabilities to build teams that can address the required areas effectively for particular intervention options.

Program staff must have some understanding about how nutrition and related data (and indicators) are collected, analyzed, and presented. They should also be able to act on the evidence that is presented to them and provide solutions to solving bottlenecks and lack of positive progress. A critical capability for program staff is putting in place appropriate, but not overbearing, reporting and accountability mechanisms as part of the progress-tracking processes within MSN systems.

Program staff must be able to function effectively in a multistakeholder environment. Essential for this is interpersonal communication across sectors and stakeholders and within programs. It also involves the ability to advocate for nutrition to stakeholders who do not necessarily prioritize nutrition in their own domains. This is the art of knowing what to say, when to say it, and how to say it. Program staff managers should be able to influence others and provide leadership for nutrition through effective coordination and communication.

Frontline Workers

Frontline staff work primarily with implementation and surveillance at the community level and must have the ability to empathize with households in the communities they serve. Their technical skills should allow them to perform implementation functions effectively. Context-based training should provide needed competencies, as well as an understanding of how

a program fits in the broader system. Like program staff, frontline staff require coordination and negotiation skills to work effectively in communities within a larger multisectoral MSN team. For this, interpersonal communication skills and engagement for effective information sharing with community members and colleagues are critical.

Examples of frontline workers in Africa include Ethiopia's Health Development Army, which is primarily a volunteer female community health worker (CHW) program (Lemma and Matji 2013) and the One Million Community Health Workers campaign in Africa, which works to scale up CHW numbers in Africa and advocates to international donors and governments for the recognition of CHWs as a formal health cadre. The momentum for CHWs has had much less emphasis on effective engagement with broader nutrition-related activities. For example, little investment has been made to integrate nutrition into agriculture extension agents' day-to-day work activities, despite their extensive presence in communities (Fanzo et al. 2015).

Researchers and Evaluators

Although programming and management are essential skills, programming also needs to be supported with rigorous evidence, ongoing surveillance, and impact evaluations, which is where researchers play a key role. Researchers should have cross-disciplinary training to address complexities in MSN systems; they should also have skills in research design, quantitative and qualitative data collection and analysis, and writing and communicating data and results (Chiwona-Karltun and Sartas 2016). Research capacities include having some basic understanding grounded in public health, nutrition assessment, epidemiology, behavioral science, ethics, or food systems. The area of implementation research is also critical to test new innovations (such as with mobile technology or point-of-care diagnostics) for suitability and scalability to inform program decisions. In many African countries, the SUN academic networks, which were meant to generate evidence to inform decisions, have been weak.

Historically, in most academic institutions, nutrition has been "overprofessionalized" with strict curricula to fulfill degree requirements. However, although core science competencies should be maintained, it is also necessary for the training to become responsive to current needs. There is also a need to train a diverse research cadre that includes different disciplines, including those in "professional" practice, who gain experience and knowledge in practical environment settings.

Competency Gaps in Africa Regarding Nutrition Professionals

No data currently exist to help determine the numbers or competency of the nutrition workforce in Africa, even for rural agriculture extension workers (Fanzo et al. 2015). Africa remains highly dependent on external help to fill the human capacity gaps for nutrition programming, evidence generation, and monitoring and evaluation. This gap limits the ability to generate context-specific solutions that come from local knowledge on the ground; instead, prescriptive solutions are often provided that may not always work for a given context. It is, however, encouraging that in the Malabo Declaration (2015), the African heads of state recognized the need for addressing professional competencies on the continent (African Union 2014).

A landscape assessment of 14 African countries observed limited readiness to scale up nutrition and insufficient human resource capacity for public health nutrition. These insufficiencies were characterized by staff shortage, lack of degree programs, and poorly focused nutrition training

(Trübswasser et al. 2012). From a survey of 83 existing academic training programs within 16 countries in West Africa, few countries had any degree-granting programs, and most did not address all aspects of nutrition and public health nutrition comprehensively. Even countries with adequate training programs failed to produce adequate numbers for national needs (Aryeetey, Laar, and Zotor 2015). Of the 36 countries with the highest burdens of stunting, 21 had major gaps in nutrition training, continuing education, and institutional support (Geissler 2015). In addition to a lack of capacity, many African countries face a curious mix of a significant need for nutrition professionals at a time when government recruitment is frozen or significantly curtailed due to resource limitations.

Although capacity to alleviate undernutrition has received some attention, there has been less attention to the capacity to address overweight/obesity and the growing burden of noncommunicable diseases (NCDs) (Naghavi and Forouzanfar 2013). In the 2010 WHO assessment of the capacity to prevent and control NCDs, of the 185 responding countries, most reported having a unit or branch dedicated to NCDs. However, 12 percent had no funding and cited staff concerns with their ability to address the complexities required by NCD treatment and care. Low-income countries—particularly those in West Africa—were more likely to report funding gaps for NCD prevention and control (WHO 2012).

Academic research output is also indicative of limited nutrition capacity in Africa. There is a dearth of scientific publications originating from African institutions, and only a few examine key topics in public health nutrition (Aaron et al. 2010; Lachat et al. 2015). Although publications are merely one product of research and may not accurately characterize researcher training processes, previous authors have argued that African higher-education institutions do not have the means to provide adequate training to sustain home-grown leaders for nutrition (Brown et al. 2010). It is challenging for young African scholars to break into the international scientific nutrition community with little funding for research, traveling to conferences, or publishing in journals (Chiwona-Karltun and Sartas 2016).

Institutional Arrangements in the Short and Medium Term

Informal education and vocational training of the nutrition workforce is important for those outside the net of formal education programs. Vocational and community schools can offer certificates and short-course trainings. More frequent and more in-depth opportunities to build both applied program and teamwork skills should also be provided. The opportunities could take the form of expanded in-service trainings, network meetings to build skills, massive open online courses (MOOCs), or case studies.

Professionalization, certification, and continuing education are critical for competency and relevance of a competent African nutrition workforce. Immediate opportunities for training the current workforce could focus on midlevel managers or could use online platforms or MOOCs (such as the London School of Hygiene and Tropical Medicine's Programming for Nutrition Outcomes or its Agriculture, Nutrition, and Health program). Such courses could be adapted for in-person facilitation or tailored to organizational needs. At the country level, national nutrition associations, in collaboration with training institutions, can provide contextualized continuing competency training activities for their membership.

For the current workforce, technical skill building must include leadership training and on-site coaching. On-the-job technical training can be addressed with practitioner workshops, network meetings, and job training rather than semester or yearlong academic courses. Action learning projects,

where practitioners translate knowledge into skills, are one example of an approach that mixes short technical courses, on-site coaching, and training by doing.

In-service training represents an opportunity to increase the skills and knowledge of those who have not had formal pre-service education or training prior to working in a position that focuses on nutrition. A 2013 systematic review of in-service nutrition training programs for CHWs concluded that such programs increased the knowledge and competency of those delivering interventions (Sunguya et al. 2013). The review found that community health workers and other frontline workers were more likely to take on the shorter trainings. The challenge was developing course-relevant material for well-managed and well-maintained courses.

Long-Term Training and Competency Building

Gillespie and Margetts (2013) argued that it is no coincidence that the regions with insufficient service delivery are those that lack appropriate academic curricula and high-quality training programs. Africa suffers from outdated training and assessment materials; lack of practical, hands-on training; and few resources to strengthen public health nutrition programs in universities. Shrimpton et al. (2016) noted that there is no authoritative source of information pertaining to the education of the nutrition workforce globally, and, of those that offer nutrition programs, what is being taught is often poorly or narrowly focused.

Thus, there is consensus on the need for revised program curricula for training and credentialing a nutrition workforce that can work in teams to provide complementarity of skill sets and expertise. For those enrolled in formal "pre-service" nutrition programs, several areas of study appear necessary, including nutritional biology and biochemistry, nutrition assessment, epidemiology, statistics, program management, analysis and writing, leadership, advocacy and negotiation, behavioral science, communication, and ethics. To foster multisectoral engagement and teamwork, those in formal nutrition programs should be required to include in their coursework at least the hallmark, basic theoretical content in agriculture, food systems, environment, toxicology, ethnography, economics, climate change, and urbanization. It is impossible for one person to be an expert on all of these topics, but exposure to these cross-disciplinary areas is important, as is the desire to build one's own capacity and specialization. In addition to university degree programs, there should be serious consideration of vocational and community schools for implementing diploma or short-course trainings. Nutrition certificates or diplomas could be offered, and the curricula could be supported by local African universities and UN agencies working in those countries.

Those entering the nutrition field need to be confident that they will have a career, with opportunities for advancement and adequate remuneration. However, budgets are tight, and funding is limited, particularly for building capacity. Therefore, many go abroad, where there are better incentives. It is also difficult for many African governments to compete with international NGO salaries and benefits. Countries where this is a major problem should explore sustainable means of retaining and sustaining the needed nutrition workforce. The involvement of national and low- and middle-income country universities will be a key driving force for developing the curriculum and competencies that match the social, cultural, and physical environment. UN agencies and international organizations can provide technical support to educational programs and give students opportunities to learn in the field, such as through coordinated internship programs based in both urban and rural settings in Africa.

The Role of Leadership Capacity in Bringing About Change in Nutrition in Africa

This section focuses on leadership, leadership development, and how that relates to leading nutrition change interventions. Leadership capacity is considered a crosscutting capacity for nutrition at the individual, organizational, and system level.

As already emphasized, addressing malnutrition in all its forms requires multisectoral action and a change in how things are done in order to bring about the desired nutrition outcomes and calls for effective leadership. The SUN Strategy 2016–2020 aims to support in-country leadership capacity and multisectoral coordination efforts (Scaling Up Nutrition Movement 2016). The Comprehensive Africa Agriculture Development Programme (CAADP) is the African Union's framework to stimulate transformation in the agriculture sector toward achievement of agriculture-led socioeconomic growth and better nutrition (NEPAD 2015). The CAADP framework has a strong focus on leadership capacity development and multisectoral collaboration on action to achieve the desired outcomes (NEPAD 2015). One objective of the action plan for the prevention of NCDs is to strengthen national capacity, leadership, governance, multisectoral action, and partnerships to accelerate country response for the prevention and control of NCDs (WHO 2013). Therefore, various role players recognize leadership capacity as a critical success factor for a multisectoral approach to combating malnutrition (SUN 2016; NEPAD 2015; WHO 2013 and 2014).

It is common, however, to confuse leadership with management. Yet these are two very different concepts. Box 11.1 explains the differences and why both are essential for effective nutrition action (Kotter 2001 and 2012; Jerling 2015).

Different leadership models with different strengths and weaknesses have been developed from a variety of perspectives (Northouse 2010). Many theories focus on individual traits of leaders and their relationships with those they lead or work with, while others see leadership more as a social process (Day 2001). Regardless of which theory is favored, from an MSN perspective, the outcomes achieved by leadership are the net result of a series of complex interactions between people exhibiting different traits (behaviors, attitudes, orientations, and skills) in the context of the systems and structures devised to facilitate change processes for nutrition.

BOX 11.1—LEADERSHIP COMPARED TO MANAGEMENT

For nutrition action, management is a set of processes, such as planning, budgeting, structuring jobs, staffing jobs, measuring performance, controlling, and problem solving, that helps teams and stakeholder organizations to predictably do what they know how to do well. Management, therefore, helps produce products and deliver services as promised, with consistent quality, on budget, day after day, week after week. Management is crucial to preserve the status quo and to perform well.

Leadership is associated with taking an organization into the future; leaders find and successfully exploit opportunities around a shared purpose and vision that go beyond the self-interest of the individual or a single institution. In multisectoral action, leadership is about gaining commitment that is aligned to a common purpose and empowering individuals, sectors, teams, and organizations with the necessary skills, orientations, and resources to bring about the desired change. Change is a process that is led, not managed.

Source: Authors

BOX 11.2—SOME ELEMENTS OF TRANSFORMATIONAL LEADERSHIP THAT CAN BE DEVELOPED

- The orientation and abilities of individuals, such as emotional intelligence
- Having a strong sense of purpose that goes beyond self-interest
- Strong moral and ethical values
- Trustworthiness
- A high degree of self-awareness
- The courage to confront tough issues
- Being in-tune with reality
- The ability to deal with ambiguity
- Self-confidence
- Empowerment
- The ability to create motivating climates
- The ability to and willingness to learn
- Energy
- Demonstrating commitment
- Mentorship
- The ability to network
- Excellent communication skills
- The ability to build teams
- The ability to manage resistance to change

Source: Based on Coetsee (2011) and McCauley and Van Velsor (2004).

Leadership Capabilities and Successful Change Intervention

A number of behaviors of leaders are associated with successfully implementing change. Many elements of transformational leadership, servant leadership, and authentic leadership could be effective in producing the change needed for nutrition at the continental, national, subnational, and community level. These leadership elements can be developed and are included in Box 11.2; however, these are just some elements of a leader. Being overly controlling, only focusing on one's own views, and overfocusing on accountability can be counterproductive leadership behaviors (Chi et al. 2012; Gilley et al. 2009; Nisbett et al. 2015, Higgs and Rowland 2011; Schneider and George 2011). Leadership capabilities can be learned and are not the exclusive domain of a few chosen individuals higher up in the hierarchy of organizations. Rather, leadership is required at every level throughout an organization (Kotter 2001). Given that leadership capabilities and behaviors are strongly related to many of the key challenges experienced by countries in implementing nutrition action, it is an important capacity to develop within the entire system.

Figure 11.2 gives some examples of leadership capabilities relevant to the different categories of the nutrition workforce identified in this chapter. Given the crosscutting nature of leadership, it is important to come to a common understanding of what leadership is and what leadership development should focus on, as is the case for clinical professions and the educational and regulatory environments for those professions in the United Kingdom (Long and Spurgeon 2012).

Developing Leadership Capabilities

The ability to lead planned change is of critical importance in achieving the goal of improving the nutrition landscape of Africa and bringing about a nutrition revolution. Over the past 30 years, there has been a dramatic increase in interest in leadership development (Hernez-Broome and Hughes 2004). Within the nutrition world, earlier leadership development initiatives were largely structured as single projects (Johnson-Welch, MacQuarrie, and Bunch 2005) or one-off workshops (Wahlqvist et al. 2008), until the inception of the European Nutrition Leadership Platform in 1994 (Gilsenan and Korver 2009). With the advent of the SUN Movement and the challenges that have been faced pertaining to limitations in leadership capacity, the focus has shifted to the impact of leadership development on effective intervention implementation. Research has shown that leaders and leadership capabilities develop when there is an identified need and as a result of a variety of experiences that contain elements of novelty and challenge in a supportive environment (McCauley and Van Velsor 2004). These experiences may be typical face-to-face classroom settings, but coaching, mentoring, and other blended forms of learning, including experiential learning, are also critical (Hernez-Broome and Hughes 2004). Leadership development initiatives are more likely to have impact when embedded in the beneficiary's working environment and when they form part of a longer-term structured, integrated development approach, as opposed to a one-off or ad hoc approach (Hernez-Broome and Hughes 2004). The implication for the nutrition fraternity is that in addition to generic nutrition leadership development programs, it is critical to embed leadership development activities within institutional work plans for continued development of leadership capabilities in the nutrition workforce. It would also be of great benefit to develop leadership modules within nutrition programs for university graduates, as is the case in the United States within agriculture (Velez et al. 2014).

Examples of Nutrition Leadership Development Programs with an African Focus

There have been four examples of leadership development programs with a focus on Africa. The first and oldest is the African Nutrition Leadership Programme (ANLP), a 10-day leadership immersion program aimed at leader development for mid- and early-career individuals living or working in Africa (Jerling et al. 2015). The primary point of departure of the ANLP is that leadership is a body of orientations, attitudes, and behavior that can be acquired and developed. Although leadership might be expected from individuals in certain positions, leadership, in itself, is not a position, and leaders lead from wherever they stand. The francophone *Le Programme de Leadership Africain en Nutrition* (PLAN), hosted in Morocco, has similar aims and covers some nutrition technical content (PLAN 2015). Transform Nutrition is a program hosted in the UK; it has a low- and middle-income country focus. Although its main focus is on technical skills, it includes elements of leadership development (Institute of Development Studies 2016). The Scaling Up Nutrition Leadership in Africa (SUNLEAD) project (Jerling et al. 2015) aims to develop a larger group of leadership trainers to enable scaling up of nutrition leadership development in Africa. SUNLEAD, a UNICEF- and Sight Life–supported program of the ANSP initiative, was designed to increase change leadership capacity to improve team effectiveness at the district level. It has been implemented in Uganda and Rwanda in

BOX 11.3—TRANSFORMING MULTISECTORAL ACTION PLANS INTO ACTION—AN ILLUSTRATIVE CASE STUDY

As part of a national nutrition plan, a multisectoral district nutrition coordinating committee (DNCC) planned to install latrines for 40 percent of households (500 in total) in 5 villages in the district and couple it with an education program aimed at ensuring the sustained use of the infrastructure. The project is supported by the government through the Ministry of Water and Sanitation. The DNCC includes the ministries of agriculture, planning, education, health, land affairs, water and sanitation, and gender and is chaired by the district nutritionist. Not all ministries are represented at the subdistrict level. The program targets underserved districts far from the capital. Two large development partners are active in the district but have a focus on agricultural production and small business development. For this DNCC to successfully deliver on its mandate, the following specific team and individual capacities are required:

1. A critical mass of individuals in the DNCC who have the orientation and skills to develop the DNCC into a team that takes responsibility for its own growth and development and for delivering on its mandate with a strategic longer-term view
2. A good awareness among team members of their own strengths and weaknesses and the impact of this for the technical, managerial, and leadership functions required
3. The ability to develop plans and put them into action and grow the DNCC into a more effective team, encouraging learning from experience—Dealing with internal team conflicts, politics, and power struggles requires a high degree of emotional intelligence, which is a capability that has to be planned for and that develops over time.
4. The ability to balance the need to wait for directives from higher levels with taking one's own initiative to achieve goals
5. The ability to lead without formal power, to drive team behavior through focusing on a worthwhile purpose beyond self-interest
6. The ability and skills to create aligned commitment within the team (DNCC) and among community members and beneficiaries at that village level and among partners and sectors
7. The ability to build effective work teams with clear roles and responsibilities for all stakeholders involved—national, provincial, district, subdistrict, and village levels and development partners
8. The expertise to know what expertise is present in the team and what needs to be developed or sourced from elsewhere
9. The skills to prioritize scarce resources; demands on staff who have multiple responsibilities, deliverables, and reporting lines; and time allocation
10. The ability to communicate priority setting of decisions back to their sectors and to deal with conflicting demands and resistance to change
11. The ability to lobby for more resources despite having low levels of power or authority to do so
12. The technical skills to perform the work (community engagement, earthworks, building, adult education, and so on)
13. Managerial skills to deal with project requirements (project planning, procurement, scheduling, monitoring progress, reporting)
14. The ability to manage resistance from development partners who would like to have their projects prioritized, from village members who will not benefit, from subdistrict structures that will not benefit, and from sectors that feel left out or threatened by the changes being implemented
15. The ability to draw all these issues into one coherent, prioritized implementation plan with all stakeholders committed and to act upon it in a systematic measurable way

Source: Authors

BOX 11.4—GENERIC REQUIREMENTS FOR AN EFFECTIVE NUTRITION LEADERSHIP CAPACITY BUILDING PROGRAM—SHARING EXPERIENCE FROM THE AFRICAN NUTRITION LEADERSHIP PROGRAMME

Leadership capacity development programs may have a number of general goals, depending on context and need. In general, they should include the following.

They should create awareness

- that leadership is a behavior and not a position;
- of the importance of developing a purpose beyond self-interest;
- of an acceptance of one's control over one's actions as opposed to blaming external factors;
- of one's own leadership orientation and ability and how it influences team and personal effectiveness (in recognition that all change initiatives start at an individual level); and
- that leaders are accountable to themselves for their own growth.

They should create a learning environment

- in which individuals can experience their strengths and growth areas and receive feedback on their behavior and growth;
- that allows for growth from awareness to attitude to behavior;
- in which participants experience how leadership capabilities affect team performance and work performance;
- in which participants develop a personalized action plan for growth beyond the capacity development program; and
- in which the practice of reflection as a basis for continued self-discovery and growth is embedded.

Source: Authors.

pilot phases. The SUNLEAD Africa program showed that developing leadership capabilities increased team effectiveness in all five MSN district teams that participated in the program (Jerling et al. 2015).

Developing the Capacity to Lead Change Interventions in Nutrition

Different models have been proposed for planned organizational change.[28] These models have many similarities and target a variety of perspectives and orientations. Of practical interest for multisectoral nutrition action is Coetsee's (2011) model, which is based on modern organization leadership development theory and best practices in African settings. The model has been validated in settings requiring multiple sectors to collaborate to achieve results—for example, in Kenya, to support implementation of mandatory food fortification; in Uganda and Rwanda, to increase effectiveness of district multisectoral teams implementing SUN programs; and in Zambia, within a formal organizational context (Jerling et al. 2015). Box 11.3 demonstrates a range of typical capacities that have to be developed in individuals and multisectoral nutrition teams to deliver effective nutrition action.

There is broad consensus that effective leadership is essential for working to overcome the nutrition challenges in Africa. The current capacity to lead nutrition interventions at various levels is not optimal, and several leadership development initiatives have developed. The capacity to scale up leadership development has also grown, though much more is

28 For more about these models, see Kotter (2012); Taffinder (1998); Pendlebury et al. (1998); Nadler and Nadler (1998); Leppit (2006); Kirkpatrick (2001); Kanter et al. (1992); Anderson and Ackerman-Anderson (2002); Mento et al. (2002); Light (2005); and Coetsee (2011).

required to support needs across Africa. Building the capacity to scale up nutrition leadership development is urgent in order to achieve the various nutrition targets at the country, regional, and global levels.

Conclusion

The information in this chapter has led to the following conclusions.

Much political will to address nutrition has been demonstrated, with the development of policies and strategies at the country and continental level. Moving these developments to successful implementation has faced challenges that need to be addressed to take advantage of the momentum generated by SUN, CAADP, and other nutrition initiatives. The challenges addressed in this chapter include the complex requirements for developing effective MSN systems that provide for both horizontal and vertical coordination in planning, implementing, and monitoring and evaluating programs. Work done on this in four countries—Burkina Faso, Ethiopia, Mali, and Uganda—has identified key areas in which capacity should be strengthened. This work has also indicated that this process needs to be contextual and iterative to adequately address the dynamic nature of nutrition action.

The needed critical competency areas for three types of nutrition workforce—program managers and staff, evaluators and researchers, and frontline staff—have been identified. Strategies can be adapted to address these in the short, medium, and long term. These strategies should take into account the current limitations of available training institutions. Because the limitations in training capacity are common across the continent, regional joint training activities should be explored in the short term.

The ability to lead and manage nutrition change interventions is a critical success factor and an essential competency for Africa. Achieving the desired nutrition change given the multisectoral nature of nutrition will require individuals with well-developed leadership capabilities and a variety of leadership orientations to catalyze the process in the context of limited resources. A number of encouraging programs have contributed to individual leader development; more recently, the SUNLEAD Africa project focused on developing leadership capabilities at the district level, with improved multisectoral nutrition team effectiveness through a process that also involved training trainers. It is critical to mainstream leadership training into current nutrition initiatives to address some of the implementation barriers. Efforts must be made to explore ways to incorporate leadership training into the curricula for training different types of nutrition workforce and to strengthen the technical, managerial, and leadership capacity in the workplace for existing staff.

CASE STUDY 3

Mainstreaming Nutrition in the National Agriculture Programs and Investment Plans in Mozambique and Nigeria

Mozambique—Felicidade Panguene, Anina Manganhela, Ruth Butao Ayoade, and Mercy Chikoko.
Nigeria—Olutayo Adeyemi, Zainab Towobola, Rabe Mani, Louise Setshwaelo, Mawuli Sablah, and Mohamed Ag Bendech.

Many African countries have worked to mainstream nutrition into National Agriculture Investment Plans (NAIPs) over the past five years. Countries have taken different approaches and are at different stages of the process. This case study reviews actions taken in Mozambique and Nigeria to mainstream nutrition into NAIPs and other agricultural programs and strategies. Nigeria and Mozambique both suffer from high rates of food insecurity and undernutrition, and both countries have made concerted efforts to incorporate nutrition into agricultural policies and investment plans.

Mozambique

There was a high-level commitment in Mozambique to ensure that nutrition is integrated into the NAIP. The major goals established for the NAIP include achieving sharp reductions in chronic child malnutrition and in the proportion of the population suffering from hunger. The government established a national nutrition coordination unit within the National Agriculture Extension Directorate to support the implementation of nutrition-sensitive agricultural activities. There is also a proposal for the creation of a National Institute for the Promotion of Food and Nutrition Security, although this is still pending final endorsement by government. In addition, the Mozambique government has also

- Advanced the recruitment of nutritionists to work with agricultural extension officers and provided training for multisectoral work on nutrition, including involvement of voluntary social workers, community and religious leaders, and different associations, among others.
- Reinforced the integration of nutrition and food security in sectoral programs and plans and made budget allocations, although the amounts and actual disbursement remain a challenge.
- Continued mobilization of public investment and private sector support for coordination and capacity development of the multisectoral framework to ensure alignment of nutrition interventions.

Nigeria

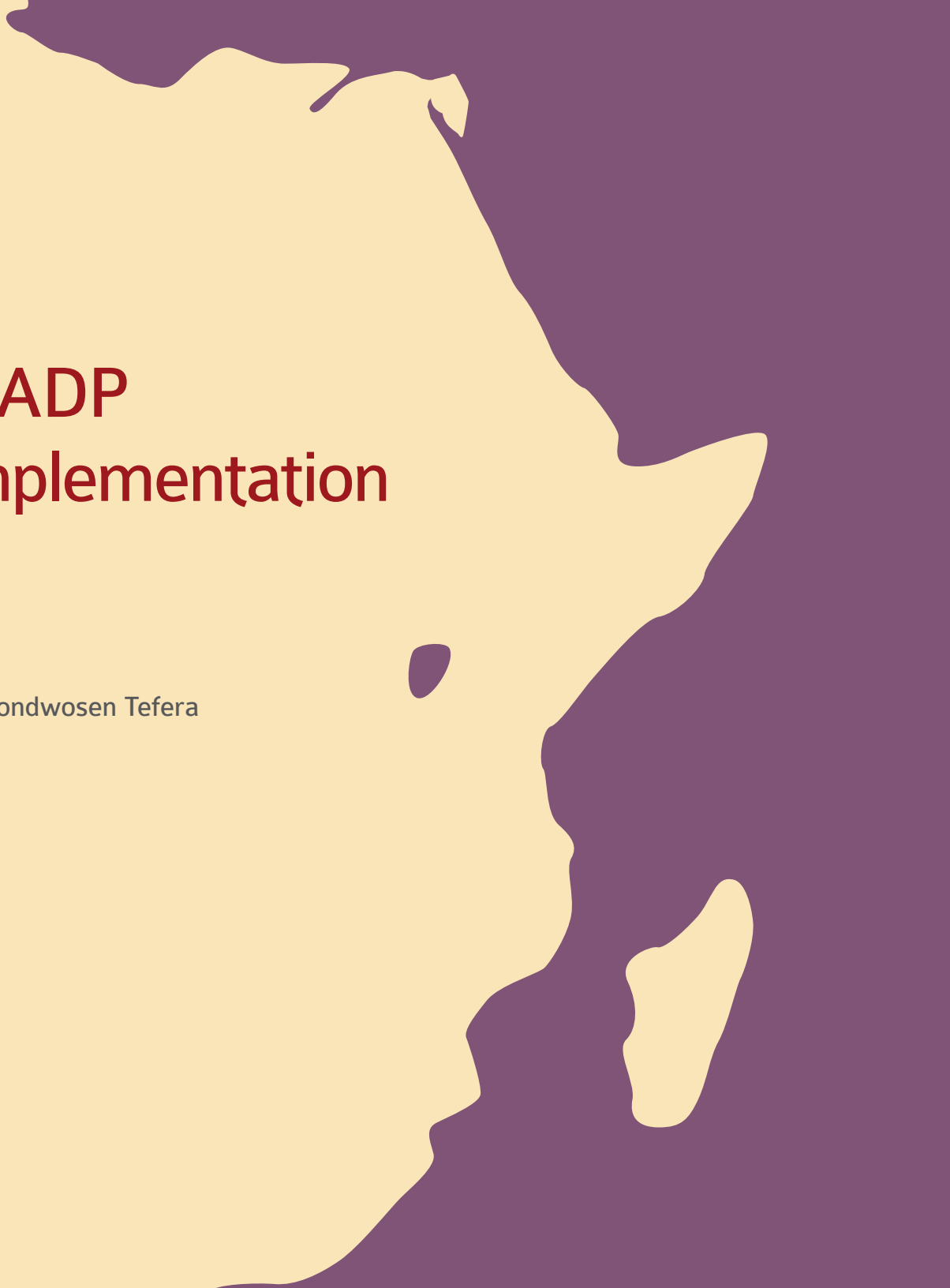
From 2011 to 2015, the Nigerian Federal Ministry of Agriculture appointed a national senior adviser on food security and nutrition with financial support from international donors. Appointment of this adviser facilitated studies to identify the needs and opportunities for mainstreaming nutrition into agriculture. The findings of these studies and the recommendations from the nutrition adviser led the agriculture minister to take several actions: convene a workshop on Mainstreaming Nutrition into Agricultural Policies, Programmes, and Value Chains; create a Nutrition Unit within an existing unit of the Ministry of Agriculture; establish a committee to review and revise the national agriculture policy to ensure that nutrition was incorporated into the revised policy; and seek technical support from the Food and Agriculture Organization of the United Nations (FAO) in developing a food security and nutrition strategy within the framework of the Agricultural Transformation Agenda. The Food Security and Nutrition Strategy 2016–2025 for Nigeria's agriculture sector has subsequently been developed, endorsed, and adopted.

A capacity development plan and an investment plan for the Agricultural Sector Food Security and Nutrition Strategy are now being developed. Technical working groups that have been established to develop a roadmap for intervening in Nigerian agriculture from 2016 to 2019 include a nutrition working group that has further advocated at the highest level of government for implementation of the strategy. This has led to continued support for the strategy despite changes to the Nigerian government, including a change of agriculture minister, during the course of developing the strategy.

CHAPTER 12

Tracking Key CAADP Indicators and Implementation Processes

Godfrey Bahiigwa, Samuel Benin, and Wondwosen Tefera



In June 2014, heads of state and government of the African Union (AU) adopted the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods, during the Twenty-Third Ordinary Session of the AU Assembly, in Malabo, Equatorial Guinea. In the Malabo Declaration, African leaders recommitted themselves to the principles and values of the Comprehensive Africa Agriculture Development Programme (CAADP) process. Specifically, they committed themselves to mutual accountability for actions and results through a systematic regular review process using the CAADP Results Framework (AUC and NPCA 2015). The revised Results Framework, with 40 prioritized indicators, builds on the previous CAADP Monitoring and Evaluation Framework (Benin, Johnson, and Omilola 2010). Since 2008, the Regional Strategic Analysis and Knowledge Support System (ReSAKSS) has been supporting the African Union Commission (AUC) and the NEPAD Planning and Coordinating Agency (NPCA) in tracking and reporting on more than 30 CAADP indicators in its Annual Trends and Outlook Report (ATOR), which is produced at the continental and regional levels. Established by the CAADP Partnership Platform and later endorsed by the AU's Conference of African Ministers of Agriculture, ReSAKSS maintains an interactive website (www.resakss.org), where the indicators can be freely accessed in the form of maps and charts, and the data can be downloaded in Microsoft Excel. The revised CAADP Results Framework has new indicators related to areas that were previously not tracked, including resilience, private sector investments, climate change, natural resource management, and some CAADP support processes. As such, ReSAKSS is continuously expanding the database to include new indicators.

The revised CAADP Results Framework has 40 indicators for tracking progress across three levels. Level 1 includes the high-level outcomes and impacts to which agriculture contributes, including wealth creation; food security and nutrition; economic opportunities, poverty alleviation, and shared prosperity; and resilience and sustainability. Level 2 includes the outputs from interventions intended to transform the agriculture sector and achieve inclusive growth: improved agricultural production and productivity; increased intra-African regional trade and functional markets; expanded local agro-industry and value-chain development, inclusive of women and youth; increased resilience of livelihoods and improved management of risks in agriculture; and improved management of natural resources for sustainable agriculture. Level 3 includes inputs and processes required to strengthen systemic capacity to deliver CAADP results and create an enabling environment in which agricultural transformation can take place: effective and inclusive policy processes; effective and accountable institutions, including assessing implementation of policies and commitments; strengthened capacity for evidence-based planning, implementation, and review; improved multi-sectoral coordination, partnerships, and mutual accountability in sectors related to agriculture; increased public and private investments in agriculture; and increased capacity to generate, analyze, and use data, information, knowledge, and innovations. This ATOR presents and discusses progress on 30 of the 40 indicators in the Results Framework.

Progress in CAADP Implementation Processes

The key indicators of progress in the CAADP implementation process include signing CAADP compacts; developing CAADP National Agricultural Investment Plans; establishment of a country SAKSS platform;

accessing the Global Agriculture and Food Security Support Program (GAFSP); undertaking agriculture Joint Sector Review (JSR) assessments; and membership in the New Alliance for Food Security and Nutrition and the Grow Africa partnerships. This progress is summarized in Table L3(a). As of August 2016, 42 out of 54 AU member states had signed CAADP compacts, and 30 had developed related national agriculture and food security investment plans (NAFSIPs). The NAFSIPs provide detailed implementation plans for achieving the goals and targets in the CAADP compacts. Following the signing of the compact and the development of a NAFSIP, countries hold a business meeting to discuss, among other things, the financing of the plan. The governments lead the process by presenting priorities in the NAFSIP, their own resources to finance the plan, and the financing gap that needs to be filled. By August 2016, 27 countries had held business meetings. To help countries finance the gaps in their NAFSIPs and achieve their targeted outcomes, GAFSP was created in 2010. To date, 17 countries in Africa have been approved for grants totaling US$611.5 million. In addition to GAFSP, other CAADP supporting initiatives are aimed at improving the pace and quality of implementation at the country level. For example, 10 African countries have signed cooperation agreements under the New Alliance for Food Security and Nutrition, which define commitments by various partners, including government, the private sector, and development partners. Another example is Grow Africa, which arose from the World Economic Forum to attract and support private sector investment in Africa's agriculture sector; 12 countries to date are participating in the partnership.

Even after signing CAADP compacts and developing NAFSIPs, countries still face questions during implementation that need to be answered. Countries need to track and report to their stakeholders the progress made in implementation of their NAFSIPs. Yet, in some cases governments' capacity for analysis and monitoring and evaluation (M&E) is weak. To fill this gap, ReSAKSS has been working to support countries to establish country SAKSS platforms that are aimed at improving the quality of policy analysis, review, and dialogue, with the ultimate goal of improving the quality of NAFSIP implementation. Eleven country SAKSS platforms have been established in the last four years, and two more SAKSS platforms are expected to be established before the end of 2016.

In its commitment to mutual accountability to actions and results, the Malabo Declaration calls for alignment, harmonization, and coordination among multisectoral efforts and multi-institutional platforms for peer review, mutual learning, and mutual accountability. It also calls for strengthening national and regional institutional capacities for knowledge and data generation and management that support evidence-based planning, implementation, and M&E. Agricultural JSRs are one way of operationalizing mutual accountability. JSRs provide an inclusive, evidence-based platform for multiple stakeholders to jointly review progress; hold each other accountable for actions, results, and commitments; and, based on gaps identified, agree on future implementation actions. To strengthen mutual accountability, as called for in the Malabo Declaration, ReSAKSS was tasked by AUC and NPCA to assist countries in enhancing existing agricultural sector review processes. In collaboration with Africa Lead, ReSAKSS initiated and completed agricultural JSR assessments in seven countries in 2014. These assessments were aimed at examining existing agricultural review mechanisms (at the country level) against JSR best practices, and identifying areas that need strengthening in order to help countries develop JSR processes that

are technically robust, more comprehensive in terms of thematic coverage, and more inclusive of non-state actors. In 2015, JRS assessments were initiated in 11 countries, but completed in 8 of them, bringing to 15 the number of countries that have completed the process to date. In 2016, assessments were initiated in 12 additional countries and are expected to be completed in early 2017. At the regional level, the Economic Community of West African States (ECOWAS) was the first regional economic community to hold a regional JSR in June 2016. The experiences and lessons learned during the JSR assessments are being used to support AUC and NPCA in preparation for the Malabo Declaration biennial review process, leading to the production of the first continental report that will be presented at the Summit of Heads of State and Government of the African Union in January 2018.

In addition to JSRs, in this ATOR we present an additional set of qualitative indicators for tracking progress in implementation of actions aimed at strengthening systemic capacity for agriculture and food security policy planning and implementation. This is the first time these indicators are being reported in the ATOR, and they will be a recurring feature in future ATORs. These indicators are presented in Table L3(b). As of August 2016, 26 countries had food reserves, local purchase for relief programs, early warning systems, and feeding programs. Eight countries had formulated new or revised NAFSIPs through an inclusive and participatory process, mainly in Eastern Africa. Seventeen countries had inclusive, institutionalized mechanisms for mutual accountability and peer review (mainly JSRs), predominantly in Western Africa. Six countries were implementing evidence-informed policies with adequate human resources in place. Fifteen countries had functional multi-sectoral and multi-stakeholder coordination bodies—mainly agricultural sector working groups, primarily in Western Africa. Five countries had successfully undertaken agriculture-related public-private partnerships (PPPs) aimed at boosting specific agricultural value chains. Tanzania and Uganda are the only two countries that reported the cumulative value of their PPPs, at US $3.2 billion and $156 million, respectively.

Progress in CAADP Indicators

The following sections assess Africa's performance on 26 of the 40 indicators of the CAADP Results Framework for which data are readily available. The remaining indicators will be added gradually in subsequent ATORs and on the ReSAKSS website as data become available. ReSAKSS will also continue to present data for eight indicators that were reported on previously and which remain of interest to stakeholders, on the ReSAKSS website and in the supplementary data tables in Annex 5a of this report. The CAAPD indicators in the 2015 ATOR are presented in six different breakdowns: (1) for Africa as a whole; (2) by AU's five geographic regions (Central, Eastern, Northern, Southern, and Western); (3) by four economic categories (countries with less favorable agricultural conditions, countries with more favorable agricultural conditions, mineral-rich countries, and middle-income countries); (4) by the eight regional economic communities (CEN-SAD, COMESA, EAC,

[29] CEN-SAD, the Community of Sahel-Saharan States; CEMAC, the Economic and Monetary Community of Central Africa; COMESA, the Common Market for Eastern and Southern Africa; EAC, the East African Community; ECCAS, the Economic Community of Central African States; ECOWAS, the Economic Community of West African States; IGAD, the Intergovernmental Authority for Development; SACU, the Southern African Customs Union; SADC, the Southern African Development Community; and UMA, the Arab Maghreb Union.

ECCAS, ECOWAS, IGAD, SADC, and UMA)[29]; (5) by the period during which countries signed the CAADP compact (CC1, CC2, CC3, and CC0)[30]; and (6) by the level or stage of CAADP implementation reached by the end of 2015 (CL0, CL1, CL2, CL3 and CL4)[31]. Annex 4 lists the countries in each CAADP category. For most indicators, post-CAADP levels (average levels from 2003–2008 and 2008–2015) are compared with levels of the pre-CAADP base period of 1995–2003. The discussion here is mainly confined to trends for Africa as a whole and for countries categorized by length of time in the CAADP process and by stage of CAADP implementation.

Wealth Creation

Africa as a whole has experienced robust economic growth in the last 20 years. *Gross domestic product (GDP) per capita* increased from an annual average of US$1,438 in 1995–2003 to $1,690 in 2003–2008, and even higher in 2008–2015, reaching an annual average of $1,892.[32] As Table L1.1.1 shows, all classifications had increasing rates of growth in GDP per capita. However, during 2008–2015, the rates of growth slowed with GDP growing at less than 1 percent per year for Africa as a whole. The slowdown in economic growth is attributed to broader developments in the global economy, notably the ripple effects of the fuel and financial crises of 2007 and 2008. Countries that signed the CAADP compact earliest (CC1 and CC2) had higher growth rates in GDP per capita during both the 2003–2008 and 2008–2015 periods than those that signed later. These fast growth rates enabled them to narrow the gap in per capita income levels with those countries that have not yet adopted the CAADP process. For example, during the 1995–2003 period, the annual average GDP per capita for CC0 countries was 4.2 times that of CC1 countries, but during the 2008–2015 period, this ratio had been reduced to 2.2. Also, countries that have gone through the key CAADP stages, from signing a CAADP compact, to developing a NAFSIP, to securing external funding sources, registered higher GDP per capita growth rates than those countries that are yet to go through these key stages. Another indicator of wealth status is *household consumption expenditure per capita* (Table L1.1.2), which increased substantially for Africa as a whole from an average of $1,015 in 1995–2003 to $1,275 in 2008–2015, with the highest annual average growth rate occurring during the 2003–2008 period, consistent with GDP per capita growth patterns. CC1 and CC2 countries had faster growth rates than CC3 and CC0 countries. The most advanced countries in the CAADP process registered the fastest improvement in household consumption expenditure per capita.

Food and Nutrition Security

Measures of hunger and malnutrition (undernourishment, underweight children, stunting, and wasting) are improving across Africa, albeit very slowly. The prevalence of *undernourishment* showed continuous decline

30 CC1 are countries that signed the compact in 2007–2009; CC2 are countries that signed the compact in 2010–2012; CC3 are countries that signed the compact in 2013-2015; and CC0 are countries that have not yet signed a CAADP compact.

31 CL0 are countries that have not started the CAADP process or are pre-compact; CL1 have signed a CAADP compact; CL2 have signed a compact and formulated a NAFSIP; CL3 have signed a compact, formulated a NAFSIP and secured one external funding source; CL4 have signed a compact, formulated a NAFSIP and secured more than one external funding source.

32 All dollars in this chapter are constant 2010 US dollars.

across Africa and in all categories over the last 20 years, although the rates of decline were lower during 2008–2015 than during 2003–2008 (Table L1.2.1). Undernourishment is lowest among countries that have not yet adopted the CAADP process—these are the countries with the highest GDP per capita and also the highest consumption expenditure per capita. However, the rates of reduction in undernourishment are faster in CAADP countries, especially in those that have been in the CAADP process the longest and those that have gone through most of the stages of the CAADP process.

The prevalence of *underweight children* under five years of age has been declining across Africa as a whole, from 24.7 percent recorded in 1995–2003 to 22.5 percent in 2003–2008, and further down to 20.0 percent in 2008–2015. The extent of decline was relatively higher in 2008–2015, at an annual average of 2 percent, compared with the two earlier periods. In the most recent CAADP period, faster rates of decline were observed in the countries that have been in the CAADP process the longest and those that have gone through the key CAADP stages (Table L1.2.2A). Despite this progress, the pace of decline needs to increase if the Malabo target of a 5 percent prevalence rate by 2025 is to be achieved.

Stunting levels are still very high in Africa, at more than 35 percent for children under five years of age. However, stunting levels are declining across the continent, from 41.9 percent in 1995–2003 to 35.6 percent in 2008–2015. The rate of decline was highest in the latter period, at an annual average of 1.8 percent (Table L1.2.2B), but more effort will be needed to achieve the Malabo target of a 10 percent prevalence rate by 2025. Countries that have been in the CAADP process the longest registered the highest rates of reduction during both CAADP periods. The prevalence of *wasting* among children under five years of age showed similar trends, declining across the continent from 10.8 percent in 1995–2003 to 10.1 percent and 9.3 percent in 2003–2008 and 2008–2015, respectively. The one exception is the non-CAADP countries, in which the prevalence of wasting increased from 8.0 percent in 2003–2008 to 8.3 percent in 2008–2015 (Table L1.2.2C). It is important to note the rise in wasting in these countries despite their having better income and consumption indicators, implying that assuring better nutrition outcomes goes beyond attaining high incomes.

Employment

The *rate of employment* (as a percent of the population above 15 years of age) for Africa as a whole has increased marginally over the last 20 years, from 90.6 percent in 1995–2003 to 91.8 percent in 2008–2015. The employment rate grew most quickly, at 0.22 percent per year, during the 2003–2008 period, but the growth rate decelerated and turned negative during the 2008–2015 period, especially in countries that have not adopted the CAADP process (Table L1.3.1).

Poverty

In Africa as a whole, the incidence of poverty has been declining, along with its depth as measured by the *poverty gap index* (PGI), which declined from 24.7 percent in 1995–2003 to 17.3 percent in 2008–2015 (Table L1.3.3). Despite the slowdown in GDP per capita growth during 2008–2015 (Table L1.1.1), poverty fell faster during this period, at an annual rate of 3.1 percent, than during 2003–2008, at 2.3 percent per year. The PGI indicates the resources that would be needed to bring the poor out of extreme poverty,

with countries that have been in the CAADP process for a shorter period needing more resources than those that have been in the process longer. The countries with the highest GDP per capita (CC0) need the least amount of resources to lift their poor out of poverty.

In Africa as a whole, the *headcount poverty ratio* at the international poverty line of $1.90/day has dropped moderately but consistently, from 49.9 percent in 1995–2003, to 45.3 percent in 2003–2008, and to 41.7 percent in 2008–2014 (Table L1.3.4). All regions, economic classifications, RECs and CAADP categories showed the same consistent reduction in poverty. However, poverty reduction appears to be accelerating. The average annual percentage reduction in poverty during 2008–2015 was greater than the annual average reduction during 2003–2008 for Africa as a whole, with varied performance among regions and economic groups. However, for the continent as a whole, the rate of poverty decline was not sufficient to meet the MDG target of halving poverty by 2015, although some individual countries achieved the target. Countries that met the MDG target were spread across all CAADP categories, perhaps confirming that CAADP interventions are complementary to others in the economy. Among the CAADP categories, only the non-CAADP countries, as a group, achieved the MDG target, reducing poverty from 19.7 percent in 1995–2003 to 9.7 percent during 2008–2015.

Income inequality, measured by the *Gini index*, has fallen marginally for Africa as a whole, declining from 44.2 in 1995–2003 to 42.6 in 2008–2015 (Table L1.3.5). The highest inequality is observed in the non-CAADP countries, and they are the only category in which inequality rose consistently over the last 20 years, from 51.7 in 1995–2003 to 53.2 in the 2008–2015 period.

Agricultural Production and Productivity

Agriculture value added in Africa increased remarkably between 1995–2003 and 2003–2008, expanding at an annual average rate of 4.67 percent, although this was still lower than the CAADP target of 6 percent (Table L2.1.1). The rate of growth decreased to 3.35 percent during 2008–2015. In general, all CAADP categories experienced robust growth during 2003–2008, with CC1, CL3, and CL4 countries achieving the CAADP target. None of the categories achieved the CAADP target during the 2008–2015 period. Overall, countries that have been in the CAADP process longest, and those that have gone through the key CAADP stages, have registered higher growth rates than the countries in the other categories. The total value of agricultural production has been rising across the continent, regardless of geographical location, economic classification, or adoption of the CAADP framework. The *agricultural production index (2004–2006=100)* for Africa as a whole rose from 80.8 in 1995–2003, to 100.4 in 2003–2008, and to 117.2 in 2008–2013 (Table L2.1.2). However, the rates of increase in agricultural production were higher in CAADP countries than in non-CAADP countries, with faster growth rates observed in the most recent period.

Labor productivity (measured as agriculture value added per agricultural worker) and *land productivity* (measured as agriculture value added per hectare of arable land) have risen over the last 20 years across Africa as a whole, with variations among the various CAADP categories (Tables L2.1.3 and L2.1.4). Labor productivity grew faster during 2003–2008, at 2.11 percent per year, than during 2008–2015, when it grew by 1.73 percent per year. The highest labor productivity was recorded in the non-CAADP countries, largely because of higher rates of mechanization in this group. Land productivity exhibits trends similar to those of labor productivity, but in this case

the countries that have gone through all the CAADP stages (CL4) had higher levels of land productivity than the non-CAADP countries, even though they started at the same annual average of $270 in 1995–2003.

In line with the CAADP Results Framework, the 2015 ATOR, for the first time, presents yield trends for the five AU priority commodities (cassava, yams, maize, meat, and milk). *Cassava yield*, measured in tons per hectare (ton/ha), increased from an annual average 8.6 ton/ha during 1995–2003 to 9.3 ton/ha during 2003–2008 (Table L2.1.5a), but declined to 8.4 ton/ha in 2015. The growth rates of cassava yields were highest during the second period. *Yam and maize yields* (Tables L2.1.5b and L2.1.5c) experienced similar trends, growing rapidly during the 2003–2008 period and experiencing declining growth rates during the 2008–2015 period. *Meat yield* measured as kilograms per head (kg/head) has increased moderately over the last 20 years, with the highest growth rate registered during 2003–2008 (Table L2.1.5d). Non-CAADP countries have higher meat yields than other categories, perhaps due to more advanced production techniques. *Milk yield* (kg/head) trends are similar to those of meat yield. Non-CAADP countries produce higher milk volumes per animal than the other categories (Table L2.1.5e).

Intra-African Regional Trade and Market Performance

The Malabo Declaration calls for tripling intra-African trade in agricultural goods and services by 2025. Over the last 20 years, *intra-African agricultural exports* more than doubled, from $599 million in 1995–2003 to $1,470 million in 2008–2015. And the average annual growth rates have been impressive in the CAADP period, growing at 6.1 percent and 21.9 percent in 2003–2008 and 2008–2015, respectively (Table L2.2.1a). Countries that have been in the CAADP process the longest and those that have gone through all the levels of the CAADP process have tended to register the highest growth rates in intra-Africa agricultural exports, although the non-CAADP countries registered the highest growth rate in the recent period. *Intra-African agricultural imports* almost doubled over the last 20 years (Table L2.2.1b) and CC1, CL4 and CC0 countries had the highest growth rates. For Africa as a whole, *domestic food price volatility*, a measure of how well food markets are functioning, increased during the first CAADP period at an annual average rate of 3.74 percent (Table L2.2.2); this was the period during which the world experienced a food crisis. However, since 2008, price volatility, although still high, has been declining. Domestic food price volatility was particularly high in countries that began the CAADP process earliest (CC1 and CC2) and countries that were farthest advanced in the CAADP process (CL3 and CL4) during the 2003–2008 period, but these countries had the highest rates of decline in volatility during the 2008–2012 period. Perhaps the heavy dependence of these countries on agriculture makes them particularly vulnerable to price fluctuations.

Agriculture Sector Expenditure

The volume of public resources invested in agriculture has increased tremendously over the last 20 years. The national average *public agriculture expenditure* in Africa increased from $708 million in 1995–2003, to $1,169 million in 2003–2008, and to $1,171 million in 2008–2014 (Table L3.5.1). The highest growth in public expenditure in Africa was recorded in 2003–2008, at 11.5 percent per year. However, during 2008–2014, public

expenditure in agriculture declined at an annual average rate of 5.6 percent, reaching an average level of $765 million in 2014. During the 2003–2008 period, public spending increased in all CAADP categories, except in the non-CAADP category, although the latter category increased spending during the 2008–2014 period.

While the volume of resources spent in agriculture has increased across all groupings, the *share of public agriculture expenditure in total public expenditure* has remained at less than 4 percent for Africa as a whole, thus failing to reach the CAADP target of 10 percent (Table L3.5.2). None of the regions or economic groups met the CAADP expenditure target during 2003–2008 or 2008–2014, although some individual countries met the target. However, countries that have been in the CAADP process the longest have the highest shares of public agricultural expenditure and have maintained the highest shares in both periods. On the other hand, countries that have only signed the CAADP compact, but not advanced further in the process, have not only maintained the lowest shares but have also seen their shares decline in the latest period. Momentum toward reaching the CAADP targets needs to be enhanced in these countries.

The *share of agriculture sector expenditure in total agricultural GDP* has largely remained stable, at around 6 percent per year. The share increased slightly from 5.6 percent in 1995–2003 to 6.2 percent in 2003–2008, but declined slightly to 5.8 percent during 2008–2014—slightly higher than during the pre-CAADP period (Table L3.5.3). It is interesting to note that countries with a larger share of agriculture in total GDP (Annex 4) show the lowest share of agricultural expenditure in agricultural GDP. This reflects limited investment in the sector relative to its contribution to total GDP. On the other hand, countries with smaller shares of agriculture in total GDP are investing a larger share of their expenditure in the sector.

CHAPTER 13

Summary and Policy Recommendations: Toward a Nutrition Revolution for Africa

Sheryl L. Hendriks and Namukolo Covic

Where Are We Now?

Multiple declarations and agreements commit African governments to reducing hunger and malnutrition and improving the diets of their populations to ensure sustainable growth and prosperity for Africa. To make these commitments count, the objectives need to be specific, measurable, achievable, relevant, and time bound (SMART), as well as ambitious and aligned to the efforts of others.

Malnutrition in all its forms—undernourishment, micronutrient deficiencies, and overweight—is robbing Africa of much-needed productivity and growth potential. Addressing nutrition is an investment with high potential returns in terms of reduced health costs, increased productivity, and improved human resource capacity and economic growth. Although nutrition interventions have been seen as belonging in the health sector, integrated programs that include agriculture and other sectors can create synergies and added value. The agriculture sector needs to become more nutrition sensitive so that it can work in tandem with other sectors to drive a much-desired nutrition revolution for Africa. Achieving the goals of the Malabo Declarations on (1) accelerated agricultural growth and transformation for shared prosperity and improved livelihoods and (2) nutrition security through inclusive economic growth and sustainable development will require efforts from agriculture, social agriculture, social protection, education, water and sanitation, and more to implement high-impact interventions at scale.

A nutrition revolution for Africa will require radical actions to reduce undernutrition, correct micronutrient deficiencies, and stem the tide of increasing overweight and obesity. Each of these three problem areas must be addressed. This report has discussed opportunities for making Africa's food system deliver healthier, more nutritious foods and for making these foods more available and affordable to all people. Clearly, the choices we make (or fail to make) for agriculture and other sectors will shape the future food system and, in turn, the health and productivity of the continent.

This report has demonstrated that a great deal is known about which actions to take and the various considerations that need to be taken into account—choices of what to grow, actions to prevent spoilage that reduces the nutritional value of food, choices of what to eat or what to feed infants and young children. Chapter 3 showed that although some statistics remind us of the size of the challenge, the successes of some countries and regions point to what can be achieved with the right focus, interventions, policies, sustained commitments, and stakeholder accountability mechanisms. The evidence in support of success is strong.

Agricultural systems are instrumental in the African growth and development agenda. Agriculture is the main livelihood of much of Africa's population and is an important driver of economic development. Therefore, agriculture can be a powerful lever for raising people's health and nutritional status, while also contributing to other outcomes, such as food security, income, equity, and sustainability. The design of agricultural policies, interventions, and practices can support such a change and contribute to the nutrition revolution. Delivering and promoting the consumption of food that is affordable, safe, of good nutritional quality, and available year-round requires working across the food system. As populations become increasingly urbanized and markets more globalized, it is obvious that action is required not only at the level of production but also at all stages of the food value chain—from natural resource management and input supply to production, transport, processing, retailing, and consumption.

Positive progress has been made on the continent on a number of indicators during the CAADP implementation period, and there are early indications showing that the CAADP process might be a contributing factor. Chapter 12 on tracking CAADP indicators has demonstrated that countries that are furthest in the CAADP implementation process are doing better on several indicators, including agricultural production and productivity, intra-Africa trade, employment creation, and poverty reduction. However, the continent is still struggling to meet the set targets of increasing the share of public agriculture expenditure to 10 percent and raising annual agricultural growth to 6 percent.

Similarly for nutrition, the countries that were furthest in the CAADP process or that have been part of CAADP the longest also registered better reductions in undernourishment, underweight, stunting, and wasting. However, the rates of decline have been slow and below what is needed to reach the Malabo targets for zero hunger, including bringing stunting down to 10 percent and underweight down to 5 percent by 2025. Therefore, to accelerate the reduction of malnutrition agriculture needs to become more nutrition sensitive to bring about a nutrition revolution.

Moving Forward

The most direct pathway for improving nutrition is through agricultural production—when production translates directly into consumption for households cultivating crops. However, we need to stimulate the demand for nutritious foods, increasing the demand for and consumption of nutritious food and reducing excessive demand for foods that lead to undesirable health consequences in order to curb the acceleration of rates of overweight, obesity, and noncommunicable diseases. Doing so requires the transformation of agriculture value chains to increase the nutritional value of foods. This change will have multiple benefits for producers and consumers. It will also have a positive influence on the basket of food at the household level (such as foods for local consumption rather than export and foods with a relatively high nutritional value) that households produce or can access economically. The nutrient content and food safety (lack of contamination risk) should all be enhanced. Like other productive sectors, agriculture is a source of household income (raised through wages earned by agricultural workers or through the marketed sales of food produced) and expenditure on nutrition-enhancing goods and services (including health, education, and social services). Agriculture is known to be a more important source of income for the poor and undernourished in Africa than other economic sectors.

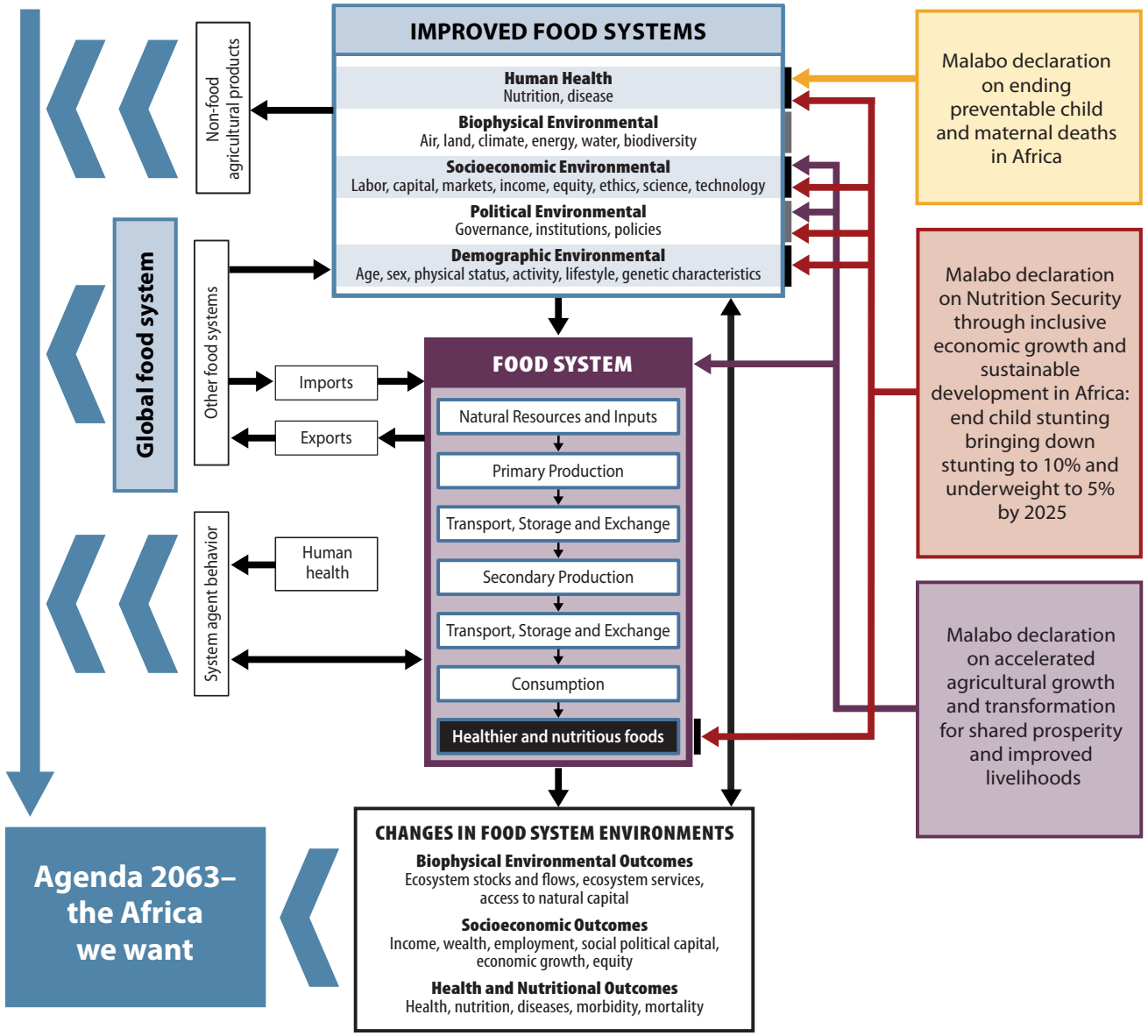
Achieving all of the above requires a comprehensive food systems approach to agricultural development in countries and across the continent. Although the African Union and the Comprehensive Africa Agriculture Development Programme (CAADP) have not deliberately adopted a food systems approach to the development agenda, the four pillars of CAADP generally cover key elements of the food system. Some of the CAADP indicators being tracked as presented in Chapter 12 are a clear indication of this. This is also reflected by the entry points of three Malabo Declarations into a food systems framework as illustrated in Figure 13.1. Therefore, refinement of current CAADP frameworks to deliberately adopt a food systems approach offers tremendous opportunities to deliver more nutritious, healthier diets to the population at large, thus helping to overcome malnutrition in all its forms (Figure 13.1). This effort would need to be supported by behavior change communication to influence choices of what is eaten and

what is fed to children, as part of agricultural activities. In an ever-more globalized world, effort must be made to ensure that Africa's interaction with the global food system does not unduly propel the continent into a negative nutrition transition that will compromise the gains that are beginning to take place on undernutrition, as well as an unsustainable agriculture system in the long term.

Other Important Issues to Consider

Participation in value chains carries important opportunities to increase women's control over nutrition-relevant resources and decision making, particularly regarding food and healthcare. At the same time, agricultural development, especially as it is related to the expansion and formalization of markets (as with heavy and prolonged workloads), could inadvertently disempower

FIGURE 13.1—THE ELEMENTS AND CONNECTIVITY OF THE FOOD SYSTEM AT NATIONAL OR REGIONAL SCALE



Source: Adapted from Pinstrup-Andersen and Watson (2011).

women, adding to their time burden or reducing their control over income. This could have negative consequences for diet and nutrition outcomes for women and those dependent on them. Arduous and hazardous conditions of agricultural labor pose substantial risks for maternal nutritional and health status. (When their work-related energy expenditure exceeds their intakes, their dietary diversity is compromised, or they may fall sick because of the conditions in which they work.)

Continued advocacy and sensitization efforts are required, backed up with convincing data on the cost of inaction, on what works, and at what cost. However, more comprehensive evidence is needed to inform policy and program decisions, rather than the siloed data systems currently in place for agriculture, food security, poverty, and nutrition. We need more data on the different forms of malnutrition, consumption patterns, and dietary intake to monitor and track the changes in diets and nutritional status as African countries develop and undergo economic and food system transformations. Collection of data on nutrition should be imbedded within agriculture interventions to track impact of such interventions. We also need better information on public expenditure and the cost of intervention options, as well as the cost of not acting to support decision making.

Stronger national systems of policy mapping and analysis are essential to make the best choices in policy formulation and decision making. Therefore, it is important to support countries in developing the capacity to collect, analyze, and communicate this information to inform their food system and agricultural policy and program design and to monitor their impact.

For program staff, technical competency needs to align with systems-based thinking that informs design, implementation, and monitoring and evaluation of nutrition policies and programs. At the least, program staff should be grounded in the links between the food system and the health system and should have the capacity to design appropriate delivery channels through those systems by finding levers and entry points for nutrition.

Finally, all of the above needs transformational leadership to bring about coordinated change and to address the dynamics of dealing with multiple sectors and stakeholders amid competing demands. Leadership is also critical for managing resistance to change and to create an environment in which the desired change can take place effectively. In this way, Africa can undergo a nutrition revolution that is in line with the African Union's Agenda 2063.

Recommendations

To achieve a nutrition revolution for Africa, we recommend the following:

1. At all levels, make the political choice to position nutrition as a priority at the highest level of governance within an integral element of funded comprehensive growth and development strategies.

2. Make deliberate efforts to increase the nutrition sensitivity of current and future agriculture programs and projects by incorporating nutrition components, including leveraging agricultural extension networks at the country level, and providing a nutrition workforce within the agriculture sector to support nutrition action. It will also be critical to integrate nutrition objectives and indicators into the design and monitoring mechanisms of all future programs seeking to achieve priority national development objectives, as well as Malabo Declarations and Sustainable Development Goal targets.

3. Establish strong institutional structures to coordinate efforts and ensure that existing resources in agriculture, social protection,

education, and water and sanitation are leveraged to scale up high-impact interventions.

4. Create national growth and development strategies that include a blend of nutrition-specific and nutrition-sensitive programs that seek to increase the overall supply and distribution of healthy, nutrient-dense foods at affordable prices through agricultural value chains that support sustainable livelihoods for rural households. This calls for a food systems approach.

5. Make agricultural policy and practice more nutrition sensitive and, therefore, more effective in improving nutrition and agriculture. This can be achieved through a review of agriculture, food, and trade policies to identify reforms necessary to stimulate the local supply and demand of healthy nutritious foods and discourage the consumption of unhealthy foods and food waste. This will also help ensure that unfavorable food policies do not aggravate nutritional challenges, especially in rapidly transforming food systems.

6. Create and strengthen institutional and policy environments that enable agriculture to support nutrition and health goals.

7. Harness the potential for science, technology, and innovation to reduce postharvest losses and food waste; promote product diversification with nutritious foods; improve processing to extend shelf life and make healthy foods easier to prepare; and improve storage and preservation to retain nutritional value, ensure food safety, and extend seasonal availability.

8. Accelerate efforts to reduce exposure to mycotoxins, such as aflatoxins, in the food value chain in support of nutrition, health, and economic objectives.

9. Develop capacity and leadership to use evidence-informed decision making to enhance the impact of agriculture on nutrition and health.

10. Accelerate current efforts to develop transformational leadership capabilities, which are needed to manage the change processes required to effectively coordinate and implement nutrition programs and interventions amid competing priorities and demands.

11. African academic institutions must work to develop the needed nutrition workforce to leverage current momentum on nutrition and sustain it into the future, including providing attention to frontline staff.

12. Make commitments that count—specific, measurable, achievable, relevant, and time bound, as well as ambitious and aligned to the efforts of others. More needs to be invested in more and better data. Inclusive annual national and subnational reporting mechanisms need to be developed and implemented to assess progress on commitments, nutrition outcomes, and actions in a timely way.

ANNEXES

Core CAADP M&E and Supplementary Indicators

Annexes:
Core CAADP M&E and Supplementary Indicators

This section presents data and trends across three levels of the CAADP Results Framework as well as supplementary data and trends.[33]

The data are presented at the aggregate level for the entire continent (Africa); the five geographic regions of the African Union (central, eastern, northern, southern, and western); eight Regional Economic Communities (CEN-SAD, COMESA, EAC, ECCAS, ECOWAS, IGAD, SADC, and UMA);[34] four economic categories that are classified according agricultural production potential, alternative nonagricultural sources of growth, and income level; and nine CAADP groups representing either the period during which countries signed a CAADP compact or the level of CAADP implementation reached by countries by the end of 2015. Data for individual countries and regional groupings is available at www.resakss.org.

Technical Notes to Annex Tables

1. To control for year-to-year fluctuations, point estimates are avoided. Therefore, the values under the column "2003" are averages over the years 2002 to 2004 and the values under the column "2015" are averages over the years 2014 to 2015.

2. Annual average level and annual average change for 2003–2015 include data from 2003 up to the most recent year that is measured and available.

3. Annual average level is the simple average over the years shown, inclusive of the years shown.

4. Annual average change for all indicators is annual average percent change, the beginning to the end years shown by fitting an exponential growth function to the data points (that is, "LOGEST" function in Excel).

5. For indicators for which there are only a few measured data points over the years specified in the range (such as poverty, which is measured once every three to five years or so), a straight-line method was used to obtain missing values for the individual years between any two measured data points. Otherwise, estimated annual average change based on the measured values is used to obtain missing values either preceding or following the measured

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33 Future Annual Trends and Outlook Reports (ATORs) will report on more of the CAADP Results Framework indicators as more data becomes available.

34 CEN-SAD is the Community of Sahel-Saharan States; COMESA is the Common Market for Eastern and Southern Africa; EAC is the East African Community; ECCAS is the Economic Community of Central African States; ECOWAS is the Economic Community of West African States; IGAD is the Intergovernmental Authority for Development; SADC is the Southern Africa Development Community; and UMA is the Union du Maghreb Arabe.

data point. In cases where the missing values could not be interpolated, the data is reported as missing and excluded from the calculations for that time period. Any weights used for these indicators are adjusted to account for the missing data in the series of the indicator.

6. Values for Africa, the regional aggregations (central, eastern, northern, southern, and western), economic aggregations (less favorable agriculture conditions, more favorable agriculture conditions, mineral-rich countries, and middle-income countries), Regional Economic Communities (CEN-SAD, COMESA, EAC, ECCAS, ECOWAS, IGAD, SADC, and UMA), and CAADP groups: Compact 2007–2009 (CC1), Compact 2010–2012 (CC2), Compact 2013–2015 (CC3), Compact not yet (CC0), Level 0 (CL0), Level 1 (CL1), Level 2 (CL2), Level 3 (CL3), and Level 4 (CL4) are calculated by weighted summation.[35] The weights vary by indicator and weights are based on each country's proportion in the total value of the indicator used for the weighting measured at the respective aggregate level. Each country i's weight in region j (wij) is then multiplied by the country's data point (xi) and then summed up for the relevant countries in the region to obtain the regional value (yj) according to: $yj = \Sigma i\ wijxi$.

The trend data are organized as follows:

Annex 1
Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development

Annex 2
Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth

Annex 3
Level 3— Strengthening Systemic Capacity to Deliver Results

Annex 4
Country Classification by Period When CAADP Compact Was Signed and Level of CAADP Implementation

Annex 5
Supplementary Data Tables

35 CC1 are countries that signed the compact in 2007–2009; CC2 are countries that signed the compact in 2010–2012; CC3 are countries that signed the compact in 2013-2015; and CC0 are countries that have not yet signed a CAADP compact. CL0 are countries that have not started the CAADP process or are pre-compact; CL1 have signed a CAADP compact; CL2 have signed a compact and formulated a NAFSIP; CL3 have signed a compact, formulated a NAFSIP and secured one external funding source; CL4 have signed a compact, formulated a NAFSIP and secured more than one external funding source.

ANNEX 1a: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.1.1

TABLE L1.1.1—GDP PER CAPITA (constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	1,438	1.08	1,533	1,690	3.84	1,892	0.90	1,943
Central	712	-0.15	736	787	2.23	847	1.35	883
Eastern	558	1.52	596	663	5.04	799	1.39	838
Northern	2,562	2.40	2,821	3,093	3.59	3,393	0.03	3,391
Southern	2,993	0.52	3,077	3,367	4.12	3,709	0.55	3,765
Western	1,015	1.09	1,148	1,341	5.40	1,650	2.73	1,779
Less favorable agriculture conditions	421	1.27	456	504	3.51	602	3.15	657
More favorable agriculture conditions	459	0.47	464	494	3.03	596	3.54	658
Mineral-rich countries	410	-1.59	400	427	3.01	512	3.00	556
Middle-income countries	2,291	1.48	2,490	2,776	4.18	3,103	0.73	3,171
CEN-SAD	1,354	1.56	1,487	1,677	4.51	1,921	0.90	1,971
COMESA	957	0.94	988	1,072	3.74	1,176	-0.31	1,165
EAC	550	0.98	581	630	3.42	748	2.85	810
ECCAS	886	0.18	906	1,059	6.85	1,277	1.45	1,338
ECOWAS	1,015	1.09	1,148	1,341	5.40	1,650	2.73	1,779
IGAD	557	1.46	594	667	5.70	816	1.09	849
SADC	1,833	0.25	1,864	2,018	3.63	2,196	0.54	2,231
UMA	3,138	2.37	3,493	3,856	3.40	4,099	-0.27	4,070
CAADP Compact 2007–09 (CC1)	805	1.16	923	1,100	6.20	1,400	3.20	1,526
CAADP Compact 2010–12 (CC2)	577	0.09	584	622	2.66	718	2.58	776
CAADP Compact 2013–15 (CC3)	1,356	1.34	1,414	1,611	6.01	1,891	0.86	1,948
CAADP Compact not yet (CC0)	3,362	1.77	3,637	3,951	3.15	4,181	-0.03	4,174
CAADP Level 0 (CL0)	3,362	1.77	3,637	3,951	3.15	4,181	-0.03	4,174
CAADP Level 1 (CL1)	1,433	1.26	1,489	1,718	6.59	2,035	0.74	2,087
CAADP Level 2 (CL2)	510	-1.03	502	522	1.60	566	1.95	605
CAADP Level 3 (CL3)	459	1.72	492	531	3.53	661	3.09	714
CAADP Level 4 (CL4)	801	0.99	894	1,040	5.41	1,294	3.09	1,411

Source: ReSAKSS based on World Bank (2016) and ILO (2016).

ANNEX 1b: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.1.2

TABLE L1.1.2—HOUSEHOLD CONSUMPTION EXPENDITURE PER CAPITA (constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	1,015	0.55	1,066	1,128	2.38	1,275	2.08	1,370
Central	444	-1.19	438	444	1.16	489	2.27	536
Eastern	560	0.22	561	598	2.80	709	2.32	749
Northern	1,563	0.46	1,587	1,616	1.95	1,917	2.62	2,073
Southern	1,913	0.92	2,010	2,155	2.99	2,376	1.27	2,503
Western	752	1.54	879	984	3.35	1,142	2.83	1,267
Less favorable agriculture conditions	348	0.54	369	371	1.57	423	2.85	462
More favorable agriculture conditions	431	0.63	436	451	1.80	508	2.15	533
Mineral-rich countries	273	-1.79	262	282	3.27	303	0.96	317
Middle-income countries	1,447	0.81	1,543	1,649	2.64	1,893	2.34	2,054
CEN-SAD	963	1.05	1,041	1,124	3.06	1,306	2.58	1,420
COMESA	832	-0.03	820	844	2.31	953	1.82	1,003
EAC	432	0.67	439	459	2.26	550	3.16	593
ECCAS	463	2.02	524	551	3.39	718	3.47	846
ECOWAS	752	1.54	879	984	3.35	1,142	2.83	1,267
IGAD	650	0.38	650	696	2.82	822	2.55	875
SADC	1,164	0.46	1,197	1,269	2.51	1,377	1.02	1,438
UMA	1,674	-0.76	1,658	1,612	0.07	1,772	2.47	1,932
CAADP Compact 2007–09 (CC1)	756	1.67	905	1,022	3.48	1,202	3.08	1,343
CAADP Compact 2010–12 (CC2)	427	-0.04	424	442	2.09	496	1.99	526
CAADP Compact 2013–15 (CC3)	790	1.68	854	908	3.63	1,158	3.16	1,313
CAADP Compact not yet (CC0)	2,062	0.50	2,112	2,201	2.00	2,434	1.83	2,564
CAADP Level 0 (CL0)	2,062	0.50	2,112	2,201	2.00	2,434	1.83	2,564
CAADP Level 1 (CL1)	814	1.55	877	938	4.10	1,221	3.21	1,391
CAADP Level 2 (CL2)	389	-0.83	380	392	1.52	415	1.19	436
CAADP Level 3 (CL3)	307	1.22	327	353	3.49	415	2.32	446
CAADP Level 4 (CL4)	702	1.43	806	894	3.11	1,044	2.97	1,156

Source: ReSAKSS based on World Bank (2016) and ILO (2016).

ANNEX 1c: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.2.1

TABLE L1.2.1—PREVALENCE OF UNDERNOURISHMENT (% of population)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	24.3	-2.18	22.2	20.3	-3.55	17.2	-2.08	16.3
Central	37.0	-4.00	31.4	29.1	-3.16	23.9	-2.49	22.6
Eastern	44.3	-2.19	40.1	36.9	-3.55	31.4	-2.23	29.4
Northern	6.2	-0.77	5.9	5.6	-1.69	5.1	-1.03	5.0
Southern	28.4	-2.24	26.2	24.8	-2.28	21.1	-2.58	19.6
Western	16.1	-2.82	14.3	12.3	-6.20	9.7	-1.90	9.2
Less favorable agriculture conditions	31.9	-4.80	25.8	24.1	-2.80	19.4	-3.48	17.4
More favorable agriculture conditions	41.4	-2.19	37.8	34.8	-3.51	29.3	-2.44	27.3
Mineral-rich countries	36.3	2.03	38.9	38.3	-0.92	34.7	-1.48	33.7
Middle-income countries	12.3	-3.02	10.8	9.4	-5.48	7.6	-1.62	7.3
CEN-SAD	15.4	-2.06	14.3	12.8	-4.92	10.6	-1.70	10.2
COMESA	33.8	-2.16	30.8	28.8	-2.89	24.8	-2.06	23.5
EAC	35.0	-0.02	34.1	31.7	-3.10	28.4	-1.61	27.1
ECCAS	44.3	-4.04	36.5	32.5	-4.52	24.1	-4.12	21.6
ECOWAS	16.1	-2.82	14.3	12.3	-6.20	9.7	-1.90	9.2
IGAD	47.2	-3.29	40.9	37.0	-3.96	30.6	-2.83	28.2
SADC	30.4	-0.89	29.5	28.0	-2.48	24.7	-1.68	23.6
UMA	7.4	-1.20	6.8	6.3	-2.93	5.3	-1.96	5.0
CAADP Compact 2007–09 (CC1)	27.5	-4.35	22.9	20.3	-4.87	16.0	-2.88	14.8
CAADP Compact 2010–12 (CC2)	31.7	-0.13	31.4	29.4	-2.81	25.9	-1.84	24.6
CAADP Compact 2013–15 (CC3)	39.5	-2.57	35.4	31.8	-4.65	24.9	-2.80	23.2
CAADP Compact not yet (CC0)	6.4	-0.91	6.1	5.9	-1.08	5.6	-0.47	5.6
CAADP Level 0 (CL0)	6.4	-0.91	6.1	5.9	-1.08	5.6	-0.47	5.6
CAADP Level 1 (CL1)	40.7	-2.19	37.3	34.2	-3.81	28.3	-2.20	26.7
CAADP Level 2 (CL2)	31.2	-2.85	26.9	23.4	-6.29	16.5	-3.07	15.6
CAADP Level 3 (CL3)	28.4	-1.08	26.7	25.2	-1.57	22.8	-2.01	21.6
CAADP Level 4 (CL4)	29.5	-2.77	26.3	23.8	-4.33	19.5	-2.49	18.2

Source: ReSAKSS based on World Bank (2016) and ILO (2016).

ANNEX 1d: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.2.2A

TABLE L1.2.2A—PREVALENCE OF UNDERWEIGHT, WEIGHT FOR AGE (% of children under 5)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	24.7	-1.12	23.4	22.5	-1.66	20.0	-2.01	18.5
Central	28.0	-0.61	26.6	26.0	-1.00	23.7	-1.20	22.9
Eastern	29.8	-1.59	27.4	26.2	-1.97	23.0	-2.31	21.4
Northern	8.6	-2.61	8.2	6.9	-4.81	5.6	-3.29	5.2
Southern	18.5	-2.10	17.0	15.6	-3.94	12.3	-3.68	10.8
Western	27.9	-1.26	26.7	26.0	-0.88	24.2	-1.38	22.1
Less favorable agriculture conditions	32.3	-0.94	31.3	31.1	-0.55	30.1	-0.09	30.1
More favorable agriculture conditions	27.5	-1.66	25.2	24.0	-2.22	20.6	-2.49	19.0
Mineral-rich countries	28.0	-0.67	26.3	25.3	-1.51	22.4	-1.78	21.4
Middle-income countries	20.8	-1.11	20.0	19.1	-1.67	17.0	-2.38	15.1
CEN-SAD	24.0	-0.88	23.3	22.6	-1.08	21.0	-1.51	19.3
COMESA	26.4	-1.09	24.8	23.7	-1.84	21.0	-2.07	19.7
EAC	21.1	-2.42	18.8	18.0	-1.97	15.5	-2.88	14.1
ECCAS	28.0	-1.75	25.6	24.3	-2.22	20.4	-2.68	18.8
ECOWAS	27.9	-1.26	26.7	26.0	-0.88	24.2	-1.38	22.1
IGAD	31.1	-1.57	28.7	27.3	-2.10	24.0	-2.33	22.2
SADC	23.7	-1.34	21.9	20.9	-2.15	17.9	-2.40	16.6
UMA	8.6	-1.21	8.3	6.7	-6.44	4.9	-5.27	4.1
CAADP Compact 2007–09 (CC1)	31.9	-1.75	29.7	28.4	-1.68	25.6	-2.03	23.0
CAADP Compact 2010–12 (CC2)	22.7	-1.41	20.9	20.2	-1.46	17.6	-2.00	16.6
CAADP Compact 2013–15 (CC3)	27.2	-0.87	25.9	24.7	-1.77	22.4	-1.86	21.2
CAADP Compact not yet (CC0)	11.7	-0.73	11.8	11.1	-2.50	9.9	-1.52	9.5
CAADP Level 0 (CL0)	11.7	-0.73	11.8	11.1	-2.50	9.9	-1.52	9.5
CAADP Level 1 (CL1)	28.9	-0.85	27.5	26.2	-1.92	23.5	-1.96	22.2
CAADP Level 2 (CL2)	27.1	-0.63	25.5	24.7	-1.28	22.1	-1.60	21.2
CAADP Level 3 (CL3)	26.3	-0.93	25.3	24.6	-0.92	23.4	-0.66	23.1
CAADP Level 4 (CL4)	28.1	-1.90	25.9	24.6	-1.87	21.5	-2.52	19.1

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).
Notes: For regions or groups, level is weighted average, where weight is country's share in population under 5 years for the region or group.

ANNEX 1e: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.2.2B

TABLE L1.2.2B—PREVALENCE OF STUNTING, HEIGHT FOR AGE (% of children under 5)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	41.9	-0.99	40.2	39.2	-0.96	35.6	-1.76	33.7
Central	44.9	-0.84	44.0	43.4	-0.51	41.7	-0.54	41.0
Eastern	48.3	-1.32	45.4	43.8	-1.59	39.5	-1.76	37.3
Northern	25.5	-3.15	23.1	22.3	1.91	19.7	-3.59	18.2
Southern	43.2	-1.52	40.7	38.6	-2.77	33.2	-2.49	30.4
Western	40.4	-0.45	39.6	39.3	-0.33	36.1	-1.44	34.6
Less favorable agriculture conditions	44.6	0.04	44.4	44.7	-0.13	43.9	0.15	44.3
More favorable agriculture conditions	48.5	-1.35	45.7	44.1	-1.63	39.6	-1.78	37.3
Mineral-rich countries	46.7	-0.90	45.4	44.6	-0.69	42.3	-0.83	41.3
Middle-income countries	35.9	-1.12	34.4	33.5	-0.68	29.5	-2.56	27.3
CEN-SAD	37.6	-0.80	36.5	36.2	-0.09	33.2	-1.76	31.5
COMESA	45.6	-1.31	43.2	42.1	-0.73	38.6	-1.80	36.5
EAC	44.4	-0.97	42.3	41.4	-1.22	38.2	-1.52	36.3
ECCAS	46.6	-1.51	44.0	42.4	-1.61	38.0	-1.74	36.0
ECOWAS	40.4	-0.45	39.6	39.3	-0.33	36.1	-1.44	34.6
IGAD	48.1	-1.48	44.8	43.0	-1.86	38.0	-2.16	35.3
SADC	45.7	-1.27	43.7	42.2	-1.62	38.4	-1.50	36.6
UMA	23.2	-1.77	21.3	19.1	-3.17	15.9	-3.18	14.6
CAADP Compact 2007–09 (CC1)	46.9	-1.03	44.9	43.6	-1.07	39.3	-1.86	37.0
CAADP Compact 2010–12 (CC2)	41.5	-1.01	39.9	39.2	-0.93	36.3	-1.29	34.8
CAADP Compact 2013–15 (CC3)	43.3	-1.21	40.8	39.2	-1.77	35.0	-1.90	32.9
CAADP Compact not yet (CC0)	28.3	-1.95	26.8	26.1	-0.01	23.2	-2.38	21.9
CAADP Level 0 (CL0)	28.3	-1.95	26.8	26.1	-0.01	23.2	-2.38	21.9
CAADP Level 1 (CL1)	44.5	-1.31	41.8	39.9	-1.96	35.2	-2.16	32.7
CAADP Level 2 (CL2)	43.9	-0.88	42.7	42.2	-0.59	40.2	-0.67	39.3
CAADP Level 3 (CL3)	45.0	-0.44	43.7	43.1	-0.58	41.6	-0.41	41.4
CAADP Level 4 (CL4)	45.6	-1.15	43.4	42.2	-1.21	37.5	-2.14	35.0

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).
Notes: For regions or groups, level is weighted average, where weight is country's share in population under 5 years for the region or group.

ANNEX 1f: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.2.2C

TABLE L1.2.2C—PREVALENCE OF WASTING, WEIGHT FOR HEIGHT (% of children under 5)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	10.8	-1.12	10.2	10.1	-0.05	9.3	-1.33	8.6
Central	12.4	0.96	11.5	11.3	-0.83	9.5	-1.79	9.3
Eastern	10.7	-1.10	10.2	10.0	-1.04	9.3	-1.38	8.8
Northern	5.9	0.13	6.4	6.3	1.61	6.9	1.77	7.5
Southern	6.5	-1.38	6.4	6.2	-2.50	5.8	0.50	5.7
Western	14.2	-2.61	12.9	12.7	1.04	11.6	-2.34	9.8
Less favorable agriculture conditions	15.5	-2.53	14.5	13.8	-1.76	13.0	-1.17	12.4
More favorable agriculture conditions	9.1	-1.28	8.5	8.4	-1.52	7.5	-1.18	7.0
Mineral-rich countries	12.7	0.61	11.5	11.1	-1.40	8.8	-2.76	8.4
Middle-income countries	10.7	-1.23	10.3	10.3	1.50	10.0	-1.27	9.0
CEN-SAD	12.5	-1.59	11.8	11.7	0.71	11.1	-1.53	10.0
COMESA	10.3	-0.13	9.9	9.9	-0.19	9.2	-0.81	9.0
EAC	6.5	-2.32	5.8	5.8	0.11	5.4	-1.61	4.9
ECCAS	11.5	0.40	10.6	10.4	-0.82	8.9	-1.63	8.7
ECOWAS	14.2	-2.61	12.9	12.7	1.04	11.6	-2.34	9.8
IGAD	11.6	-0.97	11.1	11.0	-0.87	10.3	-1.29	9.8
SADC	9.1	-0.11	8.5	8.2	-1.67	7.1	-1.28	6.8
UMA	6.1	1.65	6.9	6.0	-4.72	5.4	0.05	5.6
CAADP Compact 2007–09 (CC1)	13.5	-2.61	12.2	12.1	0.84	11.1	-2.42	9.4
CAADP Compact 2010–12 (CC2)	9.3	-0.84	8.5	8.3	-1.02	7.0	-1.78	6.6
CAADP Compact 2013–15 (CC3)	11.2	-0.08	11.2	11.1	-0.67	10.8	-0.17	10.7
CAADP Compact not yet (CC0)	7.6	0.59	8.2	8.0	-0.21	8.3	0.96	8.7
CAADP Level 0 (CL0)	7.6	0.59	8.2	8.0	-0.21	8.3	0.96	8.7
CAADP Level 1 (CL1)	11.9	-0.09	12.0	11.8	-0.87	11.4	-0.28	11.3
CAADP Level 2 (CL2)	12.7	0.65	11.5	11.2	-1.43	9.0	-2.52	8.5
CAADP Level 3 (CL3)	10.3	-1.83	10.0	9.8	-0.78	9.6	-0.14	9.4
CAADP Level 4 (CL4)	11.5	-2.46	10.3	10.3	0.72	9.2	-2.57	7.7

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).
Notes: For regions or groups, level is weighted average, where weight is country's share in population under 5 years for the region or group.

ANNEX 1g: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.2.3

TABLE L1.2.3—CEREAL IMPORT DEPENDENCY RATIO (%)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2010)	Annual avg. change (2008–2010)	2010
Africa	23.2	3.96	25.8	26.6	1.40	27.3	0.14	27.4
Central	24.1	4.19	30.1	32.3	0.48	30.5	1.19	31.1
Eastern	14.5	5.16	16.4	17.3	1.91	19.8	2.51	20.1
Northern	48.4	0.77	44.9	46.8	3.90	50.8	-0.04	50.7
Southern	18.3	8.85	25.1	26.3	0.03	22.9	-10.04	20.5
Western	17.8	6.85	21.7	21.7	-0.20	22.0	3.77	23.3
Less favorable agriculture conditions	20.3	1.23	22.3	24.1	1.48	24.3	-1.17	24.1
More favorable agriculture conditions	12.2	6.60	15.2	15.7	1.74	17.3	-0.38	17.2
Mineral-rich countries	24.0	2.70	28.7	29.2	-1.75	25.6	0.76	25.8
Middle-income countries	29.7	3.96	31.8	32.9	1.93	34.0	0.48	34.3
CEN-SAD	24.6	3.58	26.0	27.4	2.97	30.0	2.13	30.8
COMESA	20.3	3.29	22.9	23.9	1.78	26.3	2.82	26.8
EAC	13.9	2.24	14.5	17.0	5.04	19.6	1.97	20.3
ECCAS	28.0	2.51	32.8	35.2	0.83	33.4	-0.56	33.4
ECOWAS	17.8	6.85	21.7	21.7	-0.20	22.0	3.77	23.3
IGAD	14.9	6.65	17.4	18.4	2.48	21.9	1.46	21.9
SADC	17.6	7.00	23.4	25.0	0.17	22.6	-3.58	21.9
UMA	60.8	2.36	57.8	59.1	2.76	59.6	-4.41	56.8
CAADP Compact 2007–09 (CC1)	12.9	8.70	16.7	16.2	-0.73	17.2	5.73	18.4
CAADP Compact 2010–12 (CC2)	20.6	3.03	23.7	25.3	0.95	25.0	0.29	25.3
CAADP Compact 2013–15 (CC3)	23.8	7.90	30.1	31.7	1.55	33.4	-1.61	32.2
CAADP Compact not yet (CC0)	38.7	1.79	37.6	40.0	3.99	42.0	-2.07	41.3
CAADP Level 0 (CL0)	38.7	1.79	37.6	40.0	3.99	42.0	-2.07	41.3
CAADP Level 1 (CL1)	23.7	8.15	30.4	32.6	2.21	35.1	-1.58	33.8
CAADP Level 2 (CL2)	25.8	4.10	31.8	33.4	0.01	31.3	0.91	31.8
CAADP Level 3 (CL3)	14.2	2.70	16.1	15.4	-6.01	11.2	-7.54	10.4
CAADP Level 4 (CL4)	15.6	6.27	18.8	18.9	0.53	20.5	4.47	21.6

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).
Notes: Data are from 1995 to 2010. For regions or groups, level is weighted average, where weight is country's share in total population for the region or group

ANNEX 1h: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.3.1

TABLE L1.3.1—EMPLOYMENT RATE (% of population, 15+ years)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	90.6	-0.06	90.8	91.4	0.22	91.8	-0.01	91.9
Central	95.2	0.00	95.4	95.6	0.07	95.7	-0.01	95.6
Eastern	93.5	-0.02	93.8	94.0	0.03	94.2	0.02	94.2
Northern	85.2	0.06	85.7	87.6	0.93	88.3	-0.39	87.6
Southern	82.8	-0.41	82.4	83.4	0.44	83.4	-0.16	83.1
Western	93.1	-0.01	93.2	93.4	-0.03	93.8	0.15	94.4
Less favorable agriculture conditions	94.1	-0.01	94.2	94.0	-0.09	94.3	0.01	94.2
More favorable agriculture conditions	93.0	-0.06	93.2	93.4	0.05	93.5	-0.01	93.5
Mineral-rich countries	94.9	0.09	95.2	95.1	0.07	95.5	0.00	95.4
Middle-income countries	87.5	-0.12	87.6	88.6	0.44	89.2	-0.04	89.4
CEN-SAD	91.2	0.00	91.2	91.4	0.10	91.7	-0.01	91.9
COMESA	92.8	-0.05	92.7	92.9	0.11	93.0	-0.09	92.8
EAC	95.0	0.05	95.4	95.4	-0.02	95.3	-0.03	95.3
ECCAS	95.1	-0.01	95.3	95.4	0.07	95.4	-0.03	95.4
ECOWAS	93.1	-0.01	93.2	93.4	-0.03	93.8	0.15	94.4
IGAD	92.3	-0.03	92.5	92.8	0.00	92.9	0.04	93.0
SADC	89.2	-0.20	89.1	89.7	0.28	90.0	-0.05	89.8
UMA	80.8	0.13	82.5	85.7	1.31	88.0	-0.08	87.7
CAADP Compact 2007–09 (CC1)	93.5	-0.03	93.7	93.9	0.02	94.4	0.10	94.8
CAADP Compact 2010–12 (CC2)	92.5	0.06	92.7	92.7	0.01	92.8	0.01	92.8
CAADP Compact 2013–15 (CC3)	91.6	-0.10	91.6	92.1	0.15	92.5	-0.01	92.4
CAADP Compact not yet (CC0)	83.3	-0.28	83.2	85.2	0.91	85.6	-0.34	85.0
CAADP Level 0 (CL0)	83.3	-0.28	83.2	85.2	0.91	85.6	-0.34	85.0
CAADP Level 1 (CL1)	91.2	-0.13	91.0	91.4	0.10	91.7	0.00	91.6
CAADP Level 2 (CL2)	94.7	-0.02	94.8	95.0	0.08	95.1	0.00	95.1
CAADP Level 3 (CL3)	94.0	0.07	94.2	94.0	-0.13	94.5	0.06	94.5
CAADP Level 4 (CL4)	92.4	0.01	92.7	92.9	0.05	93.2	0.06	93.5

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).

ANNEX 1i: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.3.3

TABLE L1.3.3—POVERTY GAP AT $1.90 A DAY (2011 PPP) (%)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	24.7	-2.86	21.9	20.6	-2.27	17.3	-3.10	15.6
Central	51.3	-3.63	44.0	39.7	-4.17	29.0	-6.09	23.6
Eastern	20.8	-2.32	18.1	17.0	-2.12	14.6	-3.09	13.2
Northern	1.6	-6.01	1.1	0.9	-9.52	0.4	-14.48	0.2
Southern	21.0	-2.21	19.1	18.0	-3.29	15.3	-2.55	14.0
Western	23.6	-3.02	21.3	20.7	-0.82	18.2	-1.66	17.4
Less favorable agriculture conditions	32.2	-3.56	27.7	25.4	-4.25	18.4	-5.06	15.9
More favorable agriculture conditions	23.5	-2.50	20.6	19.4	-2.24	16.4	-3.29	14.8
Mineral-rich countries	56.5	-3.37	48.8	44.8	-3.87	33.2	-5.83	27.3
Middle-income countries	16.2	-2.72	14.8	14.4	-0.68	13.3	-0.66	12.9
CEN-SAD	19.6	-2.65	17.9	17.5	-0.65	15.6	-1.53	14.9
COMESA	31.1	-2.61	27.7	26.2	-2.34	22.0	-3.39	19.7
EAC	23.2	-1.24	21.1	19.5	-3.25	16.3	-3.07	14.8
ECCAS	44.8	-3.52	38.6	35.0	-3.96	26.0	-5.59	21.6
ECOWAS	23.6	-3.02	21.3	20.7	-0.82	18.2	-1.66	17.4
IGAD	16.3	-3.87	13.4	12.4	-2.45	9.6	-5.61	7.9
SADC	35.3	-2.44	31.4	29.1	-3.36	23.8	-3.69	21.1
UMA	1.6	-6.01	1.1	0.9	-9.52	0.4	-14.48	0.2
CAADP Compact 2007–09 (CC1)	22.8	-3.20	20.1	19.7	-0.54	17.7	-1.34	17.0
CAADP Compact 2010–12 (CC2)	33.3	-2.88	29.1	26.5	-3.71	20.4	-5.08	17.3
CAADP Compact 2013–15 (CC3)	21.6	-2.15	19.9	18.8	-2.07	16.1	-3.01	14.6
CAADP Compact not yet (CC0)	6.8	-4.71	5.3	4.3	-10.96	2.5	-9.22	1.7
CAADP Level 0 (CL0)	6.8	-4.71	5.3	4.3	-10.96	2.5	-9.22	1.7
CAADP Level 1 (CL1)	25.4	-1.57	23.7	22.5	-1.88	20.0	-2.50	18.5
CAADP Level 2 (CL2)	50.7	-3.74	43.3	39.1	-4.17	28.1	-6.48	22.5
CAADP Level 3 (CL3)	28.5	-3.16	25.1	23.0	-4.56	16.5	-6.27	13.4
CAADP Level 4 (CL4)	22.2	-2.54	19.9	19.3	-0.77	17.6	-1.34	16.9

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).
Notes: For regions or groups, level is weighted average, where weight is country's share in total population for the region or group.

ANNEX 1j: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.3.4

TABLE L1.3.4—POVERTY HEADCOUNT RATIO AT $1.90/ DAY (2011 PPP, % of population)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	49.7	-1.55	46.5	45.3	-1.06	41.7	-1.26	40.1
Central	59.6	-3.50	52.5	48.5	-3.06	37.6	-4.70	32.2
Eastern	53.7	-1.56	49.3	47.5	-1.28	43.1	-1.70	41.0
Northern	7.0	-5.11	5.4	4.5	-7.85	2.4	-13.76	1.5
Southern	46.6	-1.23	44.1	42.4	-2.07	39.0	-0.99	37.6
Western	54.1	-1.42	51.6	51.0	-0.31	48.4	-0.65	47.4
Less favorable agriculture conditions	70.2	-2.14	64.2	61.0	-2.27	51.4	-2.80	47.3
More favorable agriculture conditions	57.5	-1.55	53.2	51.3	-1.25	46.7	-1.65	44.5
Mineral-rich countries	59.1	-0.67	57.5	57.3	-0.23	53.5	-1.13	52.0
Middle-income countries	39.5	-1.66	37.3	36.6	-0.79	34.6	-0.52	33.8
CEN-SAD	45.7	-1.14	44.0	43.7	-0.18	41.9	-0.53	41.2
COMESA	52.2	-1.09	49.5	48.7	-0.51	46.1	-0.94	44.9
EAC	55.0	-0.56	52.7	50.5	-1.55	46.4	-1.34	44.7
ECCAS	54.0	-2.49	49.1	46.4	-2.22	39.0	-2.97	35.5
ECOWAS	54.1	-1.42	51.6	51.0	-0.31	48.4	-0.65	47.4
IGAD	46.9	-2.24	41.9	40.1	-1.31	35.2	-2.38	32.7
SADC	53.5	-0.99	50.7	49.0	-1.72	45.6	-0.99	44.2
UMA	7.0	-5.11	5.4	4.5	-7.85	2.4	-13.76	1.5
CAADP Compact 2007–09 (CC1)	55.7	-1.85	51.6	50.8	-0.49	47.4	-0.95	46.0
CAADP Compact 2010–12 (CC2)	52.0	-1.08	49.4	47.3	-1.49	43.0	-1.62	41.0
CAADP Compact 2013–15 (CC3)	50.8	-1.98	47.8	45.9	-1.66	40.5	-2.23	37.8
CAADP Compact not yet (CC0)	19.7	-3.54	16.3	14.1	-7.80	9.7	-5.64	7.8
CAADP Level 0 (CL0)	19.7	-3.54	16.3	14.1	-7.80	9.7	-5.64	7.8
CAADP Level 1 (CL1)	55.9	-1.14	53.7	52.0	-1.31	48.0	-1.55	45.7
CAADP Level 2 (CL2)	47.1	-3.71	41.5	38.5	-2.42	28.7	-5.15	24.5
CAADP Level 3 (CL3)	63.7	-1.40	60.4	57.5	-2.00	49.8	-2.40	46.5
CAADP Level 4 (CL4)	53.6	-1.44	50.2	49.4	-0.53	46.8	-0.76	45.7

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).
Notes: For regions or groups, level is weighted average, where weight is country's share in total population for the region or group.

ANNEX 1k: Level 1—Agriculture's Contribution to Economic Growth and Inclusive Development, Indicator 1.3.5

TABLE L1.2.3—GINI INDEX

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	44.2	-0.69	43.2	43.2	0.14	42.6	-0.27	42.2
Central	44.4	-0.57	43.4	43.0	-0.27	41.9	-0.52	41.3
Eastern	39.6	-0.46	38.9	39.1	0.30	39.1	-0.06	39.1
Northern	40.0	-0.03	39.9	39.8	-0.10	39.5	-0.08	39.4
Southern	55.8	-0.69	54.3	54.1	-0.45	52.1	-0.73	50.9
Western	43.1	-0.98	41.9	42.2	0.63	41.9	-0.08	41.8
Less favorable agriculture conditions	40.7	-0.23	40.3	40.3	-0.41	39.1	-0.19	39.0
More favorable agriculture conditions	41.0	-0.63	39.9	39.9	0.09	39.4	-0.32	39.1
Mineral-rich countries	46.2	-0.80	44.8	44.6	-0.51	42.6	-0.83	41.6
Middle-income countries	46.6	-0.72	45.7	46.0	0.48	45.8	-0.06	45.7
CEN-SAD	43.1	-0.76	42.2	42.4	0.44	42.0	-0.13	41.9
COMESA	42.7	-0.80	41.2	41.1	-0.15	40.3	-0.51	39.7
EAC	42.3	0.32	42.6	42.7	0.14	42.7	0.07	42.9
ECCAS	45.7	-0.63	44.5	43.9	-0.44	42.4	-0.64	41.6
ECOWAS	43.1	-0.98	41.9	42.2	0.63	41.9	-0.08	41.8
IGAD	39.6	-0.99	38.3	38.3	0.12	37.9	-0.33	37.6
SADC	49.1	-0.47	48.1	47.8	-0.34	46.4	-0.55	45.6
UMA	40.0	-0.03	39.9	39.8	-0.10	39.5	-0.08	39.4
CAADP Compact 2007–09 (CC1)	40.8	-1.17	39.5	40.0	0.86	40.3	0.12	40.5
CAADP Compact 2010–12 (CC2)	42.5	-0.43	41.6	41.2	-0.26	39.9	-0.62	39.2
CAADP Compact 2013–15 (CC3)	45.5	-0.73	43.9	43.0	-0.82	40.8	-0.96	39.6
CAADP Compact not yet (CC0)	51.7	0.07	52.3	52.7	0.28	53.2	0.25	53.7
CAADP Level 0 (CL0)	51.7	0.07	52.3	52.7	0.28	53.2	0.25	53.7
CAADP Level 1 (CL1)	46.5	-0.84	44.5	43.3	-1.03	40.6	-1.18	39.2
CAADP Level 2 (CL2)	44.9	-0.67	43.8	43.2	-0.38	41.6	-0.71	40.8
CAADP Level 3 (CL3)	42.5	-0.34	41.9	41.8	-0.58	40.3	-0.54	39.8
CAADP Level 4 (CL4)	42.2	-0.92	41.0	41.3	0.63	41.4	-0.05	41.3

Sources: ReSAKSS based on World Bank (2016) and ILO (2016).
Notes: For regions or groups, level is weighted average, where weight is country's share in population under 5 years for the region or group.

ANNEX 2a: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.1

TABLE L2.1.1—AGRICULTURE VALUE ADDED (million, constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	7,183.3	4.79	8,917.0	9,869.4	4.67	12,585.9	3.35	13,939.9
Central	2,517.0	-4.05	2,109.1	3,099.8	14.37	4,505.2	5.21	5,187.7
Eastern	8,777.9	3.60	9,471.1	9,702.2	2.01	12,157.3	4.14	13,628.7
Northern	6,518.6	2.60	7,350.6	7,315.6	-1.31	9,609.4	6.39	11,461.3
Southern	3,765.4	1.31	4,019.5	4,170.6	4.78	5,246.0	2.33	5,942.8
Western	12,493.9	8.28	18,811.4	21,922.6	6.18	27,753.9	2.51	29,828.2
Less favorable agriculture conditions	1,348.6	4.09	1,472.6	2,191.5	15.76	3,443.8	6.69	4,116.6
More favorable agriculture conditions	3,407.0	0.26	3,539.7	4,161.4	7.13	6,480.4	6.59	7,637.0
Mineral-rich countries	2,714.4	-6.24	2,085.6	2,193.3	2.92	2,763.8	3.22	3,034.1
Middle-income countries	10,937.0	5.90	14,139.2	15,472.5	4.20	19,470.5	3.25	21,562.5
CEN-SAD	10,039.3	6.66	13,286.9	14,869.4	4.77	18,753.2	3.23	20,529.9
COMESA	7,987.2	2.99	8,386.5	8,543.7	1.83	10,361.5	3.41	11,434.1
EAC	5,478.1	0.25	5,720.1	6,236.4	3.37	9,326.4	6.98	11,072.6
ECCAS	2,583.1	-0.49	2,588.0	3,492.8	12.52	5,975.9	8.02	7,693.1
ECOWAS	12,493.9	8.28	18,811.4	21,922.6	6.18	27,753.9	2.51	29,828.2
IGAD	10,748.0	4.20	11,605.2	11,741.7	1.69	14,707.9	4.53	16,721.1
SADC	3,837.6	0.01	3,955.4	4,161.2	4.65	5,418.4	3.16	6,148.2
UMA	6,140.9	2.44	6,919.9	6,847.0	-1.72	9,064.3	6.91	10,954.1
CAADP Compact 2007–09 (CC1)	13,848.4	7.89	20,618.6	24,249.9	6.74	31,432.6	2.70	33,916.6
CAADP Compact 2010–12 (CC2)	2,935.0	-0.75	2,925.7	3,152.3	3.42	4,503.5	5.94	5,273.4
CAADP Compact 2013–15 (CC3)	6,754.3	4.91	7,497.8	7,818.8	2.65	9,516.1	3.58	10,761.9
CAADP Compact not yet (CC0)	6,746.6	1.47	7,250.8	7,180.9	1.13	8,474.0	2.50	9,328.6
CAADP Level 0 (CL0)	6,746.6	1.47	7,250.8	7,180.9	1.13	8,474.0	2.50	9,328.6
CAADP Level 1 (CL1)	6,823.7	4.93	7,576.2	7,894.5	2.61	9,607.0	3.60	10,872.3
CAADP Level 2 (CL2)	2,345.3	-5.42	1,876.5	1,965.5	2.99	2,456.2	3.27	2,732.0
CAADP Level 3 (CL3)	1,596.5	2.87	1,684.5	1,973.7	8.19	3,055.4	5.98	3,578.6
CAADP Level 4 (CL4)	12,200.3	7.24	17,659.6	20,756.3	6.46	27,020.8	3.04	29,399.5

Sources: ReSAKSS based on FAO (2016), World Bank (2016), and ILO (2016).
Notes: For regions or groups, level is weighted average per country, where weight is country's share in total agricultural land area for the region or group.

ANNEX 2b: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.2

TABLE L2.1.2—AGRICULTURAL PRODUCTION INDEX (API) (2004–2006 = 100)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2013)	Annual avg. change (2008–2013)	2013
Africa	80.8	2.94	91.6	100.4	3.04	117.2	3.52	128.9
Central	91.6	0.03	93.0	100.7	3.05	117.9	3.71	128.7
Eastern	77.6	4.00	91.8	100.9	3.42	121.0	4.07	132.2
Northern	78.9	3.13	91.2	100.7	2.92	120.4	3.82	133.1
Southern	86.7	2.77	94.5	103.2	4.13	141.1	5.62	164.1
Western	79.3	3.42	90.9	99.3	2.66	108.2	2.48	117.0
Less favorable agriculture conditions	80.6	4.39	94.6	102.6	3.28	124.0	3.31	132.9
More favorable agriculture conditions	80.8	3.22	91.9	101.4	4.13	127.0	4.58	138.8
Mineral-rich countries	93.3	-0.60	94.0	100.7	2.28	124.3	5.29	136.9
Middle-income countries	79.6	3.27	91.3	100.0	2.79	113.7	3.03	125.3
CEN-SAD	80.6	4.39	94.6	102.6	3.28	124.0	3.31	118.4
COMESA	80.8	3.22	91.9	101.4	4.13	127.0	4.58	126.7
EAC	93.3	-0.60	94.0	100.7	2.28	124.3	5.29	136.6
ECCAS	79.6	3.27	91.3	100.0	2.79	113.7	3.03	156.8
ECOWAS	80.6	4.39	94.6	102.6	3.28	124.0	3.31	117.0
IGAD	80.8	3.22	91.9	101.4	4.13	127.0	4.58	126.3
SADC	93.3	-0.60	94.0	100.7	2.28	124.3	5.29	153.7
UMA	79.6	3.27	91.3	100.0	2.79	113.7	3.03	143.8
CAADP Compact 2007–09 (CC1)	77.2	3.78	90.5	99.5	2.97	111.1	3.10	121.1
CAADP Compact 2010–12 (CC2)	82.1	1.64	88.3	96.2	3.63	116.8	4.08	127.7
CAADP Compact 2013–15 (CC3)	81.4	3.59	92.5	101.2	2.84	123.6	4.11	140.3
CAADP Compact not yet (CC0)	80.7	2.92	92.1	101.0	3.01	120.0	3.33	131.4
CAADP Level 0 (CL0)	80.7	2.92	92.1	101.0	3.01	120.0	3.33	131.4
CAADP Level 1 (CL1)	82.2	3.69	93.8	100.9	2.10	121.1	3.90	138.0
CAADP Level 2 (CL2)	91.8	-0.21	92.5	101.7	3.85	122.5	3.99	133.4
CAADP Level 3 (CL3)	81.0	3.85	94.4	103.1	3.45	128.9	3.59	136.7
CAADP Level 4 (CL4)	78.2	3.51	90.4	99.5	3.19	113.2	3.48	124.2

Sources: ReSAKSS based on FAO (2016) and World Bank (2016)..
Notes: Data are from 1995 to 2013. For regions or groups, level is weighted average, where weight is country's share in total agriculture value added for the region or group.

ANNEX 2c: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.3

TABLE L2.1.3—LABOR PRODUCTIVITY (agriculture value-added per agricultural worker, constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	1,008	1.41	1,094	1,142	2.11	1,326	1.73	1,397
Central	633	-4.73	514	588	5.71	711	2.66	771
Eastern	545	-0.89	516	526	1.50	643	3.43	700
Northern	3,138	2.32	3,410	3,444	0.21	4,235	3.58	4,677
Southern	823	0.04	826	833	2.52	942	1.01	1,017
Western	1,403	5.36	1,855	2,038	3.88	2,374	0.85	2,435
Less favorable agriculture conditions	511	0.23	497	622	9.09	802	3.78	891
More favorable agriculture conditions	392	-2.11	363	390	3.33	489	3.00	527
Mineral-rich countries	504	-4.72	408	413	1.69	453	0.41	459
Middle-income countries	2,292	3.83	2,745	2,891	2.38	3,497	2.63	3,789
CEN-SAD	1,552	3.70	1,835	1,957	2.77	2,298	1.73	2,405
COMESA	744	-0.79	695	694	0.74	787	1.70	823
EAC	461	-2.22	432	445	0.91	559	3.71	611
ECCAS	604	-3.59	528	599	5.75	791	4.25	916
ECOWAS	1,403	5.36	1,855	2,038	3.88	2,374	0.85	2,435
IGAD	606	-0.56	564	570	1.55	705	3.82	779
SADC	618	-2.51	572	578	1.98	667	1.52	712
UMA	3,049	1.18	3,294	3,248	-1.60	4,134	5.89	4,848
CAADP Compact 2007–09 (CC1)	985	4.07	1,260	1,400	4.45	1,655	1.06	1,703
CAADP Compact 2010–12 (CC2)	508	-2.07	470	472	0.50	555	2.28	591
CAADP Compact 2013–15 (CC3)	1,059	1.50	1,058	1,094	2.16	1,309	4.32	1,508
CAADP Compact not yet (CC0)	3,400	2.12	3,684	3,732	1.03	4,551	3.00	4,982
CAADP Level 0 (CL0)	3,400	2.12	3,684	3,732	1.03	4,551	3.00	4,982
CAADP Level 1 (CL1)	1,072	1.42	1,062	1,090	1.77	1,291	4.40	1,492
CAADP Level 2 (CL2)	596	-4.73	490	500	2.09	562	0.92	581
CAADP Level 3 (CL3)	482	-0.11	457	483	3.40	578	1.51	602
CAADP Level 4 (CL4)	810	3.02	986	1,073	3.47	1,273	1.47	1,324

Sources: ReSAKSS based on World Bank (2016) and FAO (2016).

ANNEX 2d: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.4

TABLE L2.1.4—LAND PRODUCTIVITY (agriculture value-added per hectare of arable land, constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	164	3.05	189	206	3.79	271	4.08	304
Central	128	-3.30	112	134	7.58	177	3.97	199
Eastern	138	1.35	142	153	3.59	227	7.67	275
Northern	346	2.92	384	392	0.49	482	3.35	528
Southern	61	1.53	65	69	4.31	88	3.28	101
Western	256	6.09	347	387	4.67	493	2.60	532
Less favorable agriculture conditions	43	3.15	47	62	11.44	93	6.25	110
More favorable agriculture conditions	141	-0.36	141	158	5.23	223	5.12	255
Mineral-rich countries	138	-3.51	118	124	3.41	149	1.97	158
Middle-income countries	211	4.60	260	279	3.16	364	4.13	411
CEN-SAD	216	4.76	265	289	3.83	379	4.02	422
COMESA	204	1.00	204	214	2.66	289	5.49	334
EAC	228	0.01	232	250	2.70	345	5.30	394
ECCAS	105	-1.42	101	121	7.99	178	5.92	215
ECOWAS	256	6.09	347	387	4.67	493	2.60	532
IGAD	145	1.90	148	157	3.68	245	8.97	307
SADC	79	-1.08	78	83	3.97	108	3.70	123
UMA	188	2.10	209	209	-1.22	270	6.02	317
CAADP Compact 2007–09 (CC1)	270	5.74	366	417	5.84	554	2.94	601
CAADP Compact 2010–12 (CC2)	134	-0.35	133	139	2.21	183	4.36	206
CAADP Compact 2013–15 (CC3)	86	2.92	91	98	3.92	137	7.35	170
CAADP Compact not yet (CC0)	210	2.48	230	235	1.14	283	2.60	306
CAADP Level 0 (CL0)	210	2.48	230	235	1.14	283	2.60	306
CAADP Level 1 (CL1)	78	2.91	82	88	3.73	123	7.61	154
CAADP Level 2 (CL2)	124	-3.35	109	115	3.63	141	2.33	152
CAADP Level 3 (CL3)	88	1.19	88	97	5.19	132	3.79	146
CAADP Level 4 (CL4)	270	4.93	350	394	4.97	521	3.41	573

Sources: ReSAKSS based on World Bank (2016) and FAO (2016).

ANNEX 2e: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.5A

TABLE L2.1.5A—YIELD, CASSAVA (tonnes per hectare)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	8.6	0.97	8.9	9.3	2.19	9.3	-3.35	8.4
Central	7.8	-0.23	7.6	7.9	1.57	8.0	0.05	8.2
Eastern	8.0	0.11	7.6	7.8	4.05	7.3	-6.59	5.9
Northern								
Southern	6.4	8.52	8.1	8.5	2.98	9.9	0.28	9.0
Western	10.1	-0.42	10.3	10.8	1.41	10.3	-5.24	9.0
Less favorable agriculture conditions	6.9	7.01	8.2	8.0	1.08	9.2	3.32	10.8
More favorable agriculture conditions	7.4	2.66	7.6	7.8	2.26	7.7	-3.27	6.8
Mineral-rich countries	7.5	-0.19	7.4	7.4	-0.45	7.6	1.24	7.7
Middle-income countries	9.9	0.25	10.4	11.1	2.80	10.9	-6.07	9.1
CEN-SAD	9.7	-0.26	10.0	10.5	1.38	10.0	-4.94	8.8
COMESA	8.1	2.46	8.6	8.8	1.10	8.5	-3.15	7.9
EAC	8.4	0.22	8.1	8.1	3.27	7.2	-6.67	6.0
ECCAS	7.6	1.86	8.3	8.7	2.92	9.5	-1.19	8.9
ECOWAS	10.1	-0.42	10.3	10.8	1.41	10.3	-5.24	9.0
IGAD	10.2	9.12	12.6	12.7	-0.94	8.6	-20.84	4.0
SADC	7.3	1.37	7.5	7.8	2.75	8.5	-0.29	7.9
UMA								
CAADP Compact 2007–09 (CC1)	10.2	-0.69	10.4	11.0	1.65	10.5	-5.38	9.1
CAADP Compact 2010–12 (CC2)	7.4	1.47	7.5	7.5	0.88	7.4	-1.74	7.0
CAADP Compact 2013–15 (CC3)	7.3	4.29	8.5	9.7	6.88	11.1	-3.53	9.4
CAADP Compact not yet (CC0)	7.1	0.14	7.1	7.2	-0.71	7.4	2.43	7.7
CAADP Level 0 (CL0)	7.1	0.14	7.1	7.2	-0.71	7.4	2.43	7.7
CAADP Level 1 (CL1)	6.9	6.47	8.9	9.7	5.05	10.5	-4.78	8.2
CAADP Level 2 (CL2)	7.8	-0.55	7.6	7.9	1.72	8.3	0.50	8.4
CAADP Level 3 (CL3)	8.3	5.95	9.4	8.9	-1.92	7.2	-8.36	5.6
CAADP Level 4 (CL4)	9.2	0.05	9.3	9.8	2.36	9.8	-3.38	9.0

Sources: ReSAKSS based on FAO (2016).

ANNEX 2f: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.5B

TABLE L2.1.5B—YIELD, YAMS (tonnes per hectare)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	10.0	-0.57	10.2	10.6	0.33	9.3	-5.08	8.9
Central	7.4	-0.39	7.1	7.8	4.44	8.3	-1.00	8.1
Eastern	4.1	-0.40	4.1	4.2	0.48	7.6	22.86	12.6
Northern	5.9	-0.16	6.2	6.3	-2.22	6.1	0.72	6.1
Southern								
Western	10.3	-0.62	10.5	10.8	0.20	9.4	-5.67	8.8
Less favorable agriculture conditions	8.5	-0.08	8.7	9.4	3.79	10.3	1.88	10.7
More favorable agriculture conditions	10.2	1.54	11.1	11.3	0.38	13.0	4.06	14.8
Mineral-rich countries	7.1	-1.38	6.4	6.7	2.20	7.0	-0.51	7.0
Middle-income countries	10.1	-0.75	10.3	10.6	0.27	9.2	-5.86	8.5
CEN-SAD	10.1	-0.57	10.3	10.7	0.24	9.3	-5.52	8.7
COMESA	4.4	-1.21	4.2	4.2	0.39	7.1	20.23	11.3
EAC	5.1	1.80	5.4	5.6	-0.52	8.5	18.97	13.3
ECCAS	7.4	-0.35	7.1	7.7	4.36	8.3	-0.55	8.2
ECOWAS	10.3	-0.62	10.5	10.8	0.20	9.4	-5.67	8.8
IGAD	4.0	-0.55	4.1	4.2	0.46	7.6	23.13	12.6
SADC	6.2	-4.57	4.5	4.5	0.00	4.3	-1.26	4.2
UMA	5.9	-0.16	6.2	6.3	-2.22	6.1	0.72	6.1
CAADP Compact 2007–09 (CC1)	10.4	-0.50	10.8	11.3	0.80	10.0	-6.24	9.3
CAADP Compact 2010–12 (CC2)	8.8	-1.18	8.4	8.1	-2.24	6.8	-0.87	6.7
CAADP Compact 2013–15 (CC3)	5.8	0.27	5.7	6.3	4.50	6.7	-1.61	6.4
CAADP Compact not yet (CC0)	5.2	0.44	5.4	5.2	-0.11	5.7	4.27	6.0
CAADP Level 0 (CL0)	5.2	0.44	5.4	5.2	-0.11	5.7	4.27	6.0
CAADP Level 1 (CL1)	5.1	-0.74	5.1	5.3	2.03	5.3	-1.58	5.1
CAADP Level 2 (CL2)	7.4	-0.61	6.8	7.6	5.51	8.5	-0.99	8.2
CAADP Level 3 (CL3)	10.0	3.21	10.6	10.7	0.57	9.8	-3.87	8.4
CAADP Level 4 (CL4)	10.2	-0.69	10.5	10.8	0.18	9.5	-5.28	9.0

Sources: ReSAKSS based on FAO (2016).

ANNEX 2g: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.5C

TABLE L2.1.5C—YIELD, MAIZE (tonnes per hectare)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	1.7	1.43	1.7	1.7	2.68	2.0	0.76	2.1
Central	1.1	0.30	1.1	1.1	1.63	1.2	0.68	1.2
Eastern	1.6	0.18	1.6	1.5	5.23	1.9	3.81	2.1
Northern	5.5	3.68	6.1	6.3	0.59	6.5	0.89	6.5
Southern	1.6	1.79	1.6	1.7	2.78	2.2	2.02	2.4
Western	1.4	1.81	1.5	1.6	2.02	1.7	-1.61	1.7
Less favorable agriculture conditions	1.1	0.52	1.1	1.2	3.25	1.8	2.74	1.8
More favorable agriculture conditions	1.4	-0.36	1.3	1.3	3.89	1.6	4.15	1.8
Mineral-rich countries	1.0	-0.05	1.1	1.2	1.06	1.4	4.53	1.6
Middle-income countries	2.1	3.66	2.3	2.5	2.56	2.7	-2.83	2.6
CEN-SAD	1.9	2.29	2.0	2.1	0.59	2.1	-1.64	2.0
COMESA	1.8	0.53	1.8	1.9	2.55	2.3	3.35	2.3
EAC	1.6	-0.60	1.5	1.4	4.72	1.6	2.14	1.8
ECCAS	0.9	0.47	0.9	1.0	1.34	1.1	2.54	1.2
ECOWAS	1.4	1.81	1.5	1.6	2.02	1.7	-1.61	1.7
IGAD	1.6	1.26	1.6	1.8	3.90	2.2	5.01	2.5
SADC	1.5	0.90	1.5	1.5	3.47	1.8	1.51	2.0
UMA	0.6	2.94	0.8	0.7	-1.70	0.9	1.00	0.9
CAADP Compact 2007–09 (CC1)	1.4	1.28	1.5	1.6	4.18	1.9	0.44	2.1
CAADP Compact 2010–12 (CC2)	1.4	-0.19	1.3	1.3	4.10	1.5	2.24	1.7
CAADP Compact 2013–15 (CC3)	1.1	-0.90	1.0	1.0	-3.19	1.1	6.30	1.2
CAADP Compact not yet (CC0)	3.0	4.64	3.5	4.0	5.82	4.8	-1.82	4.8
CAADP Level 0 (CL0)	3.0	4.64	3.5	4.0	5.82	4.8	-1.82	4.8
CAADP Level 1 (CL1)	1.0	-2.49	0.8	0.8	-6.27	0.9	9.41	1.0
CAADP Level 2 (CL2)	1.1	1.33	1.1	1.1	0.83	1.2	0.53	1.2
CAADP Level 3 (CL3)	1.4	1.52	1.5	1.6	4.76	2.2	0.80	2.2
CAADP Level 4 (CL4)	1.4	0.35	1.4	1.5	4.44	1.7	1.58	1.9

Sources: ReSAKSS based on FAO (2016).

ANNEX 2h: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.5d

TABLE L2.1.5D—YIELD, MEAT (indigenous cattle, kilograms per head)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2013)	Annual avg. change (2008–2013)	2013
Africa	141.7	0.57	147.1	152.8	1.41	155.1	-0.38	154.7
Central	143.8	-0.80	139.7	139.3	0.24	141.5	0.62	143.3
Eastern	116.4	1.03	125.4	129.5	0.98	128.9	-1.07	126.9
Northern	176.0	1.39	185.3	212.7	6.08	238.0	0.11	236.8
Southern	211.6	0.51	214.5	223.4	1.21	227.3	-0.25	224.3
Western	124.3	-0.30	122.8	122.4	0.02	119.4	-0.59	118.3
Less favorable agriculture conditions	123.1	-0.42	121.6	121.6	0.05	116.4	-0.99	114.3
More favorable agriculture conditions	122.2	0.77	130.3	135.1	1.16	134.2	-1.21	132.7
Mineral-rich countries	136.5	0.40	137.5	135.0	-0.21	139.0	0.83	141.5
Middle-income countries	164.8	0.70	170.1	181.4	2.50	192.3	0.27	192.3
CEN-SAD	131.8	1.02	141.4	149.5	2.18	153.1	-0.71	152
COMESA	131.0	1.33	143.1	153.1	2.43	158.7	-0.64	158.2
EAC	122.3	1.76	142.2	152.3	2.06	148.3	-2.56	142.5
ECCAS	148.7	-0.18	145.1	142.1	-0.39	142.6	0.50	144.1
ECOWAS	124.3	-0.30	122.8	122.4	0.02	119.4	-0.59	118.3
IGAD	118.0	1.71	132.1	137.6	1.23	138.2	-1.12	136.1
SADC	169.6	0.57	172.8	178.1	0.96	177.9	-0.57	175.4
UMA	179.8	1.54	187.0	187.5	0.49	187.9	0.45	189.4
CAADP Compact 2007–09 (CC1)	121.0	-0.32	119.7	119.5	0.02	117.1	-0.47	116.3
CAADP Compact 2010–12 (CC2)	124.7	1.00	136.1	142.1	1.48	141.9	-1.33	139.9
CAADP Compact 2013–15 (CC3)	134.0	1.01	137.3	136.4	-0.14	136.8	0.20	137.6
CAADP Compact not yet (CC0)	191.8	0.84	199.8	219.9	3.85	240.1	0.19	236.9
CAADP Level 0 (CL0)	191.8	0.84	199.8	219.9	3.85	240.1	0.19	236.9
CAADP Level 1 (CL1)	133.4	1.14	137.3	136.4	-0.17	136.2	0.04	136.5
CAADP Level 2 (CL2)	133.9	-0.20	132.4	130.8	-0.07	132.6	0.76	135.1
CAADP Level 3 (CL3)	136.4	0.15	136.8	136.7	0.00	133.3	-0.40	132.7
CAADP Level 4 (CL4)	118.4	0.40	125.0	129.2	1.11	128.7	-1.20	126.9

Sources: ReSAKSS based on FAO (2016).

ANNEX 2i: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.1.5e

TABLE L2.1.5E—YIELD, MILK (whole fresh cow, kilograms per head)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2013)	Annual avg. change (2008–2013)	2013
Africa	482.6	1.68	518.5	502.7	-0.51	497.0	0.84	511.4
Central	326.3	-0.39	322.9	336.3	2.13	343.7	0.06	348.6
Eastern	372.7	2.96	430.6	398.2	-2.42	376.0	0.57	384.1
Northern	1,061.0	4.25	1,199.4	1,352.6	4.93	1,651.5	3.61	1,755.8
Southern	1,036.3	-1.38	1,040.2	1,085.8	1.79	1,121.7	1.48	1,167.1
Western	209.1	-0.22	208.0	215.4	1.86	211.0	-3.28	198.4
Less favorable agriculture conditions	305.2	-0.83	291.0	290.2	1.20	279.6	-2.99	266.6
More favorable agriculture conditions	328.3	4.86	420.9	398.1	-2.43	370.1	0.79	382.6
Mineral-rich countries	242.1	-0.43	239.9	237.8	-0.08	238.8	0.58	244.2
Middle-income countries	709.8	-0.84	675.8	674.4	1.38	725.6	1.65	750.6
CEN-SAD	477.1	1.65	498.0	481.5	0.13	501.3	0.44	505.9
COMESA	448.2	2.88	517.2	490.1	-1.42	463.4	0.01	468.4
EAC	370.7	3.17	412.5	395.0	-1.34	415.0	2.02	429.7
ECCAS	386.4	0.50	399.0	404.3	1.02	410.7	1.42	422.9
ECOWAS	209.1	-0.22	208.0	215.4	1.86	211.0	-3.28	198.4
IGAD	409.8	2.82	476.0	434.2	-2.67	402.0	0.01	405.8
SADC	553.3	-0.71	535.6	526.0	-0.61	527.8	1.98	556.8
UMA	1,012.3	3.99	1,104.0	1,217.6	4.44	1,523.7	4.91	1,652.7
CAADP Compact 2007–09 (CC1)	269.5	6.79	407.2	386.2	-2.83	312.1	-1.93	312.8
CAADP Compact 2010–12 (CC2)	328.7	2.66	363.0	351.7	-1.07	366.6	1.82	380.3
CAADP Compact 2013–15 (CC3)	415.7	-0.26	407.0	375.2	-1.88	365.4	0.10	366.1
CAADP Compact not yet (CC0)	1,155.6	2.12	1,228.6	1,317.7	3.54	1,505.3	2.81	1,587.7
CAADP Level 0 (CL0)	1,155.6	2.12	1,228.6	1,317.7	3.54	1,505.3	2.81	1,587.7
CAADP Level 1 (CL1)	412.7	-0.22	404.5	371.7	-2.02	361.5	0.11	362.1
CAADP Level 2 (CL2)	308.6	-0.60	302.2	310.6	1.52	311.9	-0.20	315.4
CAADP Level 3 (CL3)	291.2	0.18	295.6	303.5	0.97	290.5	-3.29	275.3
CAADP Level 4 (CL4)	311.0	5.47	412.9	389.8	-2.56	360.1	0.81	372.9

Sources: ReSAKSS based on FAO (2016).
Notes: Data are from 1995 to 2013.

ANNEX 2j: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.2.1A

TABLE L2.2.1A—INTRA-AFRICAN AGRICULTURAL TRADE, EXPORTS (million, constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	598.5	-1.16	520.1	456.0	6.12	1469.5	21.90	2186.3
Central	28.6	7.82	37.1	37.4	0.57	37.8	-6.43	28.7
Eastern	308.9	-2.12	299.3	304.9	6.73	458.9	5.23	508.6
Northern	73.0	8.55	106.3	189.3	22.10	440.6	4.41	455.6
Southern	1,077.5	-0.85	962.7	848.2	3.99	2,655.0	19.62	3,806.0
Western	172.5	4.64	191.6	174.3	6.35	305.3	10.39	344.6
Less favorable agriculture conditions	61.9	-1.15	66.1	83.6	16.21	127.3	-6.72	99.4
More favorable agriculture conditions	322.9	-4.50	273.1	260.6	7.06	366.1	3.90	390.2
Mineral-rich countries	114.1	21.38	184.7	217.1	2.63	357.7	24.94	484.9
Middle-income countries	680.8	-0.89	592.8	515.7	5.81	1,741.1	22.80	2,598.8
CEN-SAD	192.2	2.97	208.8	214.1	8.63	391.6	7.71	428.7
COMESA	271.6	-2.00	244.0	265.7	8.30	455.7	5.95	476.5
EAC	380.6	-0.94	367.0	362.7	5.64	508.6	2.59	532.4
ECCAS	29.2	6.13	33.6	28.1	-8.78	26.3	2.11	26.2
ECOWAS	172.5	4.64	191.6	174.3	6.35	305.3	10.39	344.6
IGAD	361.9	-2.01	347.8	371.1	8.44	572.4	4.57	592.8
SADC	1,035.8	-0.66	925.1	800.4	3.70	2,469.5	19.73	,3562.7
UMA	69.6	5.30	81.7	128.8	21.56	293.8	10.71	365.2
CAADP Compact 2007–09 (CC1)	113.0	-0.54	130.7	110.7	12.94	251.3	12.68	293.6
CAADP Compact 2010–12 (CC2)	277.3	2.20	277.3	276.5	2.81	345.5	2.54	354.7
CAADP Compact 2013–15 (CC3)	236.7	-9.44	164.8	121.2	-0.85	86.8	-4.28	67.7
CAADP Compact not yet (CC0)	1,070.2	-0.79	939.0	835.6	5.55	2,618.3	19.22	3,646.2
CAADP Level 0 (CL0)	1,070.2	-0.79	939.0	835.6	5.55	2,618.3	19.22	3,646.2
CAADP Level 1 (CL1)	266.6	-4.48	196.0	148.7	-4.75	99.8	-4.00	83.6
CAADP Level 2 (CL2)	51.7	4.73	57.7	66.9	3.73	68.8	-3.22	58.8
CAADP Level 3 (CL3)	97.9	9.64	148.4	195.2	10.92	365.0	16.97	452.1
CAADP Level 4 (CL4)	218.4	2.26	230.3	209.7	4.85	355.0	9.79	406.8

Sources: ReSAKSS based on UNCTAD (2016) and World Bank (2016).
Notes: For regions and groups, level is weighted average per country, where weight is country's share in intra-African total exports for the region or group.

ANNEX 2k: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.2.1B

TABLE L2.2.1B—INTRA-AFRICAN AGRICULTURAL TRADE, IMPORTS (million, constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	259.1	4.40	287.7	292.1	2.59	474.7	8.50	563.1
Central	116.5	-6.49	116.4	179.1	17.66	223.7	4.23	252.6
Eastern	123.2	-1.82	133.0	164.6	9.27	251.3	-0.08	209.2
Northern	142.8	8.77	194.1	195.2	4.66	309.6	4.84	350.8
Southern	350.0	4.59	404.7	390.4	0.57	672.0	10.23	806.8
Western	208.7	4.96	204.1	241.4	5.34	337.3	4.08	387.8
Less favorable agriculture conditions	46.9	11.04	71.3	97.4	10.88	187.3	11.53	250.1
More favorable agriculture conditions	200.8	-3.98	227.5	292.4	9.56	373.5	-0.37	342.2
Mineral-rich countries	221.1	5.51	292.6	275.6	0.87	329.9	3.07	370.3
Middle-income countries	294.7	6.31	320.7	307.6	0.72	542.9	11.01	666.6
CEN-SAD	186.0	6.33	199.2	225.7	5.19	333.6	3.24	362.5
COMESA	236.3	2.00	288.8	316.0	5.40	394.6	0.31	390.0
EAC	133.8	-3.97	131.4	177.5	12.00	265.6	-0.38	221.2
ECCAS	345.5	10.38	339.0	254.6	-8.41	248.0	3.09	257.6
ECOWAS	208.7	4.96	204.1	241.4	5.34	337.3	4.08	387.8
IGAD	145.0	0.55	162.1	207.0	10.48	316.5	-2.90	235.3
SADC	326.5	4.14	373.1	365.6	1.52	629.0	10.13	756.6
UMA	130.8	8.74	171.6	158.7	2.03	286.3	9.50	342.4
CAADP Compact 2007–09 (CC1)	251.7	3.70	231.4	260.3	3.24	360.9	4.76	414.7
CAADP Compact 2010–12 (CC2)	146.0	-0.23	150.9	184.3	8.69	236.1	0.65	221.0
CAADP Compact 2013–15 (CC3)	326.6	5.15	369.5	347.4	-1.41	369.3	-1.43	339.5
CAADP Compact not yet (CC0)	274.3	4.69	323.4	328.2	4.33	691.9	13.17	850.3
CAADP Level 0 (CL0)	274.3	4.69	323.4	328.2	4.33	691.9	13.17	850.3
CAADP Level 1 (CL1)	339.5	5.70	384.8	369.9	-0.72	381.5	-1.31	353.8
CAADP Level 2 (CL2)	127.8	-7.38	129.9	205.7	21.43	326.0	1.20	300.7
CAADP Level 3 (CL3)	147.8	11.98	216.2	194.7	-2.06	235.1	6.71	301.2
CAADP Level 4 (CL4)	214.9	2.89	207.4	240.2	4.62	344.5	4.12	377.3

Sources: ReSAKSS based on UNCTAD (2016) and World Bank (2016).

Notes: For regions and groups, level is weighted average per country, where weight is country's share in intra-African total imports for the region or group.

ANNEX 2l: Level 2—Agricultural Transformation and Sustained Inclusive Agricultural Growth, Indicator 2.2.2

TABLE L2.2.2—DOMESTIC FOOD PRICE VOLATILITY (index)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2012)	Annual avg. change (2008–2012)	2012
Africa	11.0		11.6	12.7	3.74	12.6	-11.00	9.8
Central	8.3		7.8	8.7	1.24	9.2	-4.91	5.8
Eastern	10.5		11.5	13.5	6.76	14.1	-14.73	10.1
Northern	6.0		8.7	10.2	7.61	11.4	-4.76	10.2
Southern	11.3		8.9	7.9	6.10	14.8	-21.14	8.3
Western	14.4		14.8	15.8	0.87	12.0	-6.71	10.3
Less favorable agriculture conditions	12.7		11.5	15.7	3.14	13.5	-8.18	9.8
More favorable agriculture conditions	11.8		12.8	14.7	6.32	15.1	-13.54	11.7
Mineral-rich countries	18.3		16.7	11.6	-5.22	8.9	-8.51	8.4
Middle-income countries	10.3		11.1	11.8	2.89	11.7	-10.18	9.1
CEN-SAD	11.0		12.5	14.0	3.55	12.4	-10.23	9.8
COMESA	8.6		10.7	12.9	8.14	14.7	-9.38	11.9
EAC	11.4		12.7	16.0	7.55	15.5	-17.67	10.3
ECCAS	18.6		10.9	9.2	-1.87	8.6	-4.86	5.9
ECOWAS	14.4		14.8	15.8	0.87	12.0	-6.71	10.3
IGAD	11.3		11.8	15.4	9.67	16.9	-15.69	12.7
SADC	10.3		9.6	8.5	3.83	12.9	-19.80	7.2
UMA	8.7		8.5	9.2	3.88	9.5	-2.52	9.9
CAADP Compact 2007–09 (CC1)	13.5		14.1	15.1	0.99	11.5	-6.30	10.7
CAADP Compact 2010–12 (CC2)	12.2		12.7	14.8	6.09	14.6	-13.75	10.1
CAADP Compact 2013–15 (CC3)	15.6		10.4	8.1	-3.38	8.5	-6.06	4.8
CAADP Compact not yet (CC0)	6.1		8.0	9.3	8.38	13.1	-13.86	9.3
CAADP Level 0 (CL0)	6.1		8.0	9.3	8.38	13.1	-13.86	9.3
CAADP Level 1 (CL1)	20.1		12.4	8.4	-6.06	8.6	-5.58	4.7
CAADP Level 2 (CL2)	9.8		9.6	9.2	-3.22	8.3	-12.23	4.9
CAADP Level 3 (CL3)	15.8		14.4	17.5	4.28	15.7	-0.80	14.4
CAADP Level 4 (CL4)	12.8		13.7	14.7	2.84	12.4	-10.76	10.2

Sources: ReSAKSS based on FAO (2016).
Notes: Data are from 2000 to 2012. For regions or groups, level is weighted average, where weight is country's share in total food production for the region or group.

ANNEX 3a: Level 3—Strengthening Systemic Capacity to Deliver Results, Indicator 3.5.1

TABLE L3.5.1—PUBLIC AGRICULTURE EXPENDITURE (million, constant 2010 US$)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2014)	Annual avg. change (2008–2014)	2014
Africa	707.8	11.53	941.0	1168.5	11.53	1171.0	-5.64	765.3
Central	53.5	6.65	75.9	96.2	9.28	156.2	9.80	203.2
Eastern	198.1	5.78	276.4	330.6	6.36	420.2	1.14	364.7
Northern	1,520.4	6.39	1,678.8	1,546.9	-3.38	1,710.0	6.86	2,126.3
Southern	437.3	19.96	711.2	949.9	12.21	961.5	-3.62	825.5
Western	578.8	20.11	914.1	1,372.3	22.93	1,335.1	-11.56	606.2
Less favorable agriculture conditions	85.0	4.94	116.1	150.4	5.22	153.4	0.96	207.8
More favorable agriculture conditions	172.2	4.18	227.9	279.1	7.65	372.7	2.22	340.6
Mineral-rich countries	48.2	8.05	62.4	100.5	19.75	164.4	4.83	356.5
Middle-income countries	919.3	11.26	1,179.1	1,478.6	12.26	1,490.6	-5.63	1013.2
CEN-SAD	876.7	9.36	1,058.5	1,325.4	13.25	1,244.3	-9.04	656.4
COMESA	1,048.1	5.48	1,079.8	939.7	-5.27	796.4	0.75	596.0
EAC	186.1	3.48	235.0	210.4	-4.60	317.8	4.05	330.2
ECCAS	80.7	3.37	92.4	223.8	34.93	340.3	0.34	309.8
ECOWAS	578.8	20.11	914.1	1,372.3	22.93	1,335.1	-11.56	606.2
IGAD	229.1	5.53	311.9	392.6	9.11	477.8	2.21	418.3
SADC	343.7	18.30	556.2	713.5	10.75	741.0	-4.21	691.3
UMA	816.4	13.47	1,316.0	1,477.3	3.97	2,299.5	9.42	2,901.9
CAADP Compact 2007–09 (CC1)	614.8	21.25	978.5	1,436.0	21.61	1,363.2	-11.63	568.7
CAADP Compact 2010–12 (CC2)	146.5	0.10	163.5	161.3	0.06	266.5	7.89	305.7
CAADP Compact 2013–15 (CC3)	91.1	1.11	94.8	222.5	34.38	338.4	-1.15	281.3
CAADP Compact not yet (CC0)	1,336.0	8.55	1,586.5	1,570.3	-0.45	1,729.5	5.09	1,931.7
CAADP Level 0 (CL0)	1,336.0	8.55	1,586.5	1,570.3	-0.45	1,729.5	5.09	1,931.7
CAADP Level 1 (CL1)	95.8	-1.48	83.8	266.0	45.72	392.3	-3.80	294.4
CAADP Level 2 (CL2)	60.8	5.82	81.4	97.1	7.44	155.4	10.07	129.7
CAADP Level 3 (CL3)	61.8	13.86	90.2	121.5	12.15	159.6	1.13	226.7
CAADP Level 4 (CL4)	524.1	18.43	832.3	1,228.6	21.60	1,197.9	-10.92	616.5

Sources: ReSAKSS based on IFPRI (2015), World Bank (2016), and national sources.

Notes: For regions or groups, level is weighted average per country, where weight is country's share in total agriculture value added for the region or group.

ANNEX 3b: Level 3—Strengthening Systemic Capacity to Deliver Results, Indicator 3.5.2

TABLE L3.5.2—SHARE OF AGRICULTURE EXPENDITURE IN TOTAL PUBLIC EXPENDITURE (%)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2014)	Annual avg. change (2008–2014)	2014
Africa	3.2	3.4	3.6	3.5	-1.2	3.0	-1.5	2.6
Central	2.0	-1.1	2.3	3.0	6.2	3.5	1.9	3.6
Eastern	5.7	-0.2	6.0	6.1	0.0	5.7	-8.3	3.3
Northern	4.6	2.8	4.6	3.9	-9.1	2.9	1.6	3.2
Southern	1.6	10.1	2.2	2.5	3.6	2.2	-4.3	1.9
Western	3.4	-2.1	3.4	3.8	6.4	4.1	2.8	5.3
Less favorable agriculture conditions	11.0	-1.3	11.6	12.3	-3.0	8.3	-2.4	8.8
More favorable agriculture conditions	6.6	-2.8	6.4	6.9	3.1	6.9	-5.0	5.6
Mineral-rich countries	5.2	2.1	5.3	7.0	13.7	7.7	-3.4	8.6
Middle-income countries	2.8	4.9	3.2	3.1	-2.1	2.6	-1.4	2.0
CEN-SAD	4.6	-1.2	4.3	3.9	-3.9	3.1	-0.8	3.9
COMESA	5.8	0.6	5.3	4.6	-5.9	3.2	-4.8	4.0
EAC	4.9	0.0	4.9	4.2	-7.1	4.2	-4.8	2.9
ECCAS	1.3	-4.2	1.3	2.1	14.9	1.8	-10.3	0.9
ECOWAS	3.4	-2.1	3.4	3.8	6.4	4.1	2.8	5.3
IGAD	5.9	0.7	6.5	7.1	2.2	6.1	-7.3	3.5
SADC	1.9	8.2	2.5	2.7	2.2	2.3	-5.2	1.9
UMA	3.5	5.6	4.2	4.2	-3.4	4.1	4.0	4.5
CAADP Compact 2007–09 (CC1)	3.2	1.8	3.7	4.3	6.5	4.3	0.8	5.8
CAADP Compact 2010–12 (CC2)	5.3	-1.9	5.1	5.3	2.3	5.9	-0.5	6.0
CAADP Compact 2013–15 (CC3)	2.0	-7.6	1.6	2.3	12.1	2.1	-12.8	1.0
CAADP Compact not yet (CC0)	3.1	6.6	3.5	3.2	-6.5	2.4	0.1	1.9
CAADP Level 0 (CL0)	3.1	6.6	3.5	3.2	-6.5	2.4	0.1	1.9
CAADP Level 1 (CL1)	2.0	-8.5	1.5	2.1	12.6	1.9	-15.0	0.9
CAADP Level 2 (CL2)	4.2	-2.5	4.0	4.1	1.6	4.7	4.2	4.6
CAADP Level 3 (CL3)	5.7	1.6	6.2	7.5	7.5	7.2	-3.6	7.3
CAADP Level 4 (CL4)	3.7	-1.2	3.9	4.3	4.8	4.6	1.6	5.2

Sources: ReSAKSS based on IFPRI (2015), World Bank (2016), and national sources.

ANNEX 3c: Level 3—Strengthening Systemic Capacity to Deliver Results, Indicator 3.5.3

TABLE L3.5.3—PUBLIC AGRICULTURE EXPENDITURE AS SHARE OF AGRICULTURE GDP (%)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2014)	Annual avg. change (2008–2014)	2014
Africa	5.6	3.5	5.8	6.2	3.1	5.8	-1.8	6.7
Central	2.0	2.3	2.6	3.1	4.9	4.0	8.1	4.9
Eastern	3.9	5.4	5.1	5.0	-2.1	4.2	-7.2	3.0
Northern	10.2	3.6	10.8	10.3	-1.7	10.0	2.7	10.9
Southern	8.7	8.9	11.2	15.1	9.5	14.7	-2.0	12.8
Western	3.1	0.5	2.7	3.2	10.0	3.0	-4.7	4.8
Less favorable agriculture conditions	5.7	0.8	7.8	8.3	-5.6	5.0	-4.3	6.6
More favorable agriculture conditions	4.1	1.3	4.7	5.0	2.4	4.9	-4.1	4.6
Mineral-rich countries	4.3	-0.1	4.3	6.1	15.9	9.5	4.3	17.2
Middle-income countries	6.1	3.9	6.1	6.5	3.2	6.1	-1.3	7.6
CEN-SAD	5.3	-0.6	4.4	4.3	0.3	3.6	-2.8	4.2
COMESA	7.0	1.8	6.9	6.5	-2.0	5.3	-2.5	5.7
EAC	3.1	4.5	3.9	3.3	-5.9	3.4	-3.6	2.8
ECCAS	3.0	-1.4	2.9	5.4	22.4	5.3	-5.4	3.1
ECOWAS	3.1	0.5	2.7	3.2	10.0	3.0	-4.7	4.8
IGAD	3.8	7.1	5.4	5.4	-1.3	4.1	-5.0	3.1
SADC	7.2	7.9	9.1	11.6	7.9	11.3	-3.8	10.7
UMA	10.7	8.4	14.2	15.8	6.1	18.0	0.0	17.4
CAADP Compact 2007–09 (CC1)	2.8	6.7	2.9	3.4	8.8	2.8	-7.6	4.5
CAADP Compact 2010–12 (CC2)	4.1	-1.0	4.3	4.8	5.5	5.8	1.8	6.6
CAADP Compact 2013–15 (CC3)	4.8	-5.0	3.9	6.3	18.6	6.2	-8.7	3.4
CAADP Compact not yet (CC0)	10.3	6.1	12.0	12.5	1.0	12.3	1.7	17.3
CAADP Level 0 (CL0)	10.3	6.1	12.0	12.5	1.0	12.3	1.7	17.3
CAADP Level 1 (CL1)	6.7	-6.3	4.9	8.4	20.1	7.5	-11.7	3.6
CAADP Level 2 (CL2)	3.0	1.5	3.4	3.4	0.4	4.1	6.7	5.5
CAADP Level 3 (CL3)	3.8	6.9	5.1	6.0	5.9	6.2	-0.5	8.5
CAADP Level 4 (CL4)	3.1	1.8	3.1	3.5	7.8	3.3	-4.6	4.4

Sources: ReSAKSS based on IFPRI (2015), World Bank (2016), and national sources.

ANNEX 3d: Level 3—Strengthening Systemic Capacity to Deliver Results

TABLE L 3(a)—PROGRESS IN CAADP IMPLEMENTATION PROCESS AS OF AUGUST 2016

Country/region	Roundtable held and compact signed	Investment plan drafted, reviewed, and validated	Business meeting held	Country SAKSS established	GAFSP funding approved (million US$)	Grow Africa first wave	JSR assessment conducted/ initiated	New Alliance Cooperation Framework launched
AFRICA*	**42**	**30**	**27**	**11**	**17**	**12**	**30**	**10**
Central Africa*	***9***	***5***	***3***	***1***	***1***		***3***	
Burundi	August 25, 2009	August 31, 2011	March 15, 2012		$30		Yes+	
Cameroon	July 17, 2013	August 22, 2014						
Central African Republic	April 15, 2011	May 21, 2012	December 21, 2013					
Chad	December 16, 2013							
Congo, Dem. Republic	March 18, 2011	May 21, 2013	November 8, 2013	Yes			Yes	
Congo, Republic	December 10, 2013						Initiated	
Equatorial Guinea	December 5, 2013							
Gabon	May 10, 2013							
São Tomé and Principé	October 17, 2013	September 2, 2014						
Eastern Africa*	***10***	***6***	***6***	***5***	***4***	***4***	***8***	***2***
Comoros, The								
Djibouti	April 19, 2012	November 22, 2012					Initiated	
Eritrea								
Ethiopia	September 28, 2009	September 25, 2010	December 7, 2010	Yes	$51	Yes	Yes	Yes
Kenya	July 24, 2010	September 14, 2010	September 27, 2010	Yes	$24	Yes	Yes	
Madagascar	October 21, 2013						Initiated	
Mauritius	July 23, 2015						Initiated	
Rwanda	March 31, 2007	December 8, 2009	December 9, 2009	Yes	$50	Yes		
Seychelles	September 16, 2011		November 19, 2015				Initiated	
Somalia								
Sudan	July 29, 2013							
Tanzania	July 8, 2010	May 31, 2011	November 10, 2011	Yes	$22.9	Yes	Yes	Yes
Uganda	March 31, 2010	September 10, 2010	September 17, 2010	Yes	$27.6		Yes	

TABLE L 3(a)—PROGRESS IN CAADP IMPLEMENTATION PROCESS AS OF AUGUST 2016 *continued*

Country/region	Roundtable held and compact signed	Investment plan drafted, reviewed, and validated	Business meeting held	Country SAKSS established	GAFSP funding approved (million US$)	Grow Africa first wave	JSR assessment conducted/ initiated	New Alliance Cooperation Framework launched
Northern Africa*	***1***	***1***	***1***					
Algeria								
Egypt								
Libya								
Mauritania	July 28, 2011	February 16, 2012	March 21, 2012					
Morocco								
Tunisia								
Southern Africa*	***7***	***3***	***3***	***1***	***2***	***2***	***7***	***2***
Angola	August 5, 2014							
Botswana								
Lesotho	September 4, 2013						Initiated	
Malawi	April 19, 2010	September 16, 2010	September 29, 2011		$39.6	Yes	Yes	Yes
Mozambique	December 9, 2011	December 13, 2012	April 12, 2013	Yes		Yes	Yes	Yes
Namibia							Initiated	
South Africa								
Swaziland	March 4, 2010						Yes	
Zambia	January 18, 2011	March 15, 2013	May 30, 2013		$31.1		Yes	
Zimbabwe	November 22, 2013						Initiated	
Western Africa*	***15***	***15***	***14***	***4***	***9***	***6***	***12***	***6***
Benin	October 16, 2009	September 25, 2010	June 7, 2011	Yes	$24	Yes	Yes	Yes
Burkina Faso	July 22, 2010	January 17, 2012	March 26, 2012		$37.1	Yes	Yes	Yes
Cape Verde	December 11, 2009	September 25, 2010	November 17, 2010				Initiated	
Côte d'Ivoire	July 27, 2010	June 20, 2012	September 14, 2012			Yes	Yes	Yes
Gambia, The	October 28, 2009	September 25, 2010	November 5, 2010		$28			
Ghana	October 28, 2009	June 9, 2010	June 17, 2010	Yes		Yes	Yes	Yes
Guinea	April 7, 2010	September 25, 2010	June 5, 2013				Initiated	
Guinea Bissau	January 18, 2011	June 3, 2011						

TABLE L 3(a)—PROGRESS IN CAADP IMPLEMENTATION PROCESS AS OF AUGUST 2016 *continued*

Country/region	Roundtable held and compact signed	Investment plan drafted, reviewed, and validated	Business meeting held	Country SAKSS established	GAFSP funding approved (million US$)	Grow Africa first wave	JSR assessment conducted/ initiated	New Alliance Cooperation Framework launched
Western Africa* *cont'd*	***15***	***15***	***14***	***4***	***9***	***6***	***12***	***6***
Liberia	October 6, 2009	June 9, 2010	June 17, 2010		$46.5		Initiated	
Mali	October 13, 2009	September 25, 2010	November 5, 2010		$37.2		Yes+	
Niger	September 30, 2009	September 25, 2010	December 15, 2010		$33		Yes+	
Nigeria	October 30, 2009	June 9, 2010	June 17, 2010			Yes	Initiated	Yes
Senegal	February 10, 2010	June 9, 2010	June 17, 2010	Yes	$40	Yes	Yes	Yes
Sierra Leone	September 18, 2009	June 9, 2010	June 17, 2010		$50			
Togo	July 30, 2009	June 9, 2010	June 17, 2010	Yes	$39		Yes+	
Regional economic communities (RECs)	***4***	***2***	***1***				***1***	
CEN-SAD								
COMESA	November 14, 2014							
EAC	In progress							
ECCAS	July 10, 2013	September 5, 2013						
ECOWAS	November 12, 2009	June 9, 2010	June 17, 2010				Yes	
IGAD	October 30, 2013							
SADC	In progress							
UMA								

Sources: Authors' compilation based on NEPAD (2015) and ReSAKSS (2016).

Notes: SAKSS = Strategic Analysis and Knowledge Support System; GAFSP = Global Agriculture and Food Security Program; JSR = Joint Sector Review; New Alliance = New Alliance for Food Security and Nutrition.

* These rows show the number of countries in each subregion that have achieved the milestone.

** This row shows the number of RECs that have achieved the milestone.

\+ The JSR assessment was initiated in 2015 but is not yet completed.

ReSAKSS-ECA

Burundi (COMESA, EAC, ECCAS)
Central African Rep. (Cen-SAD, ECCAS)
Comoros (CEN-SAD, COMESA)
Congo, D.R. (COMESA, ECCAS, SADC)
Congo, R. (ECCAS)
Djbouti (CEN-SAD, COMESA, IGAD)
Egypt (CEN-SAD, COMESA)
Eritrea (COMESA, IGAD)
Ethiopia (COMESA, IGAD)
Gabon (ECCAS)
Kenya (Cen-SAD, COMESA, EAC, IGAD)
Libya (CEN-SAD, COMESA, UMA)
Rwanda (COMESA, EAC, ECCAS)
Seychelles (COMESA, SADC)
South Sudan (IGAD)
Sudan (CEN-SAD, COMESA, IGAD)
Tanzania (SADC)
Uganda (COMESA, EAC, IGAD)

ReSAKSS-SA

Angola (ECCAS, SADC)
Botswana (SADC)
Lesotho (SADC)
Madagascar (COMESA, SADC)
Malawi (COMESA, SADC)
Mauritius (COMESA, SADC)
Mozambique (SADC)
Namibia (SADC)
Swaziland (COMESA, SADC)
Zambia (COMESA, SADC)
Zimbabwe (COMESA, SADC)

ReSAKSS-WA

Benin (CEN-SAD, ECOWAS)
Burkina Faso (CEN-SAD, ECOWAS)
Cameroon (ECCAS)
Cape Verde (ECOWAS)
Chad (CEN-SAD, ECCAS)
Côte d'Ivoire (CEN-SAD, ECOWAS)
Gambia (CEN-SAD, ECOWAS)
Ghana (CEN-SAD, ECOWAS)
Guinea (CEN-SAD, ECOWAS)
Guinea-Bissau (CEN-SAD, ECOWAS)
Liberia (CEN-SAD, ECOWAS)
Mali (CEN-SAD, ECOWAS)
Mauritania (CEN-SAD, UMA)
Niger (CEN-SAD, ECOWAS)
Nigeria (CEN-SAD, ECOWAS)
Senegal (CEN-SAD, ECOWAS)
Sierra Leone (CEN-SAD, ECOWAS)
Togo (CEN-SAD, ECOWAS)

ANNEX 3d: Level 3—Strengthening Systemic Capacity to Deliver Results

TABLE L 3(b)—PROGRESS IN STRENGTHENING SYSTEMIC CAPACITY

Country/region	L2.4.2-Existence of food reserves, local purchases for relief programs, early warning systems and food feeding programs*	L3.1.1-Existence of a new NAIP/NAFSIP developed through an inclusive and participatory process	L3.2.1-Existence of inclusive institutionalized mechanisms for mutual accountability and peer review	L3.3.1-Existence of and quality in the implementation of evidence-informed policies and corresponding human resources	L3.4.1-Existence of a functional multi-sectoral and multi-stakeholder coordination body	L3.4.2-Cumulative number of public-private partnerships (PPPs) that are successfully undertaken	L3.4.3-Cumulative value of investments in the PPPs
AFRICA*	**26**	**8**	**17**	**6**	**15**	**5**	
Central Africa*	***4***		***2***	***1***	***1***	***2***	
Burundi	Yes		Yes	Yes	Yes	Several PPPs	Not stated
Cameroon							
Central African Republic	Yes						
Chad							
Congo, Dem. Rep.	Yes		Yes			Several PPPs	Not stated
Congo, Rep.	Yes						
Equatorial Guinea							
Gabon							
São Tomé and Principé							
Eastern Africa*	***7***	***4***	***3***	***2***	***3***	***2***	
Comoros, The							
Djibouti	Yes	Yes					
Eritrea							
Ethiopia	Yes						
Kenya	Yes					One	Not stated
Madagascar							
Mauritius							
Rwanda	Yes	Yes	Yes		Yes		
Seychelles	Yes	Yes				One	Not stated
Somalia							
South Sudan							
Sudan							

ANNEX 3d: Level 3—Strengthening Systemic Capacity to Deliver Results, continued

TABLE L 3(b)—PROGRESS IN STRENGTHENING SYSTEMIC CAPACITY *continued*

Country/region	L2.4.2-Existence of food reserves, local purchases for relief programs, early warning systems and food feeding programs*	L3.1.1-Existence of a new NAIP/NAFSIP developed through an inclusive and participatory process	L3.2.1-Existence of inclusive institutionalized mechanisms for mutual accountability and peer review	L3.3.1-Existence of and quality in the implementation of evidence-informed policies and corresponding human resources	L3.4.1-Existence of a functional multi-sectoral and multi-stakeholder coordination body	L3.4.2-Cumulative number of public-private partnerships (PPPs) that are successfully undertaken	L3.4.3-Cumulative value of investments in the PPPs
Eastern Africa* *cont'd*	***7***	***4***	***3***	***2***	***3***	***2***	
Tanzania	Yes		Yes	Yes	Yes	Not clearly stated	US$3.2 billion by 2030
Uganda	Yes	Yes	Yes	Yes	Yes	Not clearly stated	US$156 million (Public: 8%; Private: 77%; Others: 15%)
Northern Africa*							
Algeria							
Egypt							
Libya							
Mauritania							
Morocco							
Tunisia							
Southern Africa*	***7***	***2***	***4***	***1***	***3***		
Angola	Yes						
Botswana	Yes						
Lesotho							
Malawi	Yes		Yes	Yes	Yes		
Mozambique	Yes		Yes		Yes		
Namibia	Yes						
South Africa			Yes				
Swaziland		Yes					
Zambia	Yes		Yes				
Zimbabwe	Yes	Yes**			Yes		

ANNEX 3d: Level 3—Strengthening Systemic Capacity to Deliver Results, continued

TABLE L 3(b)—PROGRESS IN STRENGTHENING SYSTEMIC CAPACITY *continued*

Country/region	L2.4.2-Existence of food reserves, local purchases for relief programs, early warning systems and food feeding programs*	L3.1.1-Existence of a new NAIP/NAFSIP developed through an inclusive and participatory process	L3.2.1-Existence of inclusive institutionalized mechanisms for mutual accountability and peer review	L3.3.1-Existence of and quality in the implementation of evidence-informed policies and corresponding human resources	L3.4.1-Existence of a functional multi-sectoral and multi-stakeholder coordination body	L3.4.2-Cumulative number of public-private partnerships (PPPs) that are successfully undertaken	L3.4.3-Cumulative value of investments in the PPPs
Western Africa*	***8***	***2***	***8***	***2***	***8***	***1***	
Benin	Yes		Yes		Yes	Several PPPs	Not stated
Burkina Faso	Yes		Yes		Yes		
Cape Verde							
Côte d'Ivoire	Yes		Yes		Yes		
Gambia, The							
Ghana	Yes		Yes		Yes		
Guinea							
Guinea Bissau							
Liberia							
Mali	Yes	Yes	Yes				
Niger	Yes		Yes		Yes		
Nigeria	Yes				Yes		
Senegal	Yes		Yes	Yes	Yes		
Sierra Leone							
Togo		Yes	Yes	Yes	Yes		

Notes: NAIP = National Agricultural Investment Plan; NAFSIP = National Agriculture and Food Security Investment Plan
* This indicator is from level 2 of the CAADP Results Framework.
** Finalized recently; it does not take all Malabo commitments into account.

ANNEX 4: Distribution of countries by year of signing CAADP compact and level of CAADP implementation reached by end of 2015

TABLE 4: COUNTRY CLASSIFICATION BY PERIOD WHEN CAADP COMPACT WAS SIGNED AND STAGE OF CAADP IMPLEMENTATION

PERIOD WHEN CAADP COMPACT WAS SIGNED				LEVEL OR STAGE OF CAADP IMPLEMENTATION REACHED BY END OF 2015				
2007–2009	2010–2012	2013–2015	Not signed	LEVEL 0 Not started or pre-compact	LEVEL 1 Signed compact	LEVEL 2 Level 1 plus NAIP	LEVEL 3 Level 2 plus one external funding source	LEVEL 4 Level 3 plus other external funding source
CC1	**CC2**	**CC3**	**CC0**	**CL0**	**CL1**	**CL2**	**CL3**	**CL4**
Benin	Burkina Faso	Angola	Algeria	Algeria	Angola	Cameroon	Burundi	Benin
Burundi	Central Afr. Rep.	Cameroon	Botswana	Botswana	Chad	Cape Verde	Gambia, The	Burkina Faso
Cape Verde	Congo, Dem. Rep.	Chad	Comoros, The	Comoros, The	Congo, Rep.	Central Afr. Rep.	Liberia	Côte d'Ivoire
Ethiopia	Côte d'Ivoire	Congo, Rep.	Egypt	Egypt	Eq. Guinea	Congo, Dem. Rep.	Mali	Ethiopia
Gambia, The	Djibouti	Eq. Guinea	Eritrea	Eritrea	Gabon	Djibouti	Niger	Ghana
Ghana	Guinea	Gabon	Libya	Libya	Lesotho	Guinea	Sierra Leone	Kenya
Liberia	Guinea Bissau	Lesotho	Morocco	Morocco	Madagascar	Guinea Bissau	Togo	Malawi
Mali	Kenya	Madagascar	Namibia	Namibia	Mauritius	Mauritania	Uganda	Mozambique
Niger	Malawi	Mauritius	Somalia	Somalia	Seychelles	S. T. & Principe	Zambia	Nigeria
Nigeria	Mauritania	Sudan	South Africa	South Africa	Sudan			Rwanda
Rwanda	Mozambique	S. T. & Principe	South Sudan	South Sudan	Swaziland			Senegal
Sierra Leone	Senegal	Zimbabwe	Tunisia	Tunisia	Zimbabwe			Tanzania
Togo	Seychelles							
	Swaziland							
	Tanzania							
	Uganda							
	Zambia							
NUMBER OF COUNTRIES								
13	17	12	12	12	12	9	9	12
AVERAGE SHARE OF AGRICULTURAL GDP IN TOTAL GDP, 2003–2015 (%)								
25.7	23.1	16.4	6.9	6.9	15.7	21.9	25.2	25.1

Source: Benin (2016)

Notes: NAIP = National Agricultural Investment Plan. Three external funding sources are considered: Grow Africa, New Alliance Cooperation, and the Global Agriculture and Food Security Program (GAFSP).

ANNEX 5: Supplementary Data Tables

TABLE O.1.1A—AGRICULTURAL ODA (% of total ODA)

Region	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2014)	Annual avg. change (2008–2014)	2014
Africa	3.8	3.5	2.3	5.5	6.1	7.1
Central	2.1	2.1	18.0	3.0	19.6	4.6
Eastern	4.6	4.2	-2.1	6.0	4.5	7.4
Northern	3.8	3.6	-3.1	4.8	8.4	7.0
Southern	2.9	3.3	2.1	5.4	6.2	5.8
Western	5.1	4.0	0.4	7.0	3.4	8.8
Less favorable agriculture conditions	6.6	5.8	-2.9	7.9	5.9	8.8
More favorable agriculture conditions	5.0	5.0	-2.8	6.6	3.1	7.5
Mineral-rich countries	1.5	2.0	22.8	3.0	7.7	4.0
Middle-income countries	3.4	2.5	0.3	4.8	9.4	7.2
CEN-SAD	4.7	3.6	-1.9	6.0	5.5	7.9
COMESA	3.2	3.4	5.7	5.4	9.2	8.0
EAC	4.3	4.9	5.7	6.0	0.9	6.4
ECCAS	2.0	2.3	23.1	3.8	13.8	5.1
ECOWAS	5.1	4.0	0.4	7.0	3.4	8.8
IGAD	4.4	3.8	-2.9	5.9	8.6	7.9
SADC	2.8	3.4	8.4	4.7	3.9	5.5
UMA	5.0	3.9	-10.8	5.0	8.1	4.2
CAADP Compact 2007–09 (CC1)	4.1	3.3	-1.4	6.9	7.5	8.5
CAADP Compact 2010–12 (CC2)	3.8	4.4	9.4	5.4	2.0	6.8
CAADP Compact 2013–15 (CC3)	3.8	2.7	-4.9	5.3	16.0	7.3
CAADP Compact not yet (CC0)	3.5	3.2	-6.8	3.9	13.1	6.1
CAADP Level 0 (CL0)	3.5	3.2	-6.8	3.9	13.1	6.1
CAADP Level 1 (CL1)	3.8	2.9	-3.8	5.6	14.8	7.8
CAADP Level 2 (CL2)	2.7	2.6	12.3	2.8	4.6	3.4
CAADP Level 3 (CL3)	4.1	4.7	5.6	7.4	6.9	8.5
CAADP Level 4 (CL4)	4.5	3.9	0.3	6.4	3.0	8.0

Sources: ReSAKSS based on OECD (2016) and World Bank (2016).
Notes: Data are from 2002 to 2014.

ANNEX 5: Supplementary Data Tables

TABLE O.1.1B—AGRICULTURAL ODA (% of commitments disbursed)

Region	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2014)	Annual avg. change (2008–2014)	2014
Africa	79.8	74.8	-5.9	72.0	3.7	84.5
Central	72.9	76.8	11.2	68.0	2.0	82.8
Eastern	72.7	77.4	-3.5	75.6	3.7	89.0
Northern	116.5	70.3	-19.8	68.9	21.0	94.6
Southern	85.2	89.0	-1.8	82.4	-0.1	102.9
Western	82.6	73.9	-7.6	71.9	-0.3	71.9
Less favorable agriculture conditions	89.9	84.2	-6.7	74.4	2.2	70.9
More favorable agriculture conditions	78.7	82.3	0.7	80.6	-1.2	86.4
Mineral-rich countries	65.5	85.9	12.7	84.9	-4.4	112.8
Middle-income countries	80.9	70.1	-13.3	66.0	9.5	84.4
CEN-SAD	85.0	66.4	-8.9	68.8	6.5	82.5
COMESA	76.2	78.4	-5.8	70.4	3.2	87.4
EAC	59.6	83.0	14.9	84.1	-0.3	77.3
ECCAS	75.3	76.6	5.4	71.3	1.5	76.2
ECOWAS	82.6	73.9	-7.6	71.9	-0.3	71.9
IGAD	67.6	74.9	-6.3	74.2	6.7	92.2
SADC	79.2	85.0	1.4	84.1	-0.7	101.9
UMA	99.3	76.8	-22.7	105.7	48.1	240.8
CAADP Compact 2007–09 (CC1)	77.4	73.5	-11.2	73.4	0.3	65.1
CAADP Compact 2010–12 (CC2)	73.5	84.0	7.0	78.9	-0.8	99.7
CAADP Compact 2013–15 (CC3)	90.8	76.5	-10.7	70.3	10.0	98.0
CAADP Compact not yet (CC0)	123.5	88.5	-25.8	68.6	24.5	97.4
CAADP Level 0 (CL0)	123.5	88.5	-25.8	68.6	24.5	97.4
CAADP Level 1 (CL1)	80.0	72.4	-11.3	77.9	15.0	127.3
CAADP Level 2 (CL2)	83.9	86.5	5.7	75.0	-8.5	80.0
CAADP Level 3 (CL3)	77.9	99.6	-0.6	77.6	0.1	73.3
CAADP Level 4 (CL4)	76.0	70.0	-2.7	75.5	-0.8	80.5

Sources: ReSAKSS based on OECD (2016) and World Bank (2016).
Notes: Data are from 2002 to 2014.

ANNEX 5: Supplementary Data Tables

TABLE O.1.2A—GENERAL GOVERNMENT GROSS DEBT (% of GDP)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	63.7	-4.0	50.5	33.5	-16.5	22.6	1.3	24.5
Central	127.6	-4.1	92.4	64.0	-16.3	23.0	-14.3	16.8
Eastern	92.6	-3.8	81.1	55.5	-18.1	37.0	1.4	37.5
Northern	48.0	-6.2	38.4	27.1	-15.3	17.6	1.2	19.3
Southern	45.2	-2.6	36.5	28.0	-5.5	31.8	5.4	38.1
Western	82.5	-3.6	60.9	31.5	-29.9	11.7	-1.7	11.6
Less favorable agriculture conditions	100.4	-0.4	86.5	53.6	-21.1	32.2	3.5	33.3
More favorable agriculture conditions	73.0	-3.6	64.7	46.3	-17.0	32.1	0.8	32.4
Mineral-rich countries	203.4	0.7	173.6	119.5	-15.8	45.4	-18.9	27.1
Middle-income countries	57.2	-4.6	44.3	29.0	-16.3	20.6	2.7	23.1
CEN-SAD	69.3	-3.6	56.6	36.2	-19.6	20.4	-0.1	21.1
COMESA	76.0	-3.3	67.6	49.5	-15.0	29.5	-3.1	28.9
EAC	62.4	-4.5	54.8	38.2	-18.5	27.6	5.7	31.1
ECCAS	126.5	-6.5	84.2	52.7	-20.9	21.6	-7.4	19.6
ECOWAS	82.5	-3.6	60.9	31.5	-29.9	11.7	-1.7	11.6
IGAD	97.7	-2.8	88.5	61.0	-18.0	39.0	0.7	39.1
SADC	54.8	-3.3	43.3	33.1	-7.3	32.5	3.1	37.2
UMA	55.7	-6.5	40.2	25.6	-17.9	18.2	3.1	19.5
CAADP Compact 2007–09 (CC1)	74.2	-3.6	55.5	26.0	-38.0	7.7	4.7	9.0
CAADP Compact 2010–12 (CC2)	117.3	-2.9	95.0	67.4	-14.7	40.1	-5.3	35.4
CAADP Compact 2013–15 (CC3)	111.8	-5.5	83.8	54.2	-18.9	33.2	-0.7	33.1
CAADP Compact not yet (CC0)	37.3	-4.0	31.5	24.7	-7.3	23.5	4.9	28.2
CAADP Level 0 (CL0)	37.3	-4.0	31.5	24.7	-7.3	23.5	4.9	28.2
CAADP Level 1 (CL1)	114.4	-5.3	87.2	57.1	-18.0	35.7	-1.0	35.3
CAADP Level 2 (CL2)	146.2	-2.3	114.3	87.4	-12.9	36.6	-15.8	24.1
CAADP Level 3 (CL3)	118.8	1.0	110.1	64.3	-24.5	31.8	-1.6	31.7
CAADP Level 4 (CL4)	79.1	-4.6	58.1	30.8	-29.3	13.8	1.8	14.5

Sources: ReSAKSS based on ADB (2016) and World Bank (2016).

ANNEX 5: Supplementary Data Tables

TABLE O.1.2B—GENERAL GOVERNMENT GROSS REVENUE (% of GDP)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	23.9	2.5	25.4	27.8	2.9	27.3	0.0	25.9
Central	18.5	3.6	20.7	25.7	8.4	26.4	-1.6	24.9
Eastern	15.7	2.1	18.3	20.6	2.2	18.9	-2.8	17.6
Northern	26.6	-0.1	26.6	29.1	3.9	28.5	-2.6	26.8
Southern	26.0	0.3	25.5	28.3	4.9	30.6	-0.2	30.1
Western	22.5	10.9	27.9	29.3	-1.3	26.3	4.7	24.7
Less favorable agriculture conditions	17.8	3.3	20.8	24.6	4.8	23.4	2.3	25.2
More favorable agriculture conditions	19.1	-0.5	19.8	20.4	-1.0	21.0	1.7	21.2
Mineral-rich countries	14.5	1.9	16.2	18.6	5.6	20.9	-1.9	19.3
Middle-income countries	24.9	2.7	26.4	28.9	3.1	28.4	0.0	26.8
CEN-SAD	21.8	4.0	24.1	25.9	1.3	24.4	0.9	22.7
COMESA	20.1	-1.4	20.2	21.8	2.1	20.5	-4.1	18.6
EAC	18.3	0.1	19.1	20.6	2.4	22.2	1.3	22.3
ECCAS	26.2	2.4	26.2	32.3	9.2	34.0	-1.5	30.9
ECOWAS	22.5	10.9	27.9	29.3	-1.3	26.3	4.7	24.7
IGAD	15.6	2.5	18.7	20.6	1.3	18.2	-3.9	16.5
SADC	24.5	0.5	24.3	27.2	5.1	29.4	-0.4	28.7
UMA	28.7	1.8	30.3	33.3	4.1	33.5	-1.1	32.5
CAADP Compact 2007–09 (CC1)	22.9	12.6	29.0	30.1	-2.0	26.2	4.4	24.2
CAADP Compact 2010–12 (CC2)	18.5	0.2	19.3	20.8	2.6	22.5	1.0	22.7
CAADP Compact 2013–15 (CC3)	23.9	1.6	24.6	29.7	6.8	29.4	-1.9	26.7
CAADP Compact not yet (CC0)	25.5	0.1	25.4	27.8	4.1	28.4	-1.6	27.6
CAADP Level 0 (CL0)	25.5	0.1	25.4	27.8	4.1	28.4	-1.6	27.6
CAADP Level 1 (CL1)	25.4	1.0	25.8	30.5	6.2	30.6	-1.9	27.9
CAADP Level 2 (CL2)	13.3	5.2	16.0	21.1	8.0	20.8	-1.7	19.5
CAADP Level 3 (CL3)	19.4	1.2	20.4	22.1	1.3	20.2	1.3	20.5
CAADP Level 4 (CL4)	22.1	9.2	26.8	28.0	-1.2	25.7	3.9	24.2

Sources: ReSAKSS based on ADB (2016) and World Bank (2016).

ANNEX 5: Supplementary Data Tables

TABLE O.1.3—ANNUAL INFLATION, GDP DEFLATOR (%)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	11.43	-3.10	8.45	9.02	0.82	11.41	0.61	4.89
Central	5.1	-0.7	3.1	9.0	3.1	2.4	0.4	-5.0
Eastern	14.2	-4.0	7.6	11.0	1.4	13.0	-0.5	10.5
Northern	6.6	-1.3	5.8	8.4	1.1	7.1	0.2	4.1
Southern	9.0	-0.7	8.7	7.3	0.5	6.7	-0.6	5.2
Western	21.63	-9.04	13.73	10.84	0.09	15.26	0.82	4.43
Less favorable agriculture conditions	6.0	-1.5	4.3	7.4	1.3	2.8	-0.1	0.0
More favorable agriculture conditions	9.2	-1.4	7.2	9.7	1.5	9.9	-1.5	6.1
Mineral-rich countries	16.2	-1.0	13.9	14.8	-0.9	9.5	0.8	10.0
Middle-income countries	11.72	-3.38	8.60	8.88	0.78	9.95	0.28	4.76
CEN-SAD	13.91	-5.16	9.18	9.23	0.61	12.41	0.50	6.66
COMESA	9.8	-2.1	8.4	10.1	1.0	12.5	-0.4	11.1
EAC	10.8	-1.1	6.3	11.0	1.1	9.3	-1.2	5.8
ECCAS	5.3	-0.8	3.5	9.3	2.8	2.7	0.3	-4.4
ECOWAS	21.6	-9.0	13.7	10.8	0.1	15.3	0.8	4.4
IGAD	15.0	-4.7	7.5	10.7	1.5	15.1	-0.5	12.8
SADC	9.3	-0.8	8.7	7.7	0.6	6.8	-0.6	5.2
UMA	7.3	-1.7	4.9	7.6	1.0	3.7	0.5	-0.9
CAADP Compact 2007–09 (CC1)	23.5	-10.0	14.9	12.0	0.1	16.5	0.7	5.0
CAADP Compact 2010–12 (CC2)	8.8	-1.2	6.0	7.6	1.0	6.8	-0.5	4.4
CAADP Compact 2013–15 (CC3)	11.4	-4.0	6.7	9.3	1.8	9.8	0.1	6.0
CAADP Compact not yet (CC0)	7.4	-0.9	6.8	7.7	0.9	6.7	-0.1	4.4
CAADP Level 0 (CL0)	7.4	-0.9	6.8	7.7	0.9	6.7	-0.1	4.4
CAADP Level 1 (CL1)	12.7	-4.4	7.6	10.5	1.9	11.0	0.1	6.6
CAADP Level 2 (CL2)	4.3	-0.7	3.3	5.5	0.6	4.5	0.0	2.9
CAADP Level 3 (CL3)	10.7	-1.4	8.4	8.1	0.4	7.6	-0.9	5.2
CAADP Level 4 (CL4)	20.5	-7.8	13.1	11.4	0.4	14.9	0.5	5.2

Sources: ReSAKSS based on World Bank (2016).
Notes: For regions or groups, level is weighted average, where weight is country's share in total GDP for the region or group.

ANNEX 5: Supplementary Data Tables

TABLE O.2.1A—AGRICULTURAL EXPORTS (% of total merchandise exports)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	11.1	-3.2	9.5	7.4	-7.4	8.9	5.6	10.6
Central	5.2	-7.7	3.5	2.7	-7.2	2.8	-1.5	3.2
Eastern	45.9	-6.9	33.8	29.1	-6.0	33.1	9.0	39.7
Northern	6.0	-7.2	4.6	4.4	-0.3	6.2	6.5	7.7
Southern	11.0	-1.9	10.0	7.6	-9.4	7.9	3.7	9.0
Western	11.7	1.4	11.8	8.2	-9.7	10.4	6.8	13.2
Less favorable agriculture conditions	23.9	-6.8	15.4	11.4	-2.3	12.8	-0.4	14.0
More favorable agriculture conditions	50.3	-2.7	42.1	38.8	-2.2	39.7	0.7	40.2
Mineral-rich countries	7.0	2.0	7.7	7.2	-9.0	7.3	12.6	9.1
Middle-income countries	8.6	-2.4	7.7	5.9	-7.9	7.1	5.4	8.6
CEN-SAD	12.8	-2.3	11.1	8.4	-7.8	10.4	6.9	13.2
COMESA	21.7	-6.3	14.1	11.0	-7.7	14.1	10.1	18.5
EAC	56.7	-3.6	45.2	43.6	-0.5	43.2	0.4	45.4
ECCAS	3.0	-8.6	2.0	1.5	-10.4	1.4	0.6	1.7
ECOWAS	11.7	1.4	11.8	8.2	-9.7	10.4	6.8	13.2
IGAD	48.6	-8.8	31.8	26.3	-8.0	31.9	12.8	40.2
SADC	12.4	-2.0	11.4	8.9	-9.2	9.0	3.4	10.1
UMA	5.6	-8.6	3.9	3.6	-0.8	4.7	8.4	6.2
CAADP Compact 2007–09 (CC1)	6.8	2.9	7.5	5.6	-8.4	8.3	9.4	10.5
CAADP Compact 2010–12 (CC2)	42.5	-1.2	37.4	32.5	-4.5	29.9	-0.7	30.8
CAADP Compact 2013–15 (CC3)	9.6	-6.5	7.1	4.4	-17.4	3.6	5.2	4.2
CAADP Compact not yet (CC0)	7.7	-3.9	6.6	5.6	-3.6	7.4	5.2	8.8
CAADP Level 0 (CL0)	7.7	-3.9	6.6	5.6	-3.6	7.4	5.2	8.8
CAADP Level 1 (CL1)	9.9	-5.8	7.3	4.5	-17.6	3.6	5.6	4.2
CAADP Level 2 (CL2)	17.5	-1.9	16.1	14.1	-6.7	13.5	-2.1	13.0
CAADP Level 3 (CL3)	19.2	1.9	21.1	20.9	-1.7	19.3	-1.5	18.7
CAADP Level 4 (CL4)	15.9	-0.4	14.8	11.0	-7.7	13.9	7.4	17.4

Sources: ReSAKSS based on UNCTAD (2016) and World Bank (2016).

TABLE O.2.1B—AGRICULTURAL IMPORTS (% of total merchandise imports)

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	15.3	-0.4	14.8	13.3	-3.8	14.0	1.6	13.7
Central	17.2	-1.1	17.2	17.3	-1.8	15.8	-0.5	15.1
Eastern	15.1	0.7	14.9	13.0	-3.8	14.1	-0.5	13.0
Northern	20.1	-3.0	17.7	15.6	-2.5	16.0	1.7	16.4
Southern	9.5	0.7	9.6	8.3	-4.7	9.5	0.9	8.9
Western	17.0	3.0	18.0	16.3	-5.5	16.8	4.5	17.0
Less favorable agriculture conditions	22.3	-0.4	20.9	21.4	-2.7	19.5	-0.8	18.4
More favorable agriculture conditions	13.9	0.2	14.9	13.7	-3.6	13.4	-1.6	12.0
Mineral-rich countries	15.9	0.5	16.9	14.5	-3.3	12.8	-3.7	11.6
Middle-income countries	15.2	-0.6	14.5	13.0	-3.8	13.9	2.2	13.8
CEN-SAD	16.7	-0.1	16.2	14.6	-3.4	15.7	2.5	15.6
COMESA	17.6	-0.2	17.4	15.3	-3.3	16.6	0.9	16.0
EAC	13.5	-2.8	11.9	11.3	-1.6	11.3	-1.6	10.2
ECCAS	20.8	-1.1	19.6	17.3	-5.0	16.7	1.8	16.2
ECOWAS	17.0	3.0	18.0	16.3	-5.5	16.8	4.5	17.0
IGAD	14.7	1.5	14.3	12.2	-4.2	13.9	-1.6	12.3
SADC	10.3	0.3	10.4	9.3	-4.3	10.2	0.6	9.6
UMA	19.7	-3.8	16.7	14.9	-1.5	14.7	1.5	15.4
CAADP Compact 2007–09 (CC1)	15.8	3.4	16.8	15.2	-6.4	15.6	5.1	15.7
CAADP Compact 2010–12 (CC2)	17.9	-0.3	17.6	15.9	-2.6	14.6	-3.4	12.9
CAADP Compact 2013–15 (CC3)	17.8	0.2	17.7	15.4	-4.1	17.5	2.7	17.4
CAADP Compact not yet (CC0)	13.8	-2.2	12.8	11.5	-2.5	12.5	1.4	12.5
CAADP Level 0 (CL0)	13.8	-2.2	12.8	11.5	-2.5	12.5	1.4	12.5
CAADP Level 1 (CL1)	17.9	0.2	17.8	15.4	-4.3	17.5	3.1	17.6
CAADP Level 2 (CL2)	22.2	-0.2	22.5	21.3	-0.9	21.3	-1.2	20.3
CAADP Level 3 (CL3)	14.7	-0.4	15.1	13.2	-4.7	11.8	-1.3	11.6
CAADP Level 4 (CL4)	16.2	2.5	16.7	15.1	-5.5	14.9	2.1	14.1

Sources: ReSAKSS based on UNCTAD (2016) and World Bank (2016).

ANNEX 5: Supplementary Data Tables

TABLE O.2.2—RATIO OF AGRICULTURAL EXPORTS TO AGRICULTURAL IMPORTS

Region	Annual avg. level (1995–2003)	Annual avg. change (1995–2003)	2003	Annual avg. level (2003–2008)	Annual avg. change (2003–2008)	Annual avg. level (2008–2015)	Annual avg. change (2008–2015)	2015
Africa	0.78	-0.9	0.76	0.68	-4.9	0.65	0.5	0.68
Central	0.51	-5.7	0.37	0.33	-5.3	0.27	-6.6	0.27
Eastern	1.62	-5.6	1.34	1.19	-5.0	1.04	2.0	1.11
Northern	0.28	1.3	0.30	0.35	1.3	0.34	-1.7	0.33
Southern	1.24	-2.4	1.06	0.97	-3.3	0.92	2.3	1.03
Western	0.98	-0.5	1.09	0.80	-8.4	0.85	0.5	0.91
Less favorable agriculture conditions	0.56	-9.6	0.38	0.41	5.4	0.46	-1.9	0.47
More favorable agriculture conditions	2.16	-3.2	1.69	1.44	-4.1	1.31	1.0	1.38
Mineral-rich countries	0.48	-5.7	0.38	0.43	-0.7	0.57	17.2	0.78
Middle-income countries	0.65	0.5	0.68	0.60	-5.5	0.58	-0.2	0.60
CEN-SAD	0.78	-0.3	0.82	0.69	-7.3	0.64	-0.8	0.66
COMESA	0.88	-1.8	0.75	0.68	-5.2	0.62	0.7	0.62
EAC	2.26	-1.4	2.16	1.85	-7.0	1.47	-1.2	1.50
ECCAS	0.27	-7.8	0.20	0.20	0.0	0.17	-5.1	0.17
ECOWAS	0.98	-0.5	1.09	0.80	-8.4	0.85	0.5	0.91
IGAD	1.65	-7.5	1.28	1.16	-3.9	1.01	2.6	1.07
SADC	1.25	-2.4	1.08	0.96	-4.1	0.92	2.4	1.03
UMA	0.33	-0.4	0.32	0.38	2.4	0.34	-1.3	0.33
CAADP Compact 2007–09 (CC1)	0.61	0.3	0.75	0.59	-6.3	0.70	1.7	0.73
CAADP Compact 2010–12 (CC2)	1.99	-2.6	1.70	1.47	-5.1	1.39	0.8	1.53
CAADP Compact 2013–15 (CC3)	0.75	-5.0	0.61	0.48	-9.0	0.33	-1.0	0.33
CAADP Compact not yet (CC0)	0.53	1.7	0.53	0.53	-2.5	0.53	0.5	0.55
CAADP Level 0 (CL0)	0.53	1.7	0.53	0.53	-2.5	0.53	0.5	0.55
CAADP Level 1 (CL1)	0.75	-3.8	0.63	0.50	-8.8	0.34	-0.5	0.35
CAADP Level 2 (CL2)	0.84	-6.8	0.61	0.56	-5.2	0.51	-3.5	0.48
CAADP Level 3 (CL3)	0.91	-1.9	0.86	0.96	5.1	1.11	2.8	1.13
CAADP Level 4 (CL4)	1.27	-2.2	1.29	1.00	-6.6	1.04	1.1	1.13

Sources: ReSAKSS based on UNCTAD (2016) and World Bank (2016).

References

ARRANGED BY CHAPTER

Chapter 1

AU (African Union). 2014. "Decisions, Declarations and Resolution." Assembly of the African Union, Twenty-third Ordinary Session, June 26-27, 2014, Malabo, Equatorial Guinea. Assembly/AU/ /Dec.517-545(XXIII); Assembly/AU/ /Decl.1-4(XXIII); Assembly/AU/ /Res.1 (XXIII). Accessed August 12, 2016. http://au.int/en/sites/default/files/decisions/9661-assembly_au_dec_517_-_545_xxiii_e.pdf.

———. Undated. African Regional Nutrition Strategy. Addis Ababa. Accessed May 2016. http://www.who.int/nutrition/topics/African_Nutritional_strategy.pdf.

AU/NEPAD (African Union/New Partnership for Africa's Development). 2009. The Comprehensive Africa Agriculture Development Plan Framework for African Food Security. NEPAD: MidRand.

AUC (African Union Commission). 2015a. *Agenda 2063: The Africa We Want*. Addis Ababa. Accessed July 10, 2016. http://archive.au.int/assets/images/agenda2063.pdf

———. 2015b. Agenda 2063. The Africa We Want. A Shared Framework for Inclusive Growth and Sustainable Development. First Ten-Year Implementation Plan 2014-2023. http://www.uneca.org/sites/default/files/uploaded-documents/CoM/com2016/agenda_2063_final_revised_first_ten_year_implementation_plan_12.10.15.pdf accessed September 6, 2016.

DFID (Department for International Development of the UK Government). 2013. G8 Nutrition for Growth Commitments. Executive Summary of the Nutrition for Growth Commitments for 2020 Made at the G8 Summit. London: DFID.

FAO (Food and Agriculture Organization of the United Nations). 2016. Integrating Nutrition in CAADP investments plans. Accessed July 10, 2016. http://www.fao.org/nutrition/policies-programmes/capacity-development/caadp/en/.

FAO and WHO (World Health Organization). 2014. Rome Declaration on Nutrition. Second International Conference on Nutrition, Rome, 19–21 November, 2014. Rome. http://www.fao.org/3/a-ml542e.pdf.

HLTF (High Level Task Force on the Global Food Security Crisis). 2010. Updated Comprehensive Framework for Action. Rome.

IFPRI (International Food Policy Research Institute). 2016. Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030. Washington, DC.

New Partnership for Africa's Development. 2015. *CAADP Results Framework 2015–2025: Going for Results and Impact, Sustaining CAADP Momentum*. Midrand, South Africa.

SUN (Scaling Up Nutrition). 2016. Scaling Up Nutrition. Accessed July 10, 2016. http://scalingupnutrition.org/sun-countries.

WHO (World Health Organization). 2014. *Global Nutrition Targets 2025*. Policy brief. WHO/NMH/NHD/14.2. Geneva. http://www.who.int/nutrition/publications/globaltargets2025_policybrief_overview/en/.

Chapter 2

African Development Bank, Organisation for Economic Co-operation and Development, and United Nations Development Programme. 2015. *African Economic Outlook 2015: Regional Development and Spatial Inclusion.* Paris: OECD Publishing.

African Union. 2014. *Common African Position (CAP) on the Post-2015 Development Agenda.* Addis Ababa, Ethiopia.

———. 2015a. *Africa Regional Nutrition Strategy 2015–2025.* Addis Ababa, Ethiopia.

———. 2015b. *Agenda 2063: The Africa We Want*, 2nd ed. Addis Ababa, Ethiopia.

Black, R.E., C. G. Victora, S. P. Walker, Z. A. Bhutta, P. Christian, M. de Onis, and M. Ezzati. 2013. "Maternal and Child Undernutrition and Overweight in Low-income and Middle-income Countries." *Lancet* 382 (9890): 427–451.

FARA, NEPAD, and AUC. 2009. Implementing the Framework for African Agricultural Productivity (FAAP): An Operational Guide for Practitioners. Accra.

International Food Policy Research Institute. 2016. *Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030.* Washington, DC.

New Partnership for Africa's Development. 2015. *CAADP Results Framework 2015–2025: Going for Results and Impact, Sustaining CAADP Momentum*. Midrand, South Africa.

New Partnership for Africa's Development and African Union. 2009. *CAADP Pillar III Framework for African Food Security*. Midrand, South Africa: NEPAD.

Scaling Up Nutrition. 2016. *SUN Countries*. Accessed July 10, 2016. http://scalingupnutrition.org/sun-countries.

Steyn, N. P., and Z. J. Mchiza. 2014. "Obesity and the Nutrition Transition in Sub-Saharan Africa." *Annals of the New York Academy of Sciences* 1311: 88–101.

United Nations. 2015. The Millennium Development Goals. Accessed May 20, 2015. http://www.un.org/millenniumgoals/.

United Nations Development Programme. 2011. *Regional Integration and Human Development: A Pathway for Africa*. New York: United Nations Development Programme, Bureau for Development Policy.

World Health Organization. 2014. *The Comprehensive Implementation Plan on Maternal, Infant, and Young Child Nutrition*. Geneva.

Chapter 3

African Union. 2014. *Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods.* http://pages.au.int/sites/default/files/Malabo%20Declaration%202014_11%2026-.pdf

———. 2015a. *African Regional Nutrition Strategy 2015–2025*. http://sa.au.int/en/sites/default/files/Africa%20Regional%20Nutrition%20Strategy%202015-2025%2013.3.2015%20-%20English_0.pdf.

———. 2015b. *Agenda 2063: The Africa We Want*, 2nd ed. Addis Ababa, Ethiopia. http://agenda2063.au.int/en/about.

African Union Commission, New Partnership for Africa's Development, Economic Commission for Africa, and World Food Programme. 2014. *The Cost of Hunger in Africa (COHA). Cost of Hunger Studies*. www.costofhungerafrica.com.

Gillespie, S. J. Hodge, S. Yosef, and R. Pandya-Lorch. 2016. *Nourishing Millions: Stories of Change in Nutrition*. Washington, DC: IFPRI.

de Onis, M., K. G. Dewey, E. Borghi, A. W. Onyango, M. Blössner, B. Daelmans, E. Piwoz, and F. Branca. 2013. "The World Health Organization's Global Target for Reducing Childhood Stunting by 2025: Rationale and Proposed Actions." *Maternal and Child Nutrition* 9 (Suppl. 2): 6–26.

Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development, and World Food Programme. 2015. *The State of Food Insecurity in the World 2015: Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress*. Rome: FAO.

International Food Policy Research Institute (IFPRI). 2016. *Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030*. Washington, DC.

Kenya Ministry of Health. 2006. *Taking the Kenya Essential Package for Health to the Community.*

Kenya Ministry of Health. Unpublished. Capacity Assessment.

National Council for Law Reporting. 2012. *Food, Drugs and Chemical Substance Act*. Kenya. http://faolex.fao.org/docs/pdf/ken106440.pdf

Rice, A. 2016. "The Evolution of an Idealist." *Foreign Policy* (May/June).

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

UN (United Nations). 2016. *Sustainable Development Goals*. https://sustainabledevelopment.un.org

UNICEF 2016. *Adopting Optimal Feeding Practices Is Fundamental to a Child's Survival, Growth and Development, but Too Few Children Benefit*. Accessed August 19, 2016. http://data.unicef.org/nutrition/iycf.html.

UNICEF, World Health Organization, and World Bank. 2015. *Levels and Trends in Child Malnutrition: UNICEF–WHO–World Bank Group Joint Child Malnutrition Estimates: Key Findings of the 2015 Edition*. Washington, DC. www.who.int/nutgrowthdb/jme_brochure2015.pdf?ua=1.

World Health Organization. 2015a. *Global Health Observatory Data Repository: Overweight*. http://apps.who.int/gho/data/node.main.A897A?lang=en.

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

———. 2015c. *Obesity: Situation and Trends*. www.who.int/gho/ncd/risk_factors/obesity_text/en/.

———. 2016a. *Global Targets 2025: Poster*. www.who.int/nutrition/topics/nutrition_globaltargets2025/en/.

———. 2016b. *Noncommunicable Diseases and Mental Health: About 9 Voluntary Global Targets*. www.who.int/nmh/ncd-tools/definition-targets/en/.

Case Study 1

Black, R.E., H. Alderman, Z. A. Bhutta, S. Gillespie, L. Haddad, S. Horton, P. Webb, et al. 2013. "Maternal and Child Nutrition: Building Momentum for Impact." *Lancet* 382(9890): 372–375.

Constitution of Kenya. 2010. Bill of Rights, Specific Application of Rights, No. 53. Accessed on May 11, 2016. www.lcil.cam.ac.uk/sites/default/files/LCIL/documents/transitions/Kenya_19_2010_Constitution.pdf.

International Food Policy Research Institute. 2015. *Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition and Sustainable Development*. Washington, DC.

———. 2016. *Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030*. Washington, DC.

Government of Kenya. 2012. Act No. 30 of 2012. *Breast Milk Substitutes (Regulation and Control) Act*. Accessed August 25, 2016 www.kenyalaw.org.

Kenya, Agricultural Sector Coordination Unit. (2011). *National Food and Nutrition Security Policy*. Nairobi.

Kenya, Ministry of Health. 2006. *Taking the Kenya Essential Package for Health to the Community: A Strategy for the Delivery of Level One Services*. Kenya.

Kenya, Ministry of Public Health and Sanitation. 2009. *National Guideline for Integrated Management of Acute Malnutrition*. Kenya.

———. 2012. *National Nutrition Action Plan 2012–2017*. Calverton, Maryland: Kenya National Bureau of Statistics and ICF International.

———. 2013. *National Nutrition Monitoring and Evaluation Framework*. Kenya.

Kenya National Bureau of Statistics and ICF International. 2010. *Kenya Demographic and Health Survey 2008–09*. Calverton, Maryland. US.

Kenya, National Bureau of Statistics, ICF International, et al. 2015. *Kenya Demographic and Health Survey 2014*. Nairobi and Rockville, MD, USA.

Kenya Nutritionists and Dieticians Institute. 2015. *Kenya Nutritionists and Dieticians Institute.* Accessed May 24, 2016. www.kndi.institute/about-us/core-functions/index.html.

Masibo, P. K., and D. Makoka. 2012. "Trends and Determinants of Undernutrition among Young Kenyan Children: Kenya Demographic and Health Survey; 1993, 1998, 2003 and 2008-2009." *Public Health Nutrition*, 15(9), 1715–1727.

National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS), Office of the Vice President and Ministry of Planning and National Development, Kenya, and Macro International Inc. (MI). 1994. Kenya Demographic and Health Survey 1993. Calverton, Maryland: NCPD, CBS, and MI.

———. 1999. Kenya Demographic and Health Survey 1993.Calverton, Maryland: NCPD, CBS, and MI.

Scaling Up Nutrition (SUN). 2013. *Call for Commitments for Nutrition, Kenya*. Accessed May 27, 2016. http://scalingupnutrition.org/wp-content/uploads/2013/07/13-04-19-Kenya-Costed-Plan-Summary.pdf.

———. 2015. *SUN-Kenya: Malnutrition Kenya, Nutrition, Food Program*. Kenya, Ministry of Health. Accessed May 11, 2016. http://scalingupnutrition.org/sun-countries/kenya.

UNESCO Institute for Statistics. 2015. *Country Profiles*. Accessed April 26, 2016. http://www.uis.unesco.org/DataCentre/Pages/country-profile.aspx?code=KEN&regioncode=40540.

United Nations Standing Committee on Nutrition. 2010. *Sixth Report on the World Nutrition Situation: Progress in Nutrition*. Rome.

World Bank. 2016. *Kenya Economic Update*. Washington, DC.

World Health Organization (WHO). 2015a. *Child Health - WHO | Regional Office for Africa*. Accessed on August 13, 2015. www.afro.who.int/en/clusters-a-programmes/frh/child-and-adolescent-health/programme-components/child-health.html.

———. 2015b. Global Targets Tracking Tool. Accessed May 27, 2016. www.who.int/nutrition/trackingtool/en/.

Chapter 4

Allen, L. 2003. "Interventions for Micronutrient Deficiency Control in Developing Countries: Past, Present, and Future." *Journal of Nutrition* 133 (11): 3875S–3878S.

Barrett, C., T. Reardon, and P. Webb. 2001. "Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications." *Food Policy* 26 (4): 315–331.

Black, M. 2003. Micronutrient deficiencies and cognitive functioning. *Journal of Nutrition* 133 (11): 3927S-3931S.

Black, R., L. Allen, Z. Bhutta, L. Caulfield, M. de Onis, M. Ezzati, C. Mathers, and J. Rivera. 2008. "Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences." *Lancet* 371 (9608): 243–260.

Black, R., S. Morris, and J. Bryce. 2003. "Where and Why Are 10 Million Children Dying Every Year?" *Lancet* 361 (9376): 2226–2234.

Bwibo, N., and C. Neumann. 2003. "The Need for Animal Source Foods by Kenyan Children." *Journal of Nutrition* 133 (11): 3936S–3940S.

Caulfield, L., S. Richard, J. Rivera, P. Musgrove, and R. Black. 2006. "Stunting, Wasting, and Micronutrient Deficiency Disorders." In *Disease Control Priorities in Developing Countries*, 2nd ed., edited by D. Jamison, J. Breman, A. Measham, G. Alleyne, M. Claeson, D. Evans, P. Jha, A. Mills, and P. Musgrove, 551–567. Washington, DC: World Bank.

Coulombe, H., and Q. Wodon. 2012a. "A New Poverty Map for Ghana." In *Improving the Targeting of Social Programs in Ghana*, edited by Q. Wodon, 42–49. Washington, DC: World Bank.

———. 2012b. "A Food Insecurity Map for Ghana." In *Improving the Targeting of Social Programs in Ghana*, edited by Q. Wodon, 50–58. Washington, DC: World Bank.

De Janvry, A., M. Fafchamps, and E. Sadoulet. 1991. "Peasant Household Behaviour with Missing Markets: Some Paradoxes Explained." *Economic Journal* 101 (409): 1400–1417.

Dillon, A., K. McGee, and G. Oseni. 2015. "Agricultural Production, Dietary Diversity, and Climate Variability." *Journal of Development Studies* 51 (8): 976–995.

Dror, D., and L. Allen. 2011. "The Importance of Milk and Other Animal-Source Foods for Children in Low-Income Countries." *Food and Nutrition Bulletin* 32 (3): 227–243.

Ecker, O., P. Al-Riffai, C. Breisinger, and R. Al-Batrawy. Forthcoming. *Nutrition and Economic Development: Exploring Egypt's Exceptionalism and the Role of Food Subsidies*. IFPRI Monograph. Washington, DC: International Food Policy Research Institute (IFPRI).

FAO (Food and Agriculture Organization of the United Nations). 2016. FAOSTAT: Food Balances Sheets Database. Accessed January 23, 2016. http://faostat3.fao.org/home/E.

Finkelstein, E., I. Fiebelkorn, and G. Wang. 2003. "National Medical Spending Attributable to Overweight and Obesity: How Much, and Who's Paying?" *Health Affairs* (web exclusive): W3-219–W3-226.

Finkelstein, E., C. Ruhm, and K. Kosa. 2005. "Economic Causes and Consequences of Obesity." *Annual Review of Public Health* 26: 239–257.

Gewa, C., R. Weiss, N. Bwibo, S. Whaley, M. Sigman, S. Murphy, G. Harrison, and C. Neumann. 2009. "Dietary Micronutrients Are Associated with Higher Cognitive Function Gains among Primary School Children in Rural Kenya." *British Journal of Nutrition* 101 (9): 1378–1387.

Ghana Statistical Service. 2014. *Ghana Living Standards Survey Round 6 (GLSS 6): Main Report. Accra*.

Hassen, I., M. Dereje, B. Minten, and K. Hirvonen. 2016. *Diet Transformation in Africa: The Case of Ethiopia*. ESSP Working Paper 87. Addis Ababa: International Food Policy Research Institute.

Hirvonen, K., A. Taffesse, and I. Hassen. 2016. "Seasonality and Household Diets in Ethiopia." *Public Health Nutrition* 19 (10): 1723–1730.

Heart Protection Study Collaborative Group (HPSCG). 2004. "Effects of Cholesterol-Lowering with Simvastatin on Stroke and Other Major Vascular Events in 20 536 People with Cerebrovascular Disease or Other High-Risk Conditions." *Lancet* 363 (9411): 757–767.

ICF International. 2016. *STATcompiler*. Accessed January 23, 2016. http://www.statcompiler.com/.

Jensen, R., and N. Miller. 2010. *A Revealed Preference Approach to Measuring Hunger and Undernutrition*. NBER Working Paper 16555. Cambridge, MA: National Bureau of Economic Research.

———. 2011. "Do Consumer Price Subsidies Really Improve Nutrition?" *Review of Economics and Statistics* 93 (4): 1205–1223.

Kochar, A. 2005. "Can Targeted Food Programs Improve Nutrition? An Empirical Analysis of India's Public Distribution System." *Economic Development and Cultural Change* 54 (1): 203–235.

Kolavalli, A., E. Robinson, X. Diao, V. Alpuerto, R. Folledo, M. Slavova, G. Ngeleza, and F. Asante. 2012. "Economic Transformation in Ghana: Where Will the Path Lead?" *Journal of African Development* 14 (2): 41–78.

LaRosa, J., D. Hunninghake, D. Bush, M. Criqui, G. Getz, A. Gotto, Jr., et al. 1990. "The Cholesterol Facts: A Summary of the Evidence relating Dietary Fats, Serum Cholesterol, and Coronary Heart Disease." A joint statement by the American Heart Association and the National Heart, Lung, and Blood Institute. *Circulation* 81 (5): 1721–1733.

Larsen, C. 2003. "Animal Source Foods and Human Health during Evolution." *Journal of Nutrition* 133 (11): 3893S–3897S.

Lay, J., and D. Schüler. 2008. *Income Diversification and Poverty in a Growing Agricultural Economy: The Case of Ghana*. Proceedings of the German Development Economics Conference, Zürich, 2008.

Leroy, J., P. Gadsden, T. de Cossío, and P. Gertler. 2013. "Cash and In-Kind Transfers Lead to Excess Weight Gain in a Population of Women with a High Prevalence of Overweight in Rural Mexico." *Journal of Nutrition* 143 (3): 378–383.

Marquis, G., J. Habicht, C. Lanata, R. Black, and K. Rasmussen. 1997. "Breast Milk or Animal-Product Foods Improve Linear Growth of Peruvian Toddlers Consuming Marginal Diets." *American Journal of Clinical Nutrition* 66 (5): 1102–1109.

McMillan, M., and K. Harttgen. 2014. *What Is Driving the "African Growth Miracle"?* NBER Working Paper 20077. Cambridge, MA: National Bureau of Economic Research.

McMillan, M., D. Rodrik, and I. Verduzco-Gallo. 2014. "Globalization, Structural Change, and Productivity Growth, with an Update on Africa." *World Development* 63 (C): 11–32.

Millward, D. 1999. "The Nutritional Value of Plant-based Diets in Relation to Human Amino Acid and Protein Requirements." *Proceedings of the Nutrition Society* 58 (2): 249–260.

Murphy, S., and L. Allen. 2003. "Nutritional Importance of Animal Source Foods." *Journal of Nutrition* 133 (11): 3932S–3935S.

National Development Planning Commission, Ghana, and United Nations Development Programme. 2015. *Ghana Millennium Development Goals: 2015 Report*. Accra: NDPC and UNDP.

Neumann, C., N. Bwibo, S. Murphy, M. Sigman, S. Whaley, L. Allen, et al. 2003. "Animal Source Foods Improve Dietary Quality, Micronutrient Status, Growth, and Cognitive Function in Kenyan School Children: Background, Study Design, and Baseline Findings." *Journal of Nutrition* 133 (11): 3941S–3949S.

Pereira, P., and A. Vicente. 2013. "Meat Nutritional Composition and Nutritive Role in the Human Diet." *Meat Science* 93 (3): 586-592.

Popkin, B. 1993. "Nutritional Patterns and Transitions." *Population and Development Review* 19 (1): 138–157.

———. 1994. "The Nutrition Transition in Low-Income Countries: An Emerging Crisis." *Nutrition Reviews* 52 (9): 285–298.

———. 1998. "The Nutrition Transition and Its Health Implications in Lower-Income Countries." *Public Health Nutrition* 1 (1): 5–21.

———. 1999. "Urbanization, Lifestyle Changes, and the Nutrition Transition." *World Development* 27 (11): 1905–1916

———. 2002. "The Shift in Stages of the Nutrition Transition in the Developing World Differs from Past Experiences!" *Public Health Nutrition* 5 (1A): 205–214.

———. 2003. "The Nutrition Transition in the Developing World." *Development Policy Review* 21 (5–6): 581–597.

———. 2006. "Technology, Transport, Globalization and the Nutrition Transition." *Food Policy* 31 (6): 554–569.

———. 2009. "Global Changes in Diet and Activity Patterns as Drivers of the Nutrition Transition." In: S. Kalhan, A. Prentice, and Yajnik, editors. *Emerging Societies-Coexistence of Childhood Malnutrition and Obesity* Vol. 63, 1–14. Basel, Switzerland: Karger Publishers.

Popkin, B., and S. Du. 2003. "Dynamics of the Nutrition Transition toward the Animal Foods Sector in China and Its Implications: A Worried Perspective." *Journal of Nutrition* 133 (11): 3898S–3906S.

Popkin, B., and P. Gordon-Larsen. 2004. "The Nutrition Transition: Worldwide Obesity Dynamics and Their Determinants." *International Journal of Obesity* 28: S2–S9.

Popkin, B., S. Kim, E. Russev, S. Du, and C. Zizza. 2006. "Measuring the Full Economic Costs of Diet, Physical Activity, and Obesity-Related Chronic Diseases." *Obesity Reviews* 7 (3): 271–293.

Prentice, A. 2006. "The Emerging Epidemic of Obesity in Developing Countries." *International Journal of Epidemiology* 35 (1): 93–99.

Quaye, W. 2008. "Food Security Situation in Northern Ghana, Coping Strategies, and Related Constraints." *African Journal of Agricultural Research* 3 (5): 334–342.

Rivera, J., C. Hotz, T. González-Cossío, L. Neufeld, and A. García-Guerra. 2003. "The Effect of Micronutrient Deficiencies on Child Growth: A Review of Results from Community-Based Supplementation Trials." *Journal of Nutrition* 133 (11): 4010S–4020S.

Sandström, B., and A. Cederblad. 1980. "Zinc Absorption from Composite Meals. II. Influence of the Main Protein Source." *American Journal of Clinical Nutrition* 33 (8): 1778-1783.

Schmidhuber, J., and P. Shetty. 2005. "The Nutrition Transition to 2030: Why Developing Countries Are Likely to Bear the Major Burden." *Acta Agriculturae Scandinavica*, Section C 2 (3–4): 150–166.

Schönfeldt, H., and N. Hall. 2012. "Dietary Protein Quality and Malnutrition in Africa." *British Journal of Nutrition* 108 (S2): S69–S76.

Shrimpton, R., and C. Rokx. 2012. *The Double Burden of Malnutrition: A Review of Global Evidence*. HNP Discussion Paper 79525. Washington, DC: World Bank.

Tarozzi, A. 2005. "The Indian Public Distribution System as Provider of Food Security: Evidence from Child Nutrition in Andhra Pradesh." *European Economic Review*, 49 (5): 1305–1330.

Trogdon, J., E. Finkelstein, T. Hylands, P. Dellea, and S. Kamal-Bahl. 2008. "Indirect Costs of Obesity: A Review of the Current Literature." *Obesity Reviews* 9 (5): 489–500.

United Nations Department of Economic and Social Affairs. 2016. World Population Prospects Database. Accessed January 23, 2016. http://esa.un.org/unpd/wpp/.

World Bank. 2016. *World Development Indicators Database*. Accessed Jan 23, 2016. http://data.worldbank.org/data-catalog/world-development-indicators.

World Health Organization. 2011. *Global Status Report on Noncommunicable Diseases 2010*. Geneva.

Young, V., and P. Pellett. 1994. "Plant Proteins in Relation to Human Protein and Amino Acid Nutrition." *American Journal of Clinical Nutrition* 59 (5): 1203S–1212S.

Yusuf, S., S. Reddy, S. Ôunpuu, and S. Anand. 2001a. "Global Burden of Cardiovascular Diseases Part I: General Considerations, the Epidemiologic Transition, Risk Factors, and Impact of Urbanization." *Circulation* 104 (22): 2746–2753.

———. 2001b. "Global Burden of Cardiovascular Diseases Part II: Variations in Cardiovascular Disease by Specific Ethnic Groups and Geographic Regions and Prevention Strategies." *Circulation* 104 (23): 2855–2864.

Chapter 5

Balagamwala, M., and H. Gazdar. 2013. "Agriculture and Nutrition in Pakistan: Pathways and Disconnects." *IDS Bulletin* 44 (3): 66–74.

Bhutta, Z. A., J. K. Das, A. Rizvi, M. F. Gaffey, N. Walker, S. Horton, P. Webb, A. Lartey, and R. E. Black 2013. "Evidence-Based Interventions for Improvement of Maternal and Child Nutrition: What Can Be Done and at What Cost?" *Lancet* 382 (9890): 452–477.

Black, R. E., C. G. Victora, S. P. Walker, Z. A. Bhutta, P. Christian, M. De Onis, M. Ezzati, et al. 2013. "Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries." *Lancet* 382 (9890): 427–451.

CGIAR. 2015. *Joint A4NH/ISPC Workshop on Nutrition: Insights and Recommendations*. Independent Science and Partnership Council. www.ispc.cgiar.org/Publication/Joint-A4nhispc-Workshop-Nutrition-Brief-Number-47.

Dangour, A. D., S. Hawkesworth, B. Shankar, L. Watson, C. S. Srinivasan, E. H. Morgan, L. Haddad, and J. Waage. 2013. "Can Nutrition Be Promoted through Agriculture-Led Food Price Policies? A Systematic Review." *BMJ Open* 3 (6): E002937.

Department for International Development. 2015. *DFID's Conceptual Framework on Agriculture*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/472999/Conceptual-Framework-Agriculture2.pdf.

Dufour, C., J. Jelensperger, E. Uccello, K. Moalosi, B. Giyose, D. Kauffmann, and M. Agbendech. 2013. "Mainstreaming Nutrition in Agriculture Investment Plans in Sub-Saharan Africa: Lessons Learnt from the NEPAD CAADP Nutrition Capacity Development." *SCN News* 40: 59–66. www.unscn.org/files/Publications/SCN_News/SCNNEWS40_final_standard_res.pdf.

Ecker, O., C. Breisinger, and K. Pauw. 2011. *Growth Is Good, But Is Not Enough to Improve Nutrition*. 2020 Conference Paper 7. Washington, DC: International Food Policy Research Institute.

Ethiopia Central Statistical Agency and ICF International. 2012. *Ethiopia Demographic and Health Survey (DHS) 2011*. Addis Ababa, Ethiopia, and Calverton, MD, USA: Central Statistical Agency and ICF International. Accessed August 22, 2014. http://dhsprogram.com/pubs/pdf/fr255/fr255.pdf.

European Commission, Food and Agriculture Organization of the United Nations, Technical Center for Agricultural and Rural Cooperation, and World Bank Group. 2014. *Agriculture and Nutrition: A Common Future*. www.fao.org/3/A-At709e.pdf.

FAO (Food and Agriculture Organization of the United Nations). 2011. *The State of Food Insecurity in the World*. Rome.

———. 2013. *Synthesis of Guiding Principles on Agriculture Programming for Nutrition*. www.fao.org/docrep/017/aq194e/aq194e.pdf.

———. 2015a. *Key Recommendations for Improving Nutrition through Agriculture and Food Systems*. www.fao.org/documents/card/en/c/74018245-8bc9-4932-97ab-14fe8e9b496c/.

———. 2015b. *Designing Nutrition-Sensitive Agricultural Investments: Checklist and Guidance for Programme Formulation*. www.fao.org/documents/card/en/c/6cd87835-ab0c-46d7-97ba-394d620e9f38/.

FAO and CAADP (Comprehensive Africa Agriculture Development Programme). 2013a. *East and Central Africa Regional CAADP Nutrition Programme Development Workshop: Nutrition Country Paper: Ethiopia*. Accessed August 28, 2014. www.fao.org/fileadmin/user_upload/wa_workshop/ecafrica-caadp/ethiopia_ncp_190213.pdf.

———. 2013b. *East and Central Africa Regional CAADP Nutrition Programme Development Workshop: Nutrition Country Paper: Uganda*. Accessed August 28, 2014. www.fao.org/fileadmin/user_upload/wa_workshop/ecafrica-caadp/uganda_ncp_190213.pdf.

FAO and Institut de Recherche pour le Développement (IRD). 2015. *Moving Forward on Choosing a Standard Operational Indicator of Women's Dietary Diversity*. Rome: FAO. www.fao.org/documents/card/en/c/678ab9d4-e7a8-4388-9f9f-1c709ea47752/.

Gillespie, S., L. Haddad, V. Mannar, P. Menon, and N. Nisbett. 2013. "The Politics of Reducing Malnutrition: Building Commitment and Accelerating Progress." *Lancet* 382 (9891): 552–569.

Gillespie, S., J. Harris, and S. Kadiyala. 2012. *The Agriculture-Nutrition Disconnect in India: What Do We Know?* IFPRI Discussion Paper 01187. Washington, DC: International Food Policy Research Institute.

Gillespie, S., M. van den Bold, J. Hodge, and A. Herforth. 2015. "Leveraging Agriculture for Nutrition in South Asia and East Africa: Examining the Enabling Environment through Stakeholder Perceptions." *Food Security* 7 (3): 463–477.

Global Panel on Agriculture and Food Systems for Nutrition. 2015. *Improved Metrics and Data Are Needed for Effective Food System Policies in the Post-2015 Era.* Technical Brief No. 2. London.

Headey, D., A. Chiu, and S. Kadiyala. 2012. "Agriculture's Role in the Indian Enigma: Help or Hindrance to the Crisis of Undernutrition?" *Food Security* 4 (1): 87–102.

Herforth, A. 2015. "Access to Adequate Nutritious Food: New Indicators to Track Progress and Inform Action." In *The Fight against Hunger and Malnutrition: The Role of Food, Agriculture, and Targeted Policies*, edited by D. E. Sahn. Oxford: Oxford University Press, P139-164.

Herforth, A., and C. Dufour. 2013. "Key Recommendations for Improving Nutrition through Agriculture: Establishing a Global Consensus." *SCN News* 40: 33–38.

Herforth, A., and J. Harris. 2014. *Understanding and Applying Primary Pathways and Principles*. Arlington, VA: USAID and Spring.

Hoddinott, J., S. Gillespie, and S. Yosef. 2015. "Public-Private Partnerships and Undernutrition: Examples and Future Prospects." In *Hidden Hunger: Malnutrition and the First 1,000 Days of Life: Causes, Consequences, and Solutions*, edited by H. Biesalski and R. Black. Basel: Karger.

Hodge, J., A. Herforth, S. Gillespie, M. Beyero, M. Wagah, and R. Semakula. 2015. "Is There an Enabling Environment for Nutrition-Sensitive Agriculture in East Africa?" *Food and Nutrition Bulletin* 36 (4): 503–519.

International Food Policy Research Institute. 2015. *Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition and Sustainable Development*. Washington, DC.

International Fund for Agricultural Development. 2014. *Improving Nutrition through Agriculture*. www.ifad.org/pub/thematic/nutrition/nutrition_e_web.pdf.

Kadiyala, S., J. Harris, D. Headey, S. Yosef, and S. Gillespie. 2014. "Agriculture and Nutrition in India: Mapping Evidence to Pathways." *Annals of the New York Academy of Sciences* 1331 (December): 43–56.

Kenya Agricultural Research Institute. 2012. *Policy Responses to Food Crisis in Kenya*. Washington, DC: International Food Policy Research Institute. Accessed January 6, 2013. www.foodsecurityportal.org/kenya/food-security-report-prepared-kenya-agricultural-research-institute.

Pinstrup-Andersen, P. 2012. "Can Agriculture Meet Future Nutrition Challenges?" *European Journal of Development Research* 25 (1): 5–12.

Ruel, M. T., and H. Alderman. 2013. "Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and Child Nutrition?" *Lancet* 382 (9891): 536–551.

UNICEF 2013. *Improving Child Nutrition: The Achievable Imperative for Global Progress*. New York. Accessed August 25, 2015. www.unicef.org/gambia/improving_child_nutrition_-_the_achievable_imperative_for_global_progress.pdf.

———. 2014. *Nutritional Status Indicators Including Underweight, Wasting, Stunting, and Overweight*. Accessed August 25, 2014. http://data.unicef.org/nutrition/malnutrition#sthash.

UNICEF, World Health Organization (WHO), and World Bank. 2012. *UNICEF–WHO–World Bank Joint Child Malnutrition Estimates*. New York: UNICEF.

USAID (US Agency for International Development) Feed the Future. 2014. *Feed the Future Approach*. www.feedthefuture.gov/approach/improved--nutrition#focus-areas.

Webb, P., and S. Block. 2012. "Support for Agriculture during Economic Transformation: Impacts on Poverty and Undernutrition." *Proceedings of the National Academy of Sciences of the United States of America* 109 (31): 12309–12314.

World Bank. 2012. *Agricultural Innovation Systems: An Investment Sourcebook*. Washington, DC.

Chapter 6

Aubel, J. 2012. "The Role and Influence of Grandmothers on Child Nutrition: Culturally Designated Advisors and Caregivers." *Maternal and Child Nutrition* 8: 19–35.

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

Dillon, A., V. Moreira, D. Olney, A. Pedehombga, and E. Quinones. 2012. *HKI's EHFP Program in Burkina Faso*. Washington, DC: Helen Keller International.

Girard, A. W., J. L. Self, C. McAuliffe, and O. Olude. 2012. "The Effects of Household Food Production Strategies on the Health and Nutrition Outcomes of Women and Young Children: A Systematic Review." *Paediatric and Perinatal Epidemiology* 26 (Suppl. 1): 205–222.

Kennedy, G., T. Ballard, and M. Dop. 2011. *Guidelines for Measuring Household and Individual Dietary Diversity*. Rome: Food and Agriculture Organization of the United Nations.

Leroy, J., M. Ruel, E. Verhofstadt, and D. Olney. 2009. *Micronutrient Impact of Multisectoral Programs Focusing on Nutrition: Examples from Conditional Cash Transfer, Microcredit with Education and Agricultural Programs*. Washington, DC: IFPRI and INSP.

Masset, E., L. Haddad, A. Cornelius, and J. Isaza-Castro. 2012. "Effectiveness of Agricultural Interventions That Aim to Improve Nutritional Status of Children: Systematic Review." *BMJ* 344: d8222.

Olney, D., J. A. Behrman, E. Iruhiriye, M. van den Bold, and A. Pedehombga. 2013. *Helen Keller International's Enhanced Homestead Food Production Program in Burkina Faso: Results from a Process Evaluation*. Washington, DC: IFPRI.

Olney, D. K., L. Bliznashka, A. Pedehombga, A. Dillon, M. T. Ruel, and J. Heckert. 2016. "A 2-Year Integrated Agriculture and Nutrition Program Targeted to Mothers of Young Children in Burkina Faso Reduces Underweight among Mothers and Increases Their Empowerment: A Cluster-Randomized Controlled Trial." *Journal of Nutrition* 146: 1109–1117.

Olney, D. K., A. Pedehombga, M. T. Ruel, and A. Dillon. 2015. "A 2-Year Integrated Agriculture and Nutrition and Health Behavior Change Communication Program Targeted to Women in Burkina Faso Reduces Anemia, Wasting, and Diarrhea in Children 3–12.9 Months of Age at Baseline: A Cluster-Randomized Controlled Trial." *Journal of Nutrition* 145: 1317–1324.

Olney, D. K., A. Talukder, L. L. Iannotti, M. T. Ruel, and V. Quinn. 2009. "Assessing Impact and Impact Pathways of a Homestead Food Production Program on Household and Child Nutrition in Cambodia." *Food and Nutrition Bulletin* (FNB) 30: 355–369.

Olney, D. K., S. Vicheka, M. Kro, C. Chakriya, H. Kroeun, L. S. Hoing, A. Talukder, V. Quinn, L. Iannotti, E. Becker, and T. Roopnaraine. 2013. "Using Program Impact Pathways to Understand and Improve Program Delivery, Utilization, and Potential for Impact of Helen Keller International's Homestead Food Production Program in Cambodia." *Food and Nutrition Bulletin* (FNB), 34 (2): 169–184.

Quisumbing, A. R., D. Rubin, C. Manfre, E. Waithanji, M. van den Bold, D. Olney, N. Johnson, and R. Meinzen-Dick. 2015. "Gender, Assets, and Market-Oriented Agriculture: Learning from High-Value Crop and Livestock Projects in Africa and Asia." *Agriculture and Human Values* 32: 705–725.

Ruel, M. T., and H. Alderman. 2013. "Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and Child Nutrition?" *Lancet* 382 (9891): 536–551.

Swindale, A., and P. Bilinsky. 2006. *Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2)*. Food and Nutrition Technical Assistance III Project. Washington, DC: USAID and FHI 360.

van den Bold, M., A. Dillon, D. Olney, M. Ouedraogo, A. Pedehombga, and A. Quisumbing. 2015. "Can Integrated Agriculture-Nutrition Programmes Change Gender Norms on Land and Asset Ownership? Evidence from Burkina Faso." *Journal of Development Studies* 51 (9): 1–20.

World Bank. 2007. *From Agriculture to Nutrition: Pathways, Synergies, and Outcomes*. Washington, DC.

World Health Organization Multicentre Growth Reference Study. 2006. WHO Child Growth Standards. *Acta Paediatr Suppl* 95 (Supp. 450): 1–104.

World Health Organization. 2010. *Indicators for Assessing Infant and Young Child Feeding Practices: Part II Measurement.*

Chapter 7

Alderman, H., J. Hoddinott, and B. Kinsey. 2006. "Long Term Consequences of Early Childhood Malnutrition." *Oxford Economic Papers* 58 (3): 450–474.

Arimond, M., and M. T. Ruel. 2004. "Dietary Diversity Is Associated with Child Nutritional Status: Evidence from 11 Demographic and Health Surveys." *Journal of Nutrition* 134 (10): 2579–2585.

Asare-Marfo, D., E. Birol, C. Gonzalez, M. Moursi, S. Perez, J. Schwarz, and M. Zeller. 2013. *Prioritizing Countries for Biofortification Interventions Using Country-Level Data*. HarvestPlus Working Paper No. 11. Washington, DC: International Food Policy Research Institute, HarvestPlus.

Asare-Marfo, D., C. Herrington, E. Birol, et al. 2016. *Assessing the Adoption of High Iron Bean Varieties and Their Impact on Iron Intakes and Other Livelihood Outcomes in Rwanda: Listing Exercise Report*. Washington, DC: HarvestPlus, International Food Policy Research Institute.

Banerji, A., S. Chowdhury, H. De Groote, and J. V. Meenakshi. 2013. *Using Elicitation Mechanisms to Estimate the Demand for Nutritious Maize: Evidence from Experiments in Rural Ghana*. HarvestPlus Working Paper 10. Washington, DC: HarvestPlus, International Food Policy Research Institute.

Birol, E., D. Asare-Marfo, J. Fiedler, B. Ha, K. Lividini, M. Moursi, M. Zeller, J. V. Meenakshi, and A. J. Stein. 2014. "Cost-Effectiveness of Biofortification." *Biofortification Progress Briefs* 25. Washington, DC: HarvestPlus, International Food Policy Research Institute.

Birol, E., J. V. Meenakshi, A. Oparinde, S. Perez, and K. Tomlins. 2015. "Developing Country Consumers' Acceptance of Biofortified Foods: A Synthesis." *Food Security* 7 (3): 555–568.

Black, R. E., C. G. Victora, S. P. Walker, Z. A. Bhutta, P. Christian, M. De Onis, M. Ezzati, S. Grantham-McGregor, J. Katz, R. Martorell, R. Uauy, the Maternal and Child Nutrition Study Group. 2013. "Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries." *Lancet* 382 (9890): 427–451.

Bouis, H., and L. Haddad. 1990. *Agricultural Commercialization, Nutrition, and the Rural Poor: A Study of Philippine Farm Households.* Boulder, CO, USA: Lynne Rienner Publishers.

Bouis, H. E., C. Hotz, B. McClafferty, J. V. Meenakshi, and W. H. Pfeiffer. 2011. "Biofortification: A New Tool to Reduce Micronutrient Malnutrition." *Food and Nutrition Bulletin* 32 (Supplement 1): 31S–40S.

Bryce, J., S. El Arifeen, G. Pariyo, C. F. Lanata, D. Gwatkin, J. Habicht, and the Multi-Country Valuation of IMCI Study Group. 2003. "Reducing Child Mortality: Can Public Health Deliver?" *Lancet* 362 (9378): 159–164.

Cercamondi, C. I., I. M. Eqli, E. Mitchikpe, F. Tossou, C. Zeder, J. D. Hounhouigan, and R. F. Hurrell. 2013. "Total Iron Absorption by Young Women from Iron-Biofortified Pearl Millet Composite Meals Is Double That from Regular Millet Meals but Less Than That from Post-Harvest Iron-Fortified Millet Meals." *Journal of Nutrition* 143: 1376–1382.

CGIAR. 2014. *Getting Nutritious Foods to People*. Accessed July 28, 2016. www.cgiar.org/consortium-news/cgiar-commits-to-mainstreaming-breeding-for-mineral-and-vitamin-traits-into-conventional-food-crop-development-programs/.

Chibwe, E., H. De Groote, Z. Gitonga, and E. Birol. 2013. *A Participatory Evaluation of Vitamin A Biofortified Maize in Zambi*a. HarvestPlus, Washington, DC, unpublished.

Chomba, E., C. M. Westcott, J. E. Westcott, E. M. Mpabalwani, N. F. Krebs, Z. W. Patinkin, N. Palacios, and K. M. Hambidge. 2015. "Zinc Absorption from Biofortified Maize Meets the Requirements of Young Rural Zambian Children." *Journal of Nutrition* 145: 514–519.

Chowdhury, S., J. V. Meenakshi, K. Tomlins, and C. Owori. 2011. "Are Consumers in Developing Countries Willing to Pay More for Micronutrient-Dense Biofortified Foods? Evidence from a Field Experiment in Uganda." *American Journal of Agricultural Economics* 93 (1): 83–97.

de Brauw, A., P. Eozenou, D. O. Gilligan, C. Hotz, N. Kumar, C. Loechl, S. McNiven, J.V. Meenakshi, and M. Moursi. 2010, unpublished. *The Impact of the HarvestPlus Reaching End Users Orange-Fleshed Sweet Potato Project in Mozambique and Uganda*. Washington, DC: HarvestPlus, International Food Policy Research Institute.

de Brauw, A., M. Moursi, B. Munhaua, and C. Qiu. 2015. *Vitamin A Intakes Remain Higher among Intervention Participants Three Years after a Biofortification Intervention in Mozambique*. Working paper. Washington, DC: HarvestPlus, International Food Policy Research Institute.

FAO (Food and Agriculture Organization of the United Nations). 2013. *The State of Food and Agriculture 2013*. Rome. http://bit.ly/KAn84P.

Fiedler, J., and K. Lividini. 2014. *Zambia and Bangladesh Micronutrient Portfolio Analyses*. Washington, DC: HarvestPlus, International Food Policy Research Institute.

Finkelstein, J., S. Mehta, S. Udipi, P. Ghugre, S. Luna, M. Wenger, L. E. Murray-Kolb, E. M. Przybyszewski, and J. Haas. 2015. "A Randomized Trial of Iron-Biofortified Pearl Millet in School Children in India." *Journal of Nutrition* 145 (7): 1576–1581.

Gannon, B., C. Kaliwile, S. A. Arscott, S. Schmaelzle, J. Chileshe, N. Kalungwana, M. Mosonda, K. Pixley, C. Masi, and S. A. Tanumihardjo. 2014. "Biofortified Orange Maize Is as Efficacious as a Vitamin A Supplement in Zambian Children Even in the Presence of High Liver Reserves of Vitamin A: A Community-Based, Randomized Placebo-Controlled Trial." *American Journal of Clinical Nutrition* 100 (6): 1541–1550.

Haas, J. D., S. V. Luna, M. G. Lung'aho, M. J. Wenger, L. E. Murray-Kolb, S. Beebe, J.-B. Gahutu, and I. M. Egli. 2016. "Consuming Iron Biofortified Beans Increases Iron Status in Rwandan Women after 128 Days in a Randomized Controlled Feeding Trial." *Journal of Nutrition* 146 (8): 1586–1592.

HarvestPlus. 2014a. *The 2nd Global Conference on Biofortification Conference Report*. Washington, DC: HarvestPlus, International Food Policy Research Institute.

———. 2014b. *Kigali Declaration on Biofortified Nutritious Food*. http://biofortconf.ifpri.info/files/2014/04/Kigali-Declaration-on-Biofortified-Nutritious-Foods-April-9-20142.pdf.

——. 2016. Monitoring Data Base of HarvestPlus. Washington, DC: HarvestPlus, International Food Policy Research Institute.

Hotz, C., C. Loechl, A. de Brauw, et al. 2012b. "A Large-scale Intervention to Introduce Orange Sweet Potato in Rural Mozambique Increases Vitamin A Intakes among Children and Women." *British Journal of Nutrition* 108: 163–176.

Hotz, C., Loechl, C., Lubowa, A., et al. 2012a. "Introduction of B-carotene-Rich Orange Sweet Potato in Rural Uganda Results in Increased Vitamin A Intakes among Children and Women and Improved Vitamin A Status among Children." *Journal of Nutrition* 142: 1871–1880.

International Food Policy Research Institute/Welthungerhilfe. 2006. *The Challenge of Hunger: Global Hunger Index: Facts, Determinants, and Trends: Case Studies of Post Conflict Countries of Afghanistan and Sierra Leone*. Bonn, Germany: Deutsche Welthungerhilfe (DWHH).

Jones, K., and A. de Brauw. 2015. "Using Agriculture to Improve Child Health: Promoting Orange Sweet Potatoes Reduces Diarrhea." *World Development* 74: 15–24.

Kennedy, G., and M. Moursi. 2015. Dietary Diversity and Biofortification: Closer Than You Think. HarvestPlus. Accessed July 28, 2016. www.harvestplus.org/knowledge-market/in-the-news/dietary-diversity-and-biofortification-closer-you-think.

Kodkany, B. S., R. M. Bellad, N. S. Mahantshetti, J. E. Westcott, N. F. Krebs, J. F. Kemp, and K. M. Hambidge. 2013. "Biofortification of Pearl Millet with Iron and Zinc in a Randomized Controlled Trial Increases Absorption of These Minerals above Physiologic Requirements in Young Children." *Journal of Nutrition* 143 (9): 1489–1493.

La Frano, M. R., L. R. Woodhouse, D. J. Burnett, and B. J. Burri. 2013. "Biofortified Cassava Increases β-Carotene and Vitamin A Concentrations in the TAG-Rich Plasma Layer of American Women." *British Journal of Nutrition* 110: 310–320.

Laurie, S. M., and M. V. Van Heerden. 2011. "Consumer Acceptability of Four Products Made from Beta-carotene-Rich Sweet Potato." *African Journal of Food Science* 6 (4): 96–103.

Li, S., A. Nugroho, T. Rocheford, and W. S. White. 2010. "Vitamin A Equivalence of the β-Carotene in β-Carotene-Biofortified Maize Porridge Consumed by Women." *American Journal of Clinical Nutrition* 92 (5): 1105–1112.

Low, J. W., M. Arimond, N. Osman, B. Cunguara, F. Zano, and D. Tschirley. 2007. "A Food-Based Approach Introducing Orange Fleshed Sweet Potato Increased Vitamin A Intake and Serum Retinol Concentrations in Young Children in Rural Mozambique." *Journal of Nutrition* 137: 1320–1327.

Luna, S., S. Villalpando, T. Shamah, E. Boy, and J. D. Haas. 2012. "Inflammation, Weight Status, and Iron Status in Mexican Children in a Randomized Controlled Iron-Biofortified Bean Feeding Trial." *FASEB Journal* 26: 1031.15.

McNiven, S., D. Gilligan, and C. Hotz. 2014. Sustainability of Impact: Dimensions of *Decline and Persistence in Adoption of a Biofortified Crop in Uganda*. Working Paper. Washington, DC: International Food Policy Research Institute.

Meenakshi, J. V., A. Banerji, V. Manyong, K. Tomlins, N. Mittal, and P. Hamukwala. 2012. "Using a Discrete Choice Experiment to Elicit the Demand for a Nutritious Food: Willingness-to-Pay for Orange Maize in Rural Zambia." *Journal of Health Economics* 31: 62–71.

Murekezi, A., E. Birol, D. Asare-Marfo, and L. Katsvairo. 2013. "Farmer Feedback Study on High Iron Bean Seed Delivery in Rwanda." Paper presented at the 2013 AAEA & CAES Joint Annual Meeting, August 4–6, 2013, Washington, DC.

Naico, A. T. A., and J. L. Lusk. 2010. The Value of a Nutritionally Enhanced Staple Crop: Results from a Choice Experiment Conducted with Orange Fleshed Sweet Potatoes in Mozambique. *Journal of African Economies* 19 (4): 536–558.

Oparinde, A., A. Banerji, E. Birol, and P. Ilona. 2016a. "Information and Consumer Willingness to Pay for Biofortified Yellow Cassava: Evidence from Experimental Auctions in Nigeria." *Agricultural Economics* 47 (2): 215–233.

Oparinde, A., E. Birol, A. Murekezi, L. Katsvairo, M. Tedla-Diressie, J. D. Nkundimana, and L. Butare. 2016b. "Radio Messaging Frequency, Information Framing, and Consumer Willingness to Pay for Biofortified Iron Beans: Evidence from Revealed Preference Elicitation in Rural Rwanda." *Canadian Journal of Agricultural Economics*. Article in press. First published online on June 29, 2016. http://dx.doi.org/10.1111/cjag.12105.

Palmer, A. C., W. Siamusantu, J. Chileshe, K. J. Schulze, M. Barffour, N. E. Craft, et al. 2016. "Provitamin A-Biofortified Maize Increases Serum B-Carotene, but Not Retinol, in Marginally Nourished Children: a Cluster-Randomized Trial in Rural Zambia." *American Journal of Clinical Nutrition* (May 11): pii: ajcn132571. Epub ahead of print.

Pillay, K., J. Derera, M. Siwela, and F. J. Veldman. 2011. "Consumer Acceptance of Yellow, Provitamin A-Biofortified Maize in KwaZulu-Natal." *South African Journal of Clinical Nutrition* 24 (4): 186–191.

Pompano, L. M., E. M. Przybyszewski, S. A. Udipi, P. Ghugre, and J. D. Haas. 2013. "VO2 Max Improves in Indian School Children after a Feeding Trial with Iron Biofortified Pearl Millet." *FASEB Journal* 27: 845.28

Prasai, N., and D. Asare-Marfo. 2015. *Biofortification Priority Index: A Global Strategy Tool for Investing in Biofortification*. Web application created with Tableau 8.2. http://www.harvestplus.org/knowledge-market/BPI.

Qaim, M., A. J. Stein, and J. V. Meenakshi. 2007. "Economics of Biofortification." *Agricultural Economics* 37: 119–133.

Rosado, J. L., K. M. Hambidge, L. V. Miller, O. P. Garcia, J. Westcott, K. Gonzalez, J. Conde, C. Hotz, W. Pfeiffer, I. Ortiz-Monasterio, and N. Krebs. 2009. "The Quantity of Zinc Absorbed from Wheat in Women Is Enhanced by Biofortification." *Journal of Nutrition* 139: 1920–1925.

Saltzman, A., E. Birol, H. Bouis, E. Boy, F. De Moura, Y. Islam, and W. Pfeiffer. 2013. "Biofortification: Progress toward a More Nourishing Future." *Global Food Security* 2 (1): 9–17.

Saltzman, A., M. S. Andersson, D. Asare-Marfo, K. Lividini, F. F. De Moura, M. Moursi, A. Oparinde, and V. Taleon. 2016. "Biofortification Techniques to Improve Food Security." *Reference Module in Food Science*, First Edition, 1–9.

Scott, S. L., L. Murray-Kolb, S. Wenger, P. Udipi, P. Ghugre, and J. Haas. 2014. "Iron-Biofortified Pearl Millet Improves Attentional Function in Indian Adolescents, a 6-Month Randomized Controlled Trial." *FASEB Journal*, 28 (1 Supplement): 619.2.

Stevens, R., and A. Winter-Nelson. 2008. "Consumer Acceptance of Provitamin A-Biofortified Maize in Maputo, Mozambique." *Food Policy* 33: 341–351.

Taleon, V., M. Diressie, and T. Kandenga. Forthcoming. *Consumer Acceptance and Preference of Biofortified Yellow Cassava in the Western Provinces of Democratic Republic of Congo*. HarvestPlus Working Paper. Washington, DC: HarvestPlus, International Food Policy Research Institute.

Talsma, E. F., I. D. Brouwer, H. Verhoef, G. N. Mbera, A. M. Mwangi, A. Y. Demir, B. Maziya-Dixon, E. Boy, M. B. Zimmermann, and A . Melse-Boonstra. 2016. "Biofortified Yellow Cassava and Vitamin A Status of Kenyan Children: A Randomized Controlled Trial." *American Journal of Clinical Nutrition* 103 (1): 258–67

Talsma, E., A. Melse-Boonstra, B. P. H. de Kok, G. N. K. Mbera, A. M. Mwangi, and I. D. Brouwer. 2013. "Biofortified Cassava with Pro-Vitamin A Is Sensory and Culturally Acceptable for Consumption by Primary School Children in Kenya." *PLoS ONE* 8 (8): e73433. doi:10.1371/journal.pone.0073433.

Thompson, B., and L. Amoroso, eds. 2010. *Combating Micronutrient Deficiencies: Food-Based Approaches*. Rome: Food and Agriculture Organization of the United Nations.

United Nations Development Programme. 1990. *Human Development Report*. New York: Oxford University Press.

van Jaarsveld, P. J., M. Faber, S. A. Tanumihardjo, P. Nestel, C. J. Lombard, and A. J. Spinnler Benadé. 2005. "ß-Carotene Rich Orange-Fleshed Sweet Potato Improves the Vitamin A Status of Primary School Children Assessed with the Modified-Relative-Dose-Response Test." *American Journal of Clinical Nutrition* 81: 1080–1087.

von Grebmer, K., A. Saltzman, E. Birol, D. Wiesmann, N. Prasai, S. Yin, Y. Yohannes, P. Menon, J. Thompson, and A. Sonntag. 2014. *2014 Global Hunger Index: The Challenge of Hidden Hunger*. Bonn, Washington, DC, and Dublin: Welthungerhilfe, International Food Policy Research Institute, and Concern Worldwide.

Chapter 8

Abdallah, M. F., G. Girgin, R. Krska, T. Baydar, and M. Sulyok. 2015. *Analysis of Multiple Mycotoxins in Maize and Animal Feed in Upper Egypt Using LC-MS/MS*. www.researchgate.net/publication/285587285.

Abdel-Rahim, A. M., Osman, N. A., Idris, M. O. 1989. "Survey of Some Cereal Grains and Legume Seeds for Aflatoxin Contamination in the Sudan." *Zentralblatt für Mikrobiologie* 144: 115–121.

Abdel-Hafez, A. I. I., and S. M. Saber. 1993. "Mycoflora and Mycotoxin of Hazelnut (Corylus avellana L.) and Walnut (Juglans regia L.) Seeds in Egypt." *Zentralblatt für Mikrobiologie* 148 (2): 137–147.

Abia, W. A., B. Warth, M. Sulyok, R. Krska, A. N. Tchana, P. B. Njobeh, M. F. Dutton, and P. F. Moundipa. 2013. "Determination of Multi-Mycotoxin Occurrence in Cereals, Nuts and Their Products in Cameroon by Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS)." *Food Control* 31: 438–453.

Adebajo, L. O., A. A. Idowu, and O. O. Adesanya. 1994. "Mycoflora, and Mycotoxins Production in Nigerian Corn and Corn-Based Snacks." *Mycopathologia* 126 (3): 183–192.

Adejumo, O., O. Atanda, A. Raiola, Y. Somorin, R. Bandyopadhyay, and A. Ritieni. 2013. "Correlation between Aflatoxin M1 Content of Breast Milk, Dietary Exposure to Aflatoxin B1 and Socioeconomic Status of Lactating Mothers in Ogun State, Nigeria." *Food Chemistry and Toxicology* 56: 171–177.

Adetunji, M. C., O. O. Atanda, C. N. Ezekiel, M. Sulyok, B. Warth, E. Beltrán, R. Krska, O. Obadina, A. Bakare, and C. A. Chilaka. 2014a. "Fungal and Bacterial Metabolites of Stored Maize (Zea mays, L.) from Five Agro-Ecological Zones of Nigeria." *Mycotoxin Research* 30 (2): 89–102.

Adetunji, M. C., O. O. Atanda, C. N. Ezekiel, A. O. Dipeolu, S. V. A. Uzochukwu, J. Oyedepo, and C. A. Chilaka. 2014b. "Distribution of Mycotoxins and Risk Assessment of Maize Consumers in Five Agro-Ecological Zones of Nigeria." *European Food Research Technology* 239 (2): 287–296.

Afolabi, C. G., C. N. Ezekiel, I. A. Kehinde, A. W. Olaolu, and O. M. Ogunsanya. 2015. "Contamination of Groundnut in South-Western Nigeria by Aflatoxigenic Fungi and Aflatoxins in Relation to Processing." *Journal of Phytopathology* 163: 279–283.

Akande, A. 2015. Personal communication with the authors via phone, November 9.

Alpert, M. E., M. S. R. Hutt, G. N. Wogan, and C. S. Davidson. 1971. "Association between Aflatoxin Content of Food and Hepatoma Frequency in Uganda." *Cancer* 28 (1): 253–260.

Andretta, I., M. Kipper, C. R. Lehnen, L. Hauschild, M. M. Vale, and P. A. Lovatto. 2012. "Meta-Analytical Study of Productive and Nutritional Interactions of Mycotoxins in Growing Pigs." *Animal: An International Journal of Animal Bioscience* 6: 1476–1482.

Aflatoxin Proficiency Testing and Control in Africa. 2015. *Aflatoxin Proficiency Testing and Control in Africa (APTECA)*. Accessed May 13, 2016. http://apteca.tamu.edu/Default.aspx.

Ashraf, N., X. Giné, and D. Karlan. 2009. "Finding Missing Markets (and a Disturbing Epilogue): Evidence from an Export Crop Adoption and Marketing Intervention in Kenya." *American Journal of Agricultural Economics* 91 (4): 973–990.

Association of Southeast Asian Nations. 2015. *Regulatory Limits of Mycotoxins in ASEAN Countries, 2015*. Accessed May 12, 2016. www.hsa.gov.sg/content/dam/HSA/ASG/Food_Safety/ASEANRefLab/Aflatoxins_2015.pdf.

Atherstone, C., D. Grace, J. F. Lindahl, E. K. Kang'ethe, and F. Nelson. 2016. "Assessing the Impact of Aflatoxin Consumption on Animal Health and Productivity." *African Journal of Food, Agriculture, Nutrition and Development* 16 (3): 10949–10966.

Atehnkeng, J., P. S. Ojiambo, M. Donner, T. Ikotun, R. A. Sikora, P. J. Cotty, and R. Bandyopadhyay. 2008. "Distribution and Toxigenicity of Aspergillus Species Isolated from Maize Kernels from Three Agroecological Zones in Nigeria." *International Journal of Food Microbiology* 122: 74–84.

Atehnkeng, J., P. S. Ojiambo, P. J. Cotty, and R. Bandyopadhyay. 2014. "Field Efficacy of a Mixture of Atoxigenic Aspergillus flavus Link: Fr Vegetative Compatibility Groups in Preventing Aflatoxin Contamination in Maize (Zea mays L.). *Biological Control* 72: 62–70.

Awuah, R. T., and K. A. Kpodo. 1996. "High Incidence of Aspergillus flavus and Aflatoxins in Stored Groundnut in Ghana and the Use of a Microbial Assay to Assess the Inhibitory Effects of Plant Extracts on Aflatoxin Synthesis." *Mycopathologia* 134 (2): 109–114.

Ayalew, A., H. Fehrmann, J. Lepschy, R. Beck, and D. Abate. 2006. "Natural Occurrence of Mycotoxins in Staple Cereals from Ethiopia." *Mycopathologia* 162 (1): 57–63.

Bankole, S. A., and O. O. Mabekoje. 2004. "Occurrence of Aflatoxins and Fumonisins in Preharvest Maize from South-western Nigeria." *Food Additives and Contaminants* 21 (3): 251–255.

Berek, L., I. B. Petri, A. Mesterhazy, J. Téren, and J. Molnár. 2001. "Effects of Mycotoxins on Human Immune Functions in Vitro." *Toxicology in Vitro* 15 (1): 25–30.

Binder, E. M. 2007. "Managing the Risk of Mycotoxins in Modern Feed Production." *Animal Feed Science and Technology* 133 (1–2): 149–166.

Bondy, G. S., and J. J. Pestka. 2000. "Immunomodulation by Fungal Toxins." *Journal of Toxicology and Environmental Health: Part B Critical Review* 3: 109–143.

Britzi, M., S. Friedman, J. Miron, R. Solomon, O. Cuneah, J. Shimshoni, S. Soback, R. Ashkenazi, S. Armer, and A. Shlosberg. 2013. "Carry-Over of Aflatoxin B1 to Aflatoxin M1 in High Yielding Israeli Cows in Mid- and Late-Lactation." *Toxins* 5: 173–183.

Brown, R. L., A. Menkir, Z. Chen, D. Bhatnagar, J. Yu, H. Yao, and T. E. Cleaveland. 2013. "Breeding Aflatoxin Resistant Maize Lines Using Recent Advances in Technologies: A Review." *Food Additives and Contaminants. Part A, Chemistry, Analysis, Control, Exposure and Risk Assessment* 30 (8): 1382–1391.

Campbell, D. I., M. Elia, and P. G. Lunn. 2003. "Growth Faltering in Rural Gambian Infants Is Associated with Impaired Small Intestinal Barrier Function, Leading to Endotoxemia and Systemic Inflammation." *Journal of Nutrition* 133 (5): 1332–1338.

Castelino, J. M., M. N. Routledge, S. Wilson, D. W. Dunne, J. K. Mwatha, K. Gachuhi, C. P. Wild, and Y. Y. Gong. 2015. "Aflatoxin Exposure Is Inversely Associated with IGF1 and IGFBP3 Levels in Vitro and in Kenyan Schoolchildren." *Molecular Nutrition and Food Research* 59: 574–581.

Crean, D., and A. Ayalew. 2016 forthcoming. "The Critical Role of Food Safety in Ensuring Food Security." In *Good Nutrition for One World*. Basel, Switzerland: Karger.

Cullen, J. M., B. H. Ruebner, L. S. Hsieh, D. M. Hyde, and D. P. Hsieh. 1987. "Carcinogenicity of Dietary Aflatoxin M1 in Male Fischer Rats Compared to Aflatoxin B1." *Cancer Research* 47 (7): 1913–1917.

Daniel, J. H., L. W. Lewis, Y. A. Redwood, S. Kieszak, R. F. Breiman, W. D. Flanders, C. Bell, et al. 2011. "Comprehensive Assessment of Maize Aflatoxin Levels in Eastern Kenya, 2005–2007." *Environmental Health Perspectives* 119 (12): 1794.

Darwish, W. S., Y. Ikenaka, S. M. Nakayama, and M. Ishizuka. 2014. "An Overview on Mycotoxin Contamination of Foods in Africa." *Journal of Veterinary Medical Science* 76 (6): 789.

Dersjant-Li, Y., M. W. A. Verstegen, and W. J. J. Gerrits. 2003. "The Impact of Low Concentrations of Aflatoxin, Deoxynivalenol or Fumonisin in Diets on Growing Pigs and Poultry." *Nutrition Research Reviews* 16: 223–239.

Diop, Y., B. Ndiaye, A. Diouf, M. Fall, C. Thiaw, A. Thiam, O. Barry, M. Ciss, and D. Ba. 2000. "Artisanal Peanut Oil Contamination by Aflatoxins in Senegal." *Annales Pharmaceutiques Françaises* 58: 470–474.

Dutton, M. F., E. J. Robertson, C. Mathews, and B. D. A. Beck. 1993. "Occurrence of Mycotoxins in Maize in a Rural Area in South Africa and Methods of Prevention of Contamination and Elimination," 823–835. In J. R. N. Taylor, P. G. Randall, and J. H. Viljoen, eds. *Cereal Science and Technology: Impact on a Changing Africa*. Pretoria, South Africa: CSIR.

Edema, M., Y. Somorin, O. Atanda, O. Irurhe, H. Makun, F. Areola, E. Ewuola, C. Ezekiel, A. Oyebanji, and I. Ogara. 2015. *Compendium of Abstracts of Mycotoxicology in West Africa: 1980–2015*. Ahmedabad, India: Sarah Book Publication.

Ediage, E. N., J. D. Di Mavungu, S. Monbaliu, C. V. Peteghem, and S. De Saeger. 2011. "A Validated Multi-Analyte LC-MS/MS Method for the Quantification of 25 Mycotoxins in Cassava Flour, Peanut Cake, and Maize Samples." *Journal of Agricultural and Food Chemistry* 59 (10): 5173–5180.

Ediage, E. N., K. Hell, and S. De Saeger. 2014. "A Comprehensive Study to Explore Differences in Mycotoxin Patterns from Agro-Ecological Regions through Maize, Peanut, and Cassava Products: A Case Study, Cameroon." *Journal of Agricultural and Food Chemistry* 62: 4789–4797.

Elamin, N. H., A. M. Abdel-Rahim, and A. E. Khalid. 1988. "Aflatoxin Contamination of Groundnuts in Sudan." *Mycopathologia* 104 (1): 25–31.

El-Gohary, A. H. 1996. "Aflatoxin in some foodstuffs with special reference to public health hazard in Egypt." *Indian Journal of Animal Science* 66:468–473.

El-Kady, I. A., and M. S. Youssef. 1993. "Survey of Mycoflora and Mycotoxins in Egyptian Soybean Seeds." *Journal of Basic Microbiology* 33 (6): 371–378.

El-Tahan, F. H., M. H. El-Tahan, and M. A. Shebl. 2000. "Occurrence of Aflatoxins in Cereal Grains from Four Egyptian Governorates." *Nahrung* 44: 279–280.

Eze, U.A., and F. E. Okonofua. 2015. "High Prevalence of Male Infertility in Africa: Are Mycotoxins to Blame?" *African Journal of Reproductive Health* 19 (3); 9–17.

Ezekiel, C. N., M. Sulyok, D. A. Babalola, B. Warth, V. C. Ezekiel, and R. Krska. 2013. "Incidence and Consumer Awareness of Toxigenic Aspergillus Section Flavi and Aflatoxin B1 in Peanut Cake from Nigeria." *Food Control* 30 (2): 596–601.

Ezekiel, C. N., R. Bandyopadhyay, M. Sulyok, B. Warth, and R. Krska. 2012. "Fungal and Bacterial Metabolites in Commercial Poultry Feed from Nigeria." *Food Additives and Contaminants: Part A* 29 (8): 1288–1299.

Fafchamps, M., R. V. Hill, and B. Minten. 2008. "Quality Control in Nonstaple Food Markets: Evidence from India." *Agricultural Economics* 38 (3): 251–266.

Fapohunda, S.O., C. N. Ezekiel, O. A. Alabi, A. Omole, and S. O. Chioma. 2008. "Aflatoxin-Mediated Sperm and Blood Cell Abnormalities in Mice Fed with Contaminated Corn. *Mycobiology* 36 (4): 255–259.

Feddern, V., G. C. Dors, F. Tavernari, H. Mazzuco, J. A. Cunha, E. L. Krabbe, and G. N. Scheuermann. 2013. "Aflatoxins: Importance on Animal Nutrition." In *Aflatoxins: Recent Advances and Future Prospects*, edited by M. Razzaghi-Abyaneh, 171–195. Rijeka, Croatia: InTech Open Access.

Fink-Gremmels, J. 2008. "Mycotoxins in Cattle Feeds and Carry-Over to Dairy Milk: A Review." *Food Additives and Contaminants: Part A, Chemistry, Analysis, Control, Exposure and Risk Assessment* 25: 172–180.

Fountain, J. C., P. Khera, L. Yang, S. N. Nayak, B. T. Scully, R. D. Lee, Z.-Y. Chen, R. C. Kemerait, R. K. Varshney, and B. Guo. 2015. "Resistance to *Aspergillus flavus* in Maize and Peanut: Molecular Biology, Breeding, Environmental Stress, and Future Perspectives." *Crop Journal* 3 (3): 229–237.

Fufa, H., and K. Urga. 1996. "Screening of Aflatoxins in Shiro and Ground Red Pepper in Addis Ababa." *Ethiopian Medical Journal* 34 (4): 243–249.

Gizachew, D., B. Szonyi, A. Tegegne, J. Hanson, and D. Grace. 2016. "Aflatoxin Contamination of Milk and Dairy Feeds in the Greater Addis Ababa Milk Shed, Ethiopia." *Food Control* 59: 773–779.

Global Panel on Agriculture and Food Systems for Nutrition. 2016. "Assuring Safe Food Systems: Policy Options for a Healthier Food Supply, Global Panel on Agriculture and Food Systems for Nutrition" Policy Brief 5. http://glopan.org/sites/default/files/Food-Safety-Policy-Brief.pdf.

Gong, Y. Y., K. Cardwell, A. Hounsa, S. Egal, P. C. Turner, A. J. Hall, and C. P. Wild. 2002. "Dietary Aflatoxin Exposure and Impaired Growth in Young Children from Benin and Togo: Cross Sectional Study." *British Medical Journal* 325 (7354): 20–21.

Gong, Y. Y., S. Egal, A. Hounsa, P. C. Turner, A. J. Hall, K. F. Cardwell, and C. P. Wild. 2003. "Determinants of Aflatoxin Exposure in Young Children from Benin and Togo, West Africa: The Critical Role of Weaning." *International Journal of Epidemiology* 32 (4): 556–562.

Gong, Y. Y., A. Hounsa, S. Egal, P. C. Turner, A. E. Sutcliffe, A. J. Hall, K. F. Cardwell, and C. P. Wild. 2004. "Postweaning Exposure to Aflatoxin Results in Impaired Child Linear Growth: A Longitudinal Study in Benin, West Africa." *Environmental Health Perspectives* 112 (13): 1334–1338.

Gong, Y. Y., S. Wilson, J. K. Mwatha, M. N. Routledge, J. M. Castelino, B. Zhao, G. Kimani, H. C. Kariuki, B. Vennervald, D. W. Dunne, and C. P. Wild. 2012. "Aflatoxin Exposure May Contribute to Chronic Hepatomegaly in Kenyan School Children." *Environmental Health Perspectives* 120: 893–896.

Gong, Y. Y., S. Watson, and M. N. Routledge. 2016. "Aflatoxin Exposure and Associated Human Health Effects: A Review of Epidemiological Studies." *Food Safety* 4 (1): 14–27.

Grace, D., K. Makita, E. K. Kang'ethe, and B. Bonfoh. 2010. "Safe Food, Fair Food: Participatory Risk Analysis for Improving the Safety of Informally Produced and Marketed Food in sub-Saharan Africa." *Revue Africaine de Santé et de Productions Animales* 8(S): 3–11.

Grenier, B., and I. Oswald. 2011. "Mycotoxin Co-Contamination of Food and Feed: Meta-Analysis of Publications Describing Toxicological Interactions." *World Mycotoxin Journal* 4: 285–313.

Groopman, J. D., T. W. Kensler, and C. P. Wild. 2008. "Protective Interventions to Prevent Aflatoxin-Induced Carcinogenesis in Developing Countries." *Annual Review of Public Health* 29: 187–203.

Gulati, A., N. Minot, C. Delgado, and S. Bora. 2007. "Growth in High-Value Agriculture in Asia and the Emergence of Vertical Links with Farmers," 98–108. In *Global Supply Chains: Standards and the Poor: How the Globalization of Food Systems and Standards Affects Rural Development and Poverty*, edited by J. Swinnen. Wallingford, United Kingdom: CABI.

Hafez, A. H., A. Gomma, S. A. Mousa, and S. E. Megalla. 1983. "Aflatoxin and Aflatoxicosis. IV. The Effect of Dietary Aflatoxins on Adult Fertile Male and Female Rabbits at Various Reproductive Conditions." *Mycopathologia* 83: 183–186.

Hafez, A. H., S. E. Megalla, and A. A. Mahmed. 1982. "Aflatoxin and Aflatoxicosis." *Mycopathologia* 77: 141–144.

Hell, K., K. F. Cardwell, M. Setamou, and H. M. Poehling. 2000. "The Influence of Storage Practices on Aflatoxin Contamination in Maize in Four Agroecological Zones of Benin, West Africa." *Journal of Stored Products Research* 36 (4): 365–382.

Henry, S., F. X. Bosch, J. C. Bowers, C. J. Portier, B. J. Petersen, and L. Barraj. 1998. "Aflatoxins," 359–468. In *Safety Evaluation of Certain Food Additives and Contaminants*. Geneva, Switzerland: WHO. Prepared by the 49th Meeting of the Joint FAO/WHO Expert Committee on Food Additives.

Hernandez-Vargas, H., J. Castelino, M. J. Silver, O. Dominguez-Salas, M. P. Cros, G. Durand, et al. 2015. "Exposure to Aflatoxin B1 in Utero Is Associated with DNA Methylation in White Blood Cells of Infants in The Gambia." *International Journal of Epidemiology* 44: 1238–1248.

Hintz, H. F., H. Heitman, A. N. Booth, and W. E. Gagne. 1967. "Effects of Aflatoxin on Reproduction in Swine." *Experimental Biology and Medicine* 126: 146–148.

Hoffmann, V., K. Jones, and J. Leroy. 2015. "Mitigating Aflatoxin Exposure to Improve Child Growth in Eastern Kenya: Study Protocol for a Randomized Controlled Trial." *Trials* 16: 552.

Hoffmann, V., G. Gajate-Garrido, K. Jones, D. Kanyam, N. Magnan, and N. Opoku. 2016 "Mitigating Aflatoxin Risk through Value Chains in Ghana and Kenya." Presented at the Workshop on Engaging the Health and Nutrition Sectors in Aflatoxin Control in Africa. African Union Commission Headquarters, Addis Ababa, March 23–24.

Hudson, G. J., C. P. Wild, A. Zarba, J. D. Groopman. 1992. "Aflatoxins Isolated by Immunoaffinity Chromatography from Foods Consumed in the Gambia, West Africa." *Natural Toxins* 1: 100–105.

Huwig, A., F. Stefan, K. Othmar, and H. Dutler. 2001. "Mycotoxin Detoxication of Animal Feed by Different Adsorbents." *Toxicology Letters* 122 (2): 179–188.

International Agency for Research on Cancer (IARC). 2015. *Mycotoxin Control in Low- and Middle-Income Countries*, edited by C. P. Wild, J. D. Miller, and J. D. Groopman. IARC Working Group Report No. 9. Lyon, France.

Ismail, S., J. Shindano, D. B. Nyirenda, R. Bandyopadhyay, and J. Akello. 2014. "Does Exposure to Aflatoxin Constrain Efforts to Reduce Stunting in Zambia?" *IDS Special Collection* (September): 22–26.

Jacobson, W. C., W. C. Harmeyer, J. E. Jackson, B. Armbrecht, and H. G. Wiseman. 1978. "Transmission of Aflatoxin B 1 into the Tissues of Growing Pigs." *Bulletin of Environmental Contamination and Toxicology* 19(1): 156–161.

Jiang, Y., P. E. Jolly, W. O. Ellis, J. S. Wang, T. D. Phillips, and J. H. Williams. 2005. "Aflatoxin B1 Albumin Adduct Levels and Cellular Immune Status in Ghanaians." I*nternational Journal of Immunology* 17 (6): 807–814.

Jiang, Y., P. E. Jolly, P. Preko, J. S. Wang, W. O. Ellis, T. D. Phillips, and J. H. Williams. 2008. "Aflatoxin-Related Immune Dysfunction in Health and in Human Immunodeficiency Virus Disease." *Clinical and Developmental Immunology* 2008: Article ID 790309. doi: 10.1155/2008/790309.

Jolly, P. E. 2014. "Aflatoxin: Does It Contribute to an Increase in HIV Viral Load?" *Future Microbiology* 9 (2): 121–124.

Jolly, P. E., S. Inusah, B. Lu, W. O. Ellis, A. Nyarko, T. D. Phillips, and J. H. Williams. 2013. "Association between High Aflatoxin B1 Levels and High Viral Load in HIV Positive People." *World Mycotoxin Journal* 6: 255–261.

Kaaya, A. N., and W. Kyamuhangire. 2006. "The Effect of Storage Time and Agroecological Zone on Mould Incidence and Aflatoxin Contamination of Maize from Traders in Uganda." *International Journal of Food Microbiology* 110 (3): 217–223.

Kang'ethe, E. K., and K. A. Lang'a. 2009. "Aflatoxin B1 and M1 Contamination of Animal Feeds and Milk from Urban Centers in Kenya." *African Health Sciences* 9: 218–226.

Kankolongo, M. A., K. Hell, and I. N. Nawa. 2009. "Assessment for Fungal, Mycotoxin and Insect Spoilage in Maize Stored for Human Consumption in Zambia." *Journal of the Science of Food and Agriculture* 89 (8): 1366–1375.

Kanora, A., and D. Maes. 2009. "The Role of Mycotoxins in Pig Reproduction: A Review." *Veterinarnia Medicina* 54: 565–576.

Kayode, O. F., M. Sulyok, S. O. Fapohunda, C. N. Ezekiel, R. Krska, and C. R. B. Oguntona. 2013. "Mycotoxins and Fungal Metabolites in Groundnut- and Maize-Based Snacks from Nigeria." *Food Additives and Contaminants: Part B* 6 (4): 294–300.

Keenan, J., P. Jolly, P. Preko, J. Baidoo, J. S. Wang, T. D. Phillips, J. H. Williams, and G. McGwin, Jr. 2011. "Association between Aflatoxin B1 Albumin Adduct Levels and Tuberculosis Infection among HIV Ghanaians." *Archives of Clinical Microbiology* 2 (3): 3.

Kensler, T. W., B. D. Roebuck, G. N. Wogan, and J. D. Groopman. 2011. "Aflatoxin: A 50 Year Odyssey of Mechanistic and Translational Toxicology." *Toxicological Science* 120 (S1): S28–S48.

Kiama, T. N., J. Lindahl, A. J. Sirma, D. M. Senerwa, E. M. Waithanji, P. Ochungo, E. J. Poole, E. K. Kang'ethe, and D. Grace. 2016. "Kenya Dairy Farmer Perception of Moulds and Mycotoxins and Implications for Exposure to Aflatoxins: A Gendered Analysis." *African Journal of Food, Agriculture, Nutrition and Development* 16 (3): 11106–11125.

Khlangwiset, P., G. S. Shephard, and F. Wu. 2011. "Aflatoxins and Growth Impairment: A Review." *Critical Review of Toxicology* 41 (9): 740–755.

Kiarie, G. M., P. Dominguez-Salas, S. K. Kang'ethe, D. Grace, and J. Lindahl. 2016. "Aflatoxin Exposure among Young Children in Urban Low-income Areas of Nairobi and Association with Child Growth." *African Journal of Food, Agriculture, Nutrition and Development* 16 (3): 10967–10990.

Kimanya, M. E., C. P. Shirima, H. Magoha, D. H. Shewiyo, B. De Meulenaer, P. Kolsteren, and Y. Y. Gong. 2014. "Co-Exposures of Aflatoxins with Deoxynivalenol and Fumonisins from Maize Based Complementary Foods in Rombo, Northern Tanzania." *Food Control* 41: 76–81.

Kolosova, A., and J. Stroka. 2011. "Substances for Reduction of the Contamination of Feed by Mycotoxins: A Review." *World Mycotoxin Journal* 4 (3): 225–256.

Kpodo, K., U. Thrane, and B. Hald. 2000. "Fusaria and Fumonisins in Maize from Ghana and their Co-occurrence with Aflatoxins." *International Journal of Food Microbiology* 61: 147–157.

Leroy, J. L., J. S. Wang, and K. Jones. 2015. "Serum Aflatoxin B 1-lysine Adduct Level in Adult Women from Eastern Province in Kenya Depends on Household Socio-Economic Status: A Cross Sectional Study." *Social Science and Medicine* 146: 104–110.

Lewis, L., M. Onsongo, H. Njapau, H. Schurz-Rogers, G. Luber, S. Kieszak, J. Nyamongo, L. Backer, A. M. Dahiye, A. Misore, K. DeCock, and C. Rubin. 2005. "Aflatoxin Contamination of Commercial Maize Products during an Outbreak of Acute Aflatoxicosis in Eastern and Central Kenya." *Environmental Health Perspectives* 113: 1763–1767.

Liu, Y., and F. Wu. 2010. "Global Burden of Aflatoxin-Induced Hepatocellular Carcinoma: A Risk Assessment." *Environmental Health Perspectives* 118 (6): 818–824.

Lopez, A., and M. A. Crawford. 1967. "Aflatoxin Content of Groundnuts Sold for Human Consumption in Uganda." *Lancet* 290 (7530): 1351–1354.

Magoha, H., M. Kimanya, B. De Meulenaer, D. Roberfroid, C. Lachat, and P. Kolsteren. 2014a. "Risk of Dietary Exposure to Aflatoxins and Fumonisins in Infants Less Than 6 Months of Age in Rombo, Northern Tanzania." *Maternal and Child Nutrition* 12 (3): 516–527. doi: 10.1111/mcn.12155.

Magoha, H., B. De Meulenaer, M. Kimanya, D. Hipolite, C. Lachat, and P. Kolsteren. 2014b. "Fumonisin B1 Contamination in Breast Milk and Its Exposure in Infants under 6 Months of Age in Rombo, Northern Tanzania." *Food Chemistry and Toxicology* 74: 112–116.

Manjula, K., K. Hell, P. Fandohan, A. Abass, and R. Bandyopadhyay. 2009. "Aflatoxin and Fumonisin Contamination of Cassava Products and Maize Grain from Markets in Tanzania and Republic of the Congo." *Toxin Reviews* 28 (2–3): 63–69.

Masoero, F., A. Gallo, M. Moschini, G. Piva, and D. Diaz. 2007. "Carryover of Aflatoxin from Feed to Milk in Dairy Cows with Low or High Somatic Cell Counts." *Animal: An International Journal of Animal Bioscience* 1: 1344–1350.

Méaux, S., E. Pantiora, and S. Schneider. 2013. "Aflatoxin Mmanagement in the World Food Programme through P4P Local Procurement," 20 (9). In *Aflatoxins: Finding Solutions for Improved Food Safety*, edited by L. Unnevehr and D. Grace. Washington, DC: International Food Policy Research Institute.

Mngadi, P., R. Govinden, and B. Odhav. 2008. "Co-occurring Mycotoxins in Animal Feeds." *African Journal of Biotechnology* 7 (13): 2239–2243. doi:10.4314/ajb.v7i13.58964.

Monson, M., R. Coulombe, and K. Reed. 2015. "Aflatoxicosis: Lessons from Toxicity and Responses to Aflatoxin B1 in Poultry." *Agriculture* 5: 742–777.

Moser, C., and V. Hoffmann. 2015. "Firm Heterogeneity in Food Safety Provision: Evidence from Aflatoxin Tests in Kenya" IFPRI Discussion Paper 01416. Washington DC: IFPRI.

Mulund, M., L. Ngoma, M. Nyirenda, L. Motsei, and F. Bakunzi. 2013. "A Decade of Aflatoxin M1 Surveillance in Milk and Dairy products in Developing Countries (2001–2011): A Review," 39-60. In H.Makun, editor, *Mycotoxin and Food Safety in Developing Countries*. Rijeka, Croatia: InTech.

Mutegi, C. K., H. K. Ngugi, S. L. Hendriks, and R. B. Jones. 2009. "Prevalence and Factors Associated with Aflatoxin Contamination of Peanuts from Western Kenya." *International Journal of Food Microbiology* 130 (1): 27–34.

Mutiga, S. K., V. Hoffmann, J. W. Harvey, M. G. Milgroom, and R. J. Nelson. 2015. "Assessment of Aflatoxin and Fumonisin Contamination of Maize in Western Kenya." *Phytopathology* 105 (9): 1250–1261.

Ngoko, Z., W. F. O. Marasas, J. P. Rheeder, G. S. Shephard, M. J. Wingfield, and K. F. Cardwell. 2001. "Fungal Infection and Mycotoxin Contamination of Maize in the Humid Forest and the Western Highlands of Cameroon." *Phytoparasitica* 29 (4): 352–360.

Njapau, H., F. Nelson, T. Wesonga, and V. Manyong. 2015. *Aflatoxin: Alternative Uses and Disposal Systems: Building an Aflatoxin Safe East African Community*. Technical Policy Paper 9. Knowledge Platform 2015 Situational Analysis for East Africa Region. Dar es Salaam, Tanzania: International Institute for Tropical Agriculture.

Njoroge, S., L. Matumba, K. Kanenga, M. Siambi, F. Waliyar, J. Maruwo, and E. S. Monyo. 2016. "A Case for Regular Aflatoxin Monitoring in Peanut Butter in Sub-Saharan Africa: Lessons from a 3-Year Survey in Zambia." *Journal of Food Protection* 79 (5): 795–800.

Nyangi, C., J. K. Mugula, F. Beed, S. Boni, E. Koyano, and M. Sulyok. 2016. "Aflatoxin and Fumonisin Contamination of Marketed Maize and Maize Bran and Maize Used as Animal Feed in Northern Tanzania." *African Journal of Food Agriculture Nutrition and Development* 16 (3): 11054–11064.

Okoth, S. A., and M. A. Kola. 2012. "Market Samples as a Source of Chronic Aflatoxin Exposure in Kenya." *African Journal of Health Sciences* 20 (56–61).

Oliveira, C. A., E. Kobashigawa, T. A. Reis, L. Mestieri, R. Albuquerque, and B. Corrêa. 2000. "Aflatoxin B1 Residues in Eggs of Laying Hens Fed a Diet Containing Different Levels of the Mycotoxin." *Food Additives and Contaminants* 17: 459–462.

Oluwafemi, F., and I. N. Ibeh. 2011. "Microbial Contamination of Seven Major Weaning Foods in Nigeria." *Journal of Health, Population and Nutrition* 29 (4): 415–419.

Ortatatli, M., M. K. Ciftci, M. Tuzcu, and A. Kaya. 2002. "The Effects of Aflatoxin on the Reproductive System of Roosters." *Research in Veterinary Science* 72: 29–36.

Oswald, I. P., D. E. Marin, S. Bouhet, P. Pinton, I. Taranu, and F. Accensi. 2005. "Immunotoxicological Risk of Mycotoxins for Domestic Animals." *Food Additives and Contaminants* 22 (4): 354–360.

PACA (Partnership for Aflatoxin Control in Africa). 2016. Proceedings of the Workshop on "Engaging the Health and Nutrition Sectors in Aflatoxin Control in Africa", March 23–24, African Union Commission Headquarters, Addis Ababa, Ethiopia. www.aflatoxinpartnership.org.

Polychronaki, N., P. C. Turner, H. Mykkänen, Y. Gong, H. Amra, M. Abdel-Wahhab, and H. El-Nezami. 2006. "Determinants of Aflatoxin M1 in Breast Milk of Egyptian Mothers." *Food Additives and Contaminants* 23: 700–708.

Polychronaki, N., R. M. West, P. C. Turner, H. Amra, M. Abdel-Wahhab, H. Mykkänen, and H. El-Nezami. 2007. "A Longitudinal Assessment of Aflatoxin M1 Excretion in Breast Milk of Selected Egyptian Mothers." *Food Chemistry and Toxicology* 45: 1210–1215.

Prandini, A., G. Tansini, S. Sigolo, L. Filippi, M. Laporta, and G. Piva. 2009. "On the Occurrence of Aflatoxin M1 in Milk and Dairy Products." *Food and Chemical Toxicology* 47: 984–991.

Probst, C., H. Njapau, and P. J. Cotty. 2007. "Outbreak of an Acute Aflatoxicosis in Kenya in 2004: Identification of the Causal Agent." *Applied Environmental Microbiology* 73 (8): 2762–2764.

Revoredo, C. L., and S. Fletcher. 2002. *World Peanut Market: An Overview of the Past 30 Years.* Athens, GA: Georgia Agricultural Experiment Stations, College of Agricultural and Environmental Sciences, the University of Georgia.

Rios, L. B. D., and S. Jaffee. 2008. *Barrier, Catalyst, or Distraction? Standards, Competitiveness, and Africa's Groundnut Exports to Europe.* Agriculture and Rural Development Discussion Paper 39. Washington, DC: World Bank.

Schatzmayr, G., and E. Streit. 2013. "Global Occurrence of Mycotoxins in the Food and Feed Chain: Facts and Figures." *World Mycotoxin Journal* 6: 213–222.

Selim, M. I., W. Popendorf, M. S. Ibrahim, S. El Sharkawy, and E. S. El Kashory. 1996. "Aflatoxin B1 in Common Egyptian Foods." *Journal of AOAC international* 79 (5): 1124–1129.

Senerwa, D. M., A. J. Sirma, N. Mtimet, E. K. Kangethe, D. Grace, and J. Lindahl. 2016. "Prevalence of Aflatoxins in Feeds and Cow Milk from Five Counties in Kenya." *African Journal of Food, Agriculture, Nutrition and Development* 16 (3): 11004–11021.

Shephard, G. S. 2003. "Aflatoxin and Food Safety: Recent African Perspectives." *Journal of Toxicology: Toxin Reviews* 22 (2–3): 267–286.

Shreeve, B. J., D. S. P. Patterson, and B. A. Roberts. 1979. "The 'Carry-over' of Aflatoxin, Ochratoxin and Zearalenone from Naturally Contaminated Feed to Tissues, Urine and Milk of Dairy Cows." *Food and Cosmetics Toxicology* 17(2): 151–152.

Shuaib, F. M., P. E. Jolly, J. E. Ehiri, N. Yatich, Y. Jiang, E. Funkhouser, S. D. Person, C. Wilson, W. O. Ellis, J. S. Wang, and J. H. Williams. 2010. "Association between Birth Outcomes and Aflatoxin B1 Biomarker Blood Levels in Pregnant Women in Kumasi, Ghana." *Tropical Medicine and International Health* 15 (2): 160–167.

Singh, J., R. P. Tiwari, G. Singh, S. Singh, and D. V. Vadehra. 1987. "Biochemical and Immunological Effects of Aflatoxins in Rabbits." *Toxicology Letters* 35: 225–230.

Swinnen, J., L. Colen, and M. Maertens. 2013, "Constraints to Smallholder Participation in High-Value Agriculture in West Africa." In *Rebuilding West Africa's Food Potential*, edited by A. Elbehri. Rome: FAO/IFAD.

Tchana, A. N., P. F. Moundipa, and F. M. Tchouanguep. 2010. "Aflatoxin Contamination in Food and Body Fluids in Relation to Malnutrition and Cancer Status in Cameroon." *International Journal of Environmental Research and Public Health* 7: 178–188.

Turner, P. C., S. E. Moore, A. J. Hall, A. M. Prentice, and C. P. Wild. 2003. "Modification of Immune Function through Exposure to Dietary Aflatoxin in Gambian Children." *Environmental Health Perspectives* 111 (2): 217–220.

Turner, P. C., A. C. Collinson, Y. B. Cheung, Y. Gong, A. J. Hall, A. M. Prentice, and C. P. Wild. 2007. "Aflatoxin Exposure in Utero Causes Growth Faltering in Gambian Infants." *International Journal of Epidemiology* 36 (5): 1119–1125.

Turner, P. C., B. Flannery, C. Isitt, M. Ali, and J. Pestka. 2012. "The Role of Biomarkers in Evaluating Human Health Concerns from Fungal Contaminants in Food." *Nutrition Research Review* 25: 162–179.

Udoh, J. M., K. F. Cardwell, and T. Ikotun. 2000. "Storage Structures and Aflatoxin Content of Maize in Five Agroecological Zones of Nigeria." *Journal of Stored Products Research* 36 (2): 187–201.

Urio, E. M., A. Juma, S. Mwanyika, N. V. Mlingi, G. T. Ndunguru, and G. D. Ndossi. 2006. "The Occurrence of Aflatoxin M1 in Fresh Cow Milk Retailed in Dar es Salaam, Tanzania." *In Mycotoxins and Phycotoxins*, edited by H. Njapau, et al. Wageningen Academic Press.

Uriah, N., N. I. Ibeh, and F. Oluwafemi. 2001. "A Study on the Impact of Aflatoxins on Human Reproduction." *African Journal of Reproductive Health* 5 (1): 106–110.

Van Beuningen, C., and P. Knorringa. 2009. *Inclusive Improvement: Standards And Smallholders: Taking Stock and Moving On*. The Hague, Netherlands: HIVOS.

Wangikar, P. B., P. Dwivedi, N. Sinha, A. K. Sharma, and A. G. Telang. 2005. "Effects of Aflatoxin B1 on Embryo Fetal Development in Rabbits." *Food and Chemical Toxicology* 43: 607–615.

Wild, C. P., F. N. Rasheed, M. F. B. Jawla, A. J. Hall, L. A. M. Jansen, and R. Montesano. 1991. "In-Utero Exposure to Aflatoxin in West Africa." *Lancet* 337 (8757): 1602.

Williams, J. H., T. D. Phillips, P. E. Jolly, J. K. Stiles, C. M. Jolly, and D. Aggarwal. 2004. "Human Aflatoxicosis in Developing Countries: A Review of Toxicology, Exposure, Potential Health Consequences, and Interventions." *American Journal of Clinical Nutrition* 80: 1106–1122.

Yard, E. E., J. H. Daniel, L. S. Lewis, M. E. Rybak, E. M. Paliakov, A. A. Kim, J. M. Montgomery, R. Bunnell, M. U. Abudo, W. Akhwale, R. F. Breiman, and S. K. Sharif. 2013. "Human Aflatoxin Exposure in Kenya, 2007: A Cross-Sectional Study." *Food Additives and Contaminants: Part A* 30 (7): 1322–1331.

Wu, F., and P. Khlangwiset. 2010. "Health Economic Impacts and Cost-Effectiveness of Aflatoxin Reduction Strategies in Africa: Case Studies in Biocontrol and Postharvest Interventions." *Food Additives and Contaminants: Part A* 27 (4): 496–509.

Zinedine, A., C. Juan, J. M. Soriano, J. C. Moltó, L. Idrissi, and J. Mañes. 2007. "Limited Survey for the Occurrence of Aflatoxins in Cereals and Poultry Feeds from Rabat, Morocco." *International Journal of Food Microbiology* 115: 124–127.

Chapter 9

Alwan, A., D. R. Maclean, L. M. Riley, E. T. d'Espaignet, C. D. Mathers, G. A. Stevens, and D. Bettcher. 2010. "Monitoring and Surveillance of Chronic Non-Communicable Diseases: Progress and Capacity in High-Burden Countries." *Lancet* 376: 1861–1868.

Black, R. E., C. G. Victora, S. P. Walker, Z. A. Bhutta, P. Christian, M. De Onis, M. Ezzati, et al. 2013. "Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries." *Lancet* 382 (9890): 427–451.

Brownson, R. C., C. Royer, R. Ewing, and T. McBride. 2006. "Researchers and Policymakers: Travellers in Parallel Universes." *American Journal of Preventive Medicine* 30: 164–172.

Bryce, J., D. Coitinho, I. Darnton-Hill, D. Pelletier, and P. Pinstrup-Andersen. 2008. "Maternal and Child Undernutrition: Effective Action at National Level." *Lancet* 371: 510–526.

Catford, J. 2006. "Creating Political Will: Moving from Science to the Art of Health Promotion." *Health Promotion International* 21: 1–4.

Council on Health Research for Development. 2007. *Are International Health Research Programmes Doing Enough to Develop Research Systems and Skills in Low and Middle Income Countries?* COHRED Statement 2007. Geneva.

Doemeland, D., and J. Trevino. 2014. *Which World Bank Reports Are Widely Read?* Policy Research Working Paper 6851. Washington, DC: World Bank.

Gillespie, S., L. Haddad, V. Mannar, P. Menon, and N. Nisbett. 2013. "The Politics of Reducing Malnutrition: Building Commitment and Accelerating Progress." *Lancet* 382 (9891): 552–569.

Gillespie, S., J. Hodge, S. Yosef, and R. Pandya-Lorch. 2016. *Nourishing Millions: Stories of Change in Nutrition*. Washington, DC: International Food Policy Research Institute.

Gillespie, S., M. van den Bold, J. Hodge, and A. Herforth. 2015. "Leveraging Agriculture for Nutrition in South Asia and East Africa: Examining the Enabling Environment through Stakeholder Perceptions." *Food Security* 7: 463–477.

Holdsworth, M., A. Bour, J. Elati, Y. Kameli, A. Derouiche, E. Millstone, and F. Delpeuch. 2012. "Developing National Obesity Policy in Middle-Income Countries: A Case Study from North Africa." *Health Policy and Planning* 28 (8): 858–870.

Holdsworth, M., A. M. Kruger, E. Nago-Koukoubou, P. Mamiro, K. Smit, C. Garimoi-Orach, Y. Kameli, D. Roberfroit, and P. Kolsteren. 2014. "African Stakeholder Views of Research Options to Improve Nutritional Status in Sub-Saharan Africa in the Years to Come." *Health Policy and Planning* 30 (7): 863–874.

International Food Policy Research Institute. 2016. *Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030*. Washington, DC.

Ioannidis, J. P., S. Greenland, M. A. Hlatky, M. J. Khoury, M. R. Macleod, D. Moher, K. F. Schulz, and R. Tibshirani. 2014. "Increasing Value and Reducing Waste in Research Design, Conduct, and Analysis." *Lancet* 383 (9912): 166–175.

Lachat, C., S. Otchere, D. Roberfroid, A. Abdulai, F. M. Aguirre Seret, J. Milesevic, G. Xuereb, V. Candeias, and P. Kolsteren. 2013. "Diet and Physical Activity for the Prevention of Noncommunicable Diseases in Low- and Middle-Income Countries: A Systematic Policy Review." *PLOS Medicine* 10 (6): e1001465.

Lachat, C., E. Nago, D. Roberfoid, M. Holdsworth, K. Smit, J. Kinabo, et al. 2014. "Developing a Sustainable Nutrition Research Agenda in Africa in the Years to Come: Findings from the SUNRAY Project." *PLOS Medicine* 11 (1): e1001593.

Lachat, C., D. Roberfroid, L. Van den Broeck, N. van den Briel, E. Nago, A. M. Kruger, M. Holdsworth, C. Garimoi Orach, and P. Kolsteren. 2015. "A Decade of Nutrition Research in Africa: Assessment of the Evidence Base and Academic Collaboration." *Public Health Nutrition* 18 (10): 1890–1897.

Morris, K. 2010. "UN Raises Priority of Non-Communicable Diseases." *Lancet* 375: 1859.

Morris, S. S., B. Cogill, and R. Uauy. 2008. "Effective International Action against Undernutrition: Why Has It Proven So Difficult and What Can Be Done to Accelerate Progress?" *Lancet* 371: 608–621.

Pelletier, D. L., E. A. Frongillo, S. Gervais, L. Hoey, P. Menon, T. Ngo, R. J. Stolzfus, A. M. Ahmed, and T. Ahmed. 2012. "Nutrition Agenda Setting, Policy Formulation and Implementation: Lessons from the Mainstreaming Nutrition Initiative." *Health Policy and Planning* 27: 19–31.

Resnick, D., S. Babu, S. Haggblade, S. Hendriks, and D. Mather. 2015. *Conceptualizing Drivers of Policy Change in Agriculture, Nutrition, and Food Security: The Kaleidoscope Model*. IFPRI Discussion Paper 01414. Washington, DC: International Food Policy Research Institute.

Scaling Up Nutrition. 2014. *SUN Countries*. www.scalingupnutrition.org/sun-countries.

Sridhar, D. 2012. "Who Sets the Global Health Research Agenda? The Challenge of Multi-Bi Financing." *PLOS Medicine* 9 (9): e1001312.

Stirling, A. 2006. "Analysis, Participation and Power: Justification and Closure in Participatory Multi-Criteria Appraisal." *Land Use Policy* 23: 95–107.

———. 2008. "Opening Up and Closing Down: Power, Participation, and Pluralism in the Social Appraisal of Technology." *Science, Technology & Human Values* 33: 262–294.

———. 2010. "Keep It Complex." *Nature* 468: 1029–1031.

Tenopir, C., S. Allard, K. Douglass, A. U. Aydinoglu, L. Wu, E. Read, M. Manoff, and M. Frame. 2011. "Data Sharing by Scientists: Practices and Perceptions." *PLOS ONE* 6 (6): e21101.

Van Royen, K., C. Lachat, M. Holdsworth, K. Smit, J. Kinabo, D. Roberfroid, E. Nago, C. Garimoi Orach, and P. Kolsteren. 2013. "How Can the Operating Environment for Nutrition Research Be Improved in Sub-Saharan Africa? The Views of African Researchers." *PLOS ONE* 8 (6): e66355.

Verstraeten, R., D. Roberfroid, C. Lachat, J. L. Leroy, M. Holdsworth, L. Maes, and P. Kolsteren. 2012. "Effectiveness of Preventive School-Based Obesity Interventions in Low- and Middle-Income Countries: A Systematic Review." *American Journal of Clinical Nutrition* 96: 415–438.

Wilkinson, M. D., M. Dumontier, I. J. Aalbersberg, G. Appleton, M. Axton, A. Baak, et al. 2016. "The FAIR Guiding Principles for Scientific Data Management and Stewardship." *Scientific Data* 15 (3): 160018.

World Health Organization (WHO). 2004. *Global Strategy on Diet, Physical Activity and Health*. Geneva.

———. 2008. 2008–2013 *Action Plan for the Global Strategy for the Prevention and Control of Non-Communicable Diseases*. Geneva.

———. 2010. Population-based Strategies for Childhood Obesity: Report of the WHO Forum and Technical Meeting. Geneva. http://www.who.int/dietphysicalactivity/childhood/child-obesity-eng.pdf.

Chapter 10

Alkire, S., R. Meinzen-Dick, A. Peterman, A. Quisumbing, G. Seymour, and A.Vaz. 2013. "The Women's Empowerment in Agriculture Index." *World Development* 52: 71–91.

Baker, J. L. 2000. *Evaluating the Impact of Development Projects on Poverty: A Handbook for Practitioners*. Washington, DC: World Bank.

Ballard, T. J., A. W. Kepple, C. Cafiero, and J. Schmidhuber. 2014. "Better Measurement of Food Insecurity in the Context of Enhancing Nutrition." *Ernahrungs Umschau* 61 (2): 38–41.

Black, R. E., L. H. Allen, Z. A. Bhutta, L. E. Caulfield, M. de Onis, M. Ezzati, C. Mathers, and J. Rivera. 2008. "Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences." *Lancet* 371 (9608): 243–260.

Black, R.E., C. G. Victora, S. P. Walker, Z. A. Bhutta, P. Christian, M. de Onis, M. Ezzati, S. Grantham-MacGregor, J. Katz, R. Martorell, and R. Uauy. 2013. "Maternal and Child Undernutrition and Overweight in Low-income and Middle-income Countries." *Lancet* 382 (9890): 427–451.

Coates, J., A. Swindale, and P. Bilinsky. 2007. *Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide*, vol.3. Washington, DC: Food and Nutrition Technical Assistance Project (FANTA)/Academy for Educational Development.

FAO (Food and Agriculture Organization of the United Nations) and IRD (Institut de Recherche pour le Développement). 2014. *Defining a Standard Operational Indicator of Women's Dietary Diversity: The Women's Dietary Diversity Follow-up Project.* Rome and Montpellier.

FAO and FHI360. 2016. *Minimum Dietary Diversity for Women: A Guide for Measurement*. Rome: FAO.

Fiedler, J. L., C. A. Villalobos, A. C. De Mattos. 2008. *An Activity-based Cost Analysis of the Honduras Community-Based, Integrated Child Care (AIN-C) Programme*. Health (San Francisco). (August): 408–427.

Gertler, P. J., M. Martinez, P. Premand, L. B. Rawlings, and C. M. Vermeersch. 2010. *Impact Evaluation in Practice*. Washington, DC: World Bank.

Gibson, R. S. 2005. *Principles of Nutritional Assessment*. Oxford: Oxford University Press.

Girard, A. W., J. L. Self, C. McAuliffe, and O. Olude. 2012. "The Effects of Household Food Production Strategies on the Health and Nutrition Outcomes of Women and Young Children: A Systematic Review." *Paediatric and Perinatal Epidemiology* 26 (Suppl 1): 205–222.

Habicht, J. P., G. Pelto, and J. Lapp. 2009. *Methodologies to Evaluate the Impact of Large-scale Nutrition Programs*. Doing Impact Evaluation 13. Washington, DC: World Bank.

Habicht, J. P., C. G. Victora, and J. P. Vaughan. 1999. "Evaluation Designs for Adequacy, Plausibility and Probability of Public Health Programme Performance and Impact." *International Journal of Epidemiology* 28 (1): 10–18.

Khandker, S. R., G. B. Koolwal, and H. A. Samad, H.A. 2010. *Handbook on Impact Evaluation: Quantitative Methods and Practices*. Washington, DC: World Bank.

Leroy, J. L., and E. Frongillo. 2007. "Can Interventions to Promote Animal Production Ameliorate Undernutrition?" *The Journal of Nutrition* 137 (10): 2311–2316.

Leroy, J. L., M. T. Ruel, and E. Verhofstadt. 2009. "The Impact of Conditional Cash Transfer Programmes on Child Nutrition: A Review of Evidence using a Programme Theory Framework." *Journal of Development Effectiveness* 1 (2): 103–129.

Margolies, A., and J. Hoddinott. 2015. "Costing Alternative Transfer Modalities." *Journal of Development Effectiveness* 7 (1): 1–16.

Nguyen, P. H., P. Menon, S. C. Keithly, S. S. Kim, N. Hajeebhoy, L. M. Tran, M. T. Ruel, and R. Rawat. 2014. "Program Impact Pathway Analysis of a Social Franchise Model Shows Potential to Improve Infant and Young Child Feeding Practices in Vietnam." *Journal of Nutrition* 144 (10): 1627–1636.

Olney, D. K., L. Bliznashka, A. Pedehombga, A. Dillon, M. T. Ruel, and J. Heckert. 2016. "A 2-Year Integrated Agriculture and Nutrition Program Targeted to Mothers of Young Children in Burkina Faso Reduces Underweight among Mothers and Increases their Empowerment: A Cluster-Randomized Controlled Trial." *Journal of Nutrition* 146 (5): 1109–1117.

Olney, D. K., J. Leroy, and M. T. Ruel. Forthcoming 2017. "Evaluation of Nutrition Sensitive Interventions." In D. Taren, S. De Pee, and M. Bloem, eds. *Nutrition and Health in Developing Countries* 3rd edition. New York: Humana Press.

Olney, D. K., A. Pedehombga, M. T. Ruel, and A. Dillon. 2015. "A 2-year Integrated Agriculture and Nutrition and Health Behavior Change Communication Program Targeted to Women in Burkina Faso Reduces Anemia, Wasting, and Diarrhea in Children 3–12.9 Months of Age at Baseline: A Cluster-Randomized Controlled Trial." *Journal of Nutrition* 145 (6): 1317–1324.

Olney, D. K., R. Rawat, and M. T. Ruel. 2012. "Identifying Potential Programs and Platforms to Deliver Multiple Micronutrient Interventions." *Journal of Nutrition* 142 (1): 178S–185S.

Olney, D. K., S. Vicheka, M. Kro, C. Chakriya, H. Kroeun, L. S. Hoing, A. Talukder, V. Quinn, L. Ionnotti, E. Becker, and T. Roopnaraine. 2013. "Using Program Impact Pathways to Understand and Improve Program Delivery, Utilization, and Potential for Impact of Helen Keller International's Homestead Food Production Program in Cambodia." *Food and Nutrition Bulletin* 34 (2): 169–184.

Rawat, R., P. H. Nguyen, D. Ali, K. Saha, S. Alayon, S. S Kim, M. T. Ruel, and P. Menon. 2013. "Learning How Programs Achieve Their Impact: Embedding Theory-Driven Process Evaluation and Other Program Learning Mechanisms in Alive & Thrive." *Food and Nutrition Bulletin* 34 (3 Suppl): S212–S225.

Rossi, P. H., M. W. Lipsey, and H. E. Freeman. 2004. *Evaluation: A Systematic Approach*. Thousand Oaks, CA: Sage Publications.

Ruel, M. T., and H. Alderman. 2013. "Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and Child Nutrition?" *The Lancet*, 382 (9891): 536–551.

van den Bold, M., A. Dillon, D. Olney, M. Ouedraogo, A. Pedehombga, and A. Quisumbing. 2015. "Can Integrated Agriculture-Nutrition Programmes Change Gender Norms on Land and Asset Ownership? Evidence from Burkina Faso." *Journal of Development Studies* 51(9): 1155–1174.

Webb-Girard, A., A. Cherobon, S. Mbugua, E. Kamau-Mbuthia, A. Amin, D. W. Sellen. 2012. "Food Insecurity is Associated with Attitudes towards Exclusive Breastfeeding among Women in Urban Kenya." *Maternal & Child Nutrition* 8 (2): 199–214.

White, H. 2013. "An Introduction to the Use of Randomised Control Trials to Evaluate Development Interventions." *Journal of Development Effectiveness* 5 (1): 30–49.

World Health Organization. 2010. Indicators for Assessing Infant and Young Child Feeding Practices Part 2: Measurement. Geneva.

Chapter 11

Aaron, G. J., S. E. Wilson, and K. H. Brown. 2010. "Bibliographic Analysis of Scientific Research on Selected Topics in Public Health Nutrition in West Africa: Review of Articles Published from 1998 to 2008." *Global Public Health* 5: 42-57.

African Union (AU). 2014. *Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods*. Malabo, Equatorial Guinea.

Anderson, D., and L. S. Ackerman-Anderson. 2002. *Beyond Change Management: Advanced Strategies for Today's Transformational Leaders*. The Practicing Organization Development Series. New York: Wiley & Sons (Pfeiffer).

Aryeetey, R. N. O., A. Laar, and F. Zotor. 2015. "Capacity for Scaling Up Nutrition: A Focus on Pre-service Training in West Africa and a Ghanaian Case Study." The *Proceedings of the Nutrition Society* 74 (4): 533–537.

Brown, K. H., et al. 2010. "Strengthening Public Health Nutrition Research and Training Capacities in West Africa: Report of a Planning Workshop Convened in Dakar, Senegal, March 26–29, 2009." *Global Public Health* 5: 1–19.

Chi, H. K., C. H. Lan, and B. Dorjgotov. 2012. "The Moderating Effect of Transformational Leadership on Knowledge Management and Organizational Effectiveness." *Social Behavior and Personality: An International Journal*, 40 (6): 1015–1023.

Chiwona-Karltun, L., and M. Sartas. 2016. Current Status and Assessment of Future Opportunities. Agriculture for Nutrition and Health. A4NH Note. Washington, DC: International Food Policy Research Institute.

Coetsee, L. D. 2011. Peak Performance and Productivity. *A Practical Guide for the Creation of a Motivating Climate*. Potchefstroom: Andcork Publishers.

Day, D. V. 2001. "Leadership Development: A Review in Context." *The Leadership Quarterly* 11 (4): 581–613.

Fanzo, J., D. Dobermann, Q. Marshall, J. Wong, R. Merchan, M. I. Jaber, A. Souza, N. Verjee, and K. Davis. 2015. "Integration of Nutrition into Extension and Advisory Services: A Synthesis of Experiences, Lessons, and Recommendations." *Food and Nutrition Bulletin* 36 (2): 120–137.

Geissler, C. 2015. "Capacity Building in Public Health Nutrition." *The Proceedings of the Nutrition Society* 74 (4): 430–436.

Gillespie, S., and B. M. Margetts. 2013. "Strengthening Capacities for Enhancing the Nutrition Sensitivity of Agricultural Policy and Practice." *SCN News* 40: 6.

Gilley, A., H. S. McMillan, and J. W. Gilley. 2009. "Organizational Change and Characteristics of Leadership Effectiveness." *Journal of Leadership and Organizational Studies* 16 (1): 38–47.

Gilsenan, M.B., and O. Korver. 2009. "15th Anniversary of the European Nutrition Leadership Programme: A Seminar for Young Nutrition Professionals." *European Journal of Clinical Nutrition* 63 (12): 1458–1459.

Government of the Federal Republic of Ethiopia (GoE). 2013. *National Nutrition Programme*. Addis Ababa.

Heikens, G. T., B. C. Amadi, M. Manary, N. Rollins, and A. Tomkins. 2008. "Nutrition Interventions Need Improved Operational Capacity." *The Lancet*, 371 (9608): 181–182.

Hernez-Broome, G., and R. J. Hughes. 2004. "Leadership Development: Past, Present, and Future." *Human Resource Planning* 27 (1): 24–32.

Higgs, M., and D. Rowland. 2011. "What Does It Take to Implement Change Successfully? A Study of the Behaviors of Successful Change Leaders." *The Journal of Applied Behavioral Science* 47 (3): 309–335.

Institute of Development Studies. 2016. *Transforming Nutrition: Ideas, Policies and Outcomes 2016*. http://www.ids.ac.uk/events/transforming-nutrition-ideas-policies-and-outcomes-2016.

Jerling, J.C., L. D. Coetsee, C. Perreira, and T. Putu. 2015. *Capacity Development for Effective Programme Implementation in Two Countries in ESAR: Scaling Up Nutrition Leadership Development in Africa (SUNLEAD AFRICA)*. Potchefstroom: Andcock Publishers.

Jerling, J. C. 2015. "Reflections on Nutrition Leadership Capacity Development." *Sight and Life*, 29 (2): 49–53.

Johnson–Welch, C., K. MacQuarrie, and S. Bunch, S. 2005. *A Leadership Strategy for Reducing Hunger and Malnutrition in Africa: The Agriculture–Nutrition Advantage*. Washington, DC: International Center for Research on Women.

Kanter, R. M., B. Stein, and T. Jick. 1992. *The Challenge Of Organizational Change: How Companies Experience It and Leaders Guide It*. New York: Free Press (Maxwell Macmillan International).

Kirkpatrick, D. L. 2001. *Managing Change Effectively: Approaches, Methods, and Case Examples*. Improving Human Performance Series. Boston: Butterworth, Heinemann.

Kotter, J. P. 2001. "What Leaders Really Do." *Harvard Business Review* 79 (11): 85–96.

———. 2012. *Leading Change*. Boston: Harvard Business Review Press.

Lachat, C., D. Roberfroid, L. Van den Broek, N. Van den Briel, E. Nago, A. Kruger, M. Holdsworth, O. C. Garimoi, and P. Kolsteren. 2015. "A Decade of Nutrition Research in Africa: Assessment of the Evidence Base and Academic Collaboration." *Public Health Nutrition* 18 (10): 1890–1897.

Lemma, F. and J. Matji. 2013. "Delivery Platforms for Sustained Nutrition in Ethiopia." *The Lancet* 382 (9891): 488–489.

Leppitt, N. 2006. "Challenging the Code of Change: Part 2. Crossing the Rubicon: Extending the Integration of Change." *Journal of Change Management* 6 (3): 235–256.

Light, P. C. 2005. *The Four Pillars of High Performance: How Robust Organizations Achieve Extraordinary Results*. New York: McGraw-Hill.

Long, P. W., and P. C. Spurgeon. 2012. "Embedding Leadership into Professional, Regulatory and Educational Standards." *International Journal of Clinical Leadership* 17: 245–250.

McCauley, C.D., and E. Van Velsor. 2004. *The Center for Creative Leadership Handbook of Leadership Development*. Vol. 29. New York: John Wiley & Sons.

Mento, A.J., R. M. Jones, and W. Dirndorfer. 2002. "A Change in Management Process: Grounded in Both Theory and Practice." *Journal of Change Management* 3 (1): 45–59.

Nadler, D., and M. B. Nadle. 1998. *Champions of Change: How CEOs and their Companies are Mastering the Skills of Radical Change*. 1st ed. The Jossey–Bass Business & Management Series. San Francisco: Jossey–Bass Publishers.

Naghavi, M., and M. H. Forouzanfar. 2013. "Burden of Non-Communicable Diseases in sub-Saharan Africa in 1990 and 2010: Global Burden of Diseases, Injuries, and Risk Factors Study 2010." *The Lancet* 381: S95.

New Partnership for Africa's Development (NEPAD). 2015. *Capacity Development for CAADP Country Teams: Building Coalitions and Networks for Agricultural Transformation – Guidance Notes*. Midrand, South Africa: NEPAD.

Nisbett, N., E. Wach, L. Haddad, and S. El Arifeem. 2015. "What Drives and Constrains Effective Leadership In Tackling Child Undernutrition? Findings from Bangladesh, Ethiopia, India and Kenya." *Food Policy* 53: 33–45.

Northouse, P.G. 2010. *Leadership: Theory and Practice*. 5th ed. Thousand Oaks: Sage Publications.

Pelletier, D. 2003. "Narrative Themes How Nutrition Policies Change: Lessons from the Promotion and Use of the UNICEF Conceptual Framework." In *Combating Malnutrition: Time to Act*, edited by S. Gillespie, M. McLachlan, and R. Shrimpton. Washington, DC: World Bank.

Pelletier, D., K. Deneke, Y. Kidane, B. Haile, and F. Negussie. 1995. "The Food-First Bias and Nutrition Policy: Lessons from Ethiopia." *Food Policy* 20 (4): 279–298.

Pelletier, D., S. Gervais, H. Hafeez–ur–Rehman, D. Sanou, and J. Tumwine. 2015. "Building and Strengthening Multisectoral Nutrition Systems: Experiences and Lessons from the African Nutrition Security Partnership." Presented at the final meeting of the ANSP, Kampala, October 27.

Pendlebury, J., B. T. Grouard, and F. Meston. 1998. *The Ten Keys to Successful Change Management*. Chichester: New York: Wiley.

PLAN (Le Programme de Leadership Africain en Nutrition). 2015. *Le Programme de Leadership Africain en Nutrition*. Accessed May 2016. www.plan-francophone.com/index.php/presentation.

Scaling Up Nutrition Movement (SUN). 2014. *Scaling Up Nutrition: In Practice. Effectively Engaging Multiple Stakeholders*. Accessed May 2016. http://scalingupnutrition.org/wp-content/uploads/2014/03/Sun-in-Practice-issue-1.pdf.

———. 2016. *The SUN Movement strategy 2016–2020*. Accessed May 2016. http://scalingupnutrition.org/.

Schneider, S. K., and W. M. George, 2011. "Servant Leadership versus Transformational Leadership in Voluntary Service Organizations." *Leadership and Organization Development Journal* 32 (1): 60–77.

Shrimpton, R., L. M. DuPlessis, H. Delisle, S. Blaney, S. J. Atwood, D. Sanders, B. Margetts, and R. Hughes. 2016. "Public Health Nutrition Capacity: Assuring the Quality of Workforce Preparation for Scaling Up Nutrition Programmes." *Public Health Nutrition* 1: 1–11.

Sunguya, B. F., K. Poudel, L. Mlunde, D. Urassa, J. Yasuoka, and M. Jimba. 2013. "Nutrition Training Improves Health Workers' Nutrition Knowledge and Competence to Manage Child Undernutrition: A Systematic Review." *Frontiers in Public Health* 1: 37–37.

Taffinder, P. 1998. *Big Change: A Route–Map for Corporate Transformation*. Chichester; New York: John Wiley & Sons.

Trübswasser, U., C. Nishida, K. Engesveen, and F. Coulibaly-Zerbo. 2012. "Landscape Analysis – Assessing Countries' Readiness to Scale Up Nutrition Actions in the WHO African Region." *African Journal of Food, Agriculture, Nutrition and Development* 12 (4): 6260–6273.

UNICEF. 1991. *Strategy for Improved Nutrition of Children and Women in Developing Countries: A UNICEF Policy Review*. New York: UNICEF.

Velez, J. J., L. L. Moore, J. A. Bruce, and C. A. Stephens. 2014. "Agricultural Leadership Education: Past History, Present Reality, and Future Directions." *Journal of Leadership Studies* 7 (4): 65–70.

Wahlqvist, M. L., D. Li, J. Q. Sun, K. Ge, H. Y. Paik, S. H. Cho, S. K. Lee, C. J. Huang, and M. S. Lee. 2008. "Nutrition Leadership Training in North–East Asia: An IUNS Initiative in Conjunction with Nutrition Societies in the Region." *Asia Pacific Journal of Clinical Nutrition* 17 (4): 672–682.

World Health Organization. 2012. *Assessing National Capacity for the Prevention and Control of Noncommunicable Diseases: Report of the 2010 Global Survey*. Geneva.

———. 2013. *Global Action Plan for the Prevention of Noncommunicable Diseases 2013–2020*. Geneva.

———. 2014. *Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition*. Geneva.

Chapter 12

AfDB (African Development Bank). 2016. Data Portal. (http://dataportal.afdb.org/default.aspx) [Accessed July 20, 2016]

African Union Commission and the NEPAD Planning and Coordinating Agency (AUC and NPCA). 2015. *The CAADP Results Framework 2015–2025*. Midrand, South Africa: NPCA.

Benin, S. 2016. *Impacts of CAADP on Africa's Agricultural-Led Development*. IFPRI Discussion Paper 1553. Washington, DC: International Food Policy Research Institute

Benin, S., M. Johnson, and B. Omilola. 2010. *Monitoring and Evaluation (M&E) System for the Comprehensive African Agriculture Development Program (CAADP)*. ReSAKSS Working Paper 6. Washington, DC: International Food Policy Research Institute.

FAO (Food and Agriculture Organization of the United Nations). 2016. FAOSTAT. http://faostat3.fao.org/.

IFPRI (International Food Policy Research Institute). 2016. Statistics on public expenditures for economic development (SPEED). [Accessed July 20, 2016]

OECD (Organisation for Economic Co-operation and Development). 2016. Creditor Reporting System (CRS). http://stats.oecd.org/index.aspx?DataSetCode=CRS1.

ILO (International Labor Organization). 2016. Statistics and Databases. http://ilo.org/global/statistics-and-databases/lang--en/index.htm.

NEPAD. 2015. Countries with Compacts /Investment Plans – Nov 2015. http://www.nepad-caadp.net/sites/default/files/CountryTable/Countries%20with%20Compacts%20%26%20Investment%20Plans%20%20Nov%202015.pdf [Accessed on 20 Aug 2015].

UNCTAD (United Nations Conference on Trade and Development). 2016. UNCTADSTAT. http://unctad.org/en/Pages/statistics.aspx.

World Bank. 2016. World Development Indicators (WDI). http://data.worldbank.org/data-catalog/world-development-indicators.

Chapter 13

Pinstrup-Anderson, P., and D. Watson. 2011. *Food Policy in Developing Countries: The Role of Government in Global, National, and Local Food Systems*. Ithaca, NY: Cornell University Press.

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ISBN: 978-0-89629-593-3