The Challenge of Meeting Future Demand for Food

The world’s population, at 7 billion people today, is expected to reach 9 billion by 2050 and may exceed 10 billion by the end of the century. The vast majority of this growth will occur in developing countries, especially in South Asia and sub-Saharan Africa, regions already too familiar with chronic hunger. Much of the expansion will also occur in urban areas, where most people buy food, not grow it.

Meeting the food needs of billions will not be easy. We must at once work together to enable farmers around the world to produce higher yields—and get those crops to market efficiently—while also tending to a fragile environment and conserving the valuable resources of land and water.

As the world’s largest producer, exporter, and donor of food, the U.S. can and will play a significant role in meeting this challenge, through continued exports, through agribusiness investments, and as a source of technological innovation and financial capital. America’s strategic interest in ensuring that a growing world population has enough to eat is a strong one. The route from hunger and poverty to political turmoil can be a direct one.

Imports from surplus-producing countries like the U.S. will always be critical for those countries that cannot grow enough to meet their own needs (Figure 1). Where countries can increase their own production, this will provide the most reliable boost to both rural incomes and food supply. Most food consumed in the world is grown locally. Therefore, developing countries must grow more food, grow it more efficiently, and significantly reduce post-harvest losses. More smallholder farmers must grow food not only to feed their own families, but to feed others, and in selling to others pull themselves out of poverty.

Historically, the United States has been a leading source of agricultural knowledge and innovation, grain and other agricultural exports, agricultural development assistance, and food aid. Looking at the expected food needs of 9 billion people, we must ask once again: What role will the U.S. play in meeting this future demand? Is the U.S. making the public and private agricultural research investments necessary to be a source of innovation appropriate for the systems and challenges in food-insecure regions?

Will it maintain its commitment to addressing hunger around the world in a period of increasingly tight budgets? How might the U.S. best enable the transfer of knowledge and technology to smallholder farmers, agribusinesses, and emerging food systems? Can the U.S. play a leading role in developing agricultural systems that produce significantly more while leaving a smaller environmental footprint?

With a changing landscape of production, trade, and consumer demand, the role of U.S. agriculture will necessarily evolve. To shape this role most effectively, changes must begin now. Feeding 9 billion people will continue to require U.S. leadership, but in what form?
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How Much More Food Will Be Needed?

A key question in preparing for the growing demand is, how much more food will we need to produce? The question is difficult to answer precisely, and estimates are hard to pin down, but we will likely need to increase food production by 50 to 100 percent to support this growing and changing population.³

Some skepticism is warranted regarding all such estimates, given researchers’ poor track record in estimating demand and supply of the major food crops. Until 2005, nearly all of the widely used models predicted that the real price of major grains and oilseeds would remain constant or fall in the foreseeable future. That didn’t happen. The models missed the mark for at least four reasons:

1) They underestimated the rate of growth in economic development of the world’s most populous countries,
2) They overestimated the rate of yield gain for the world’s most important food crops,
3) They failed to foresee the rapid rise in energy prices and the resulting diversion of food crops for biofuels, and
4) The estimates ultimately depend on policy choices that are themselves influenced by the models.

As a result of these prediction misses and policy failures, developing and developed countries misdirected both research and investments. Analyzing what went wrong in the recent past is an important starting point in assessing how to meet global food demand in the future.

Part of the uncertainty about future needs is forecasting what diets will look like in the future, which will depend on rates of economic growth as well as personal and policy choices. As populations grow, so too grows the middle class, and with this growth comes changing demands for food. A growing middle class will want different, and often more resource-intensive, food, such as more processed foods, meat and other animal products, and fruits and vegetables.¹ Today, about one-third of global cereal production becomes animal feed, which then becomes eggs, dairy products, and meat.² The costs of “converting” the feed into meat and dairy products varies, but the bottom line is that the world will face increased pressure on cropland, fossil fuel energy, and water.⁶

Research and Education Are Linchpins of Increased Productivity

To increase productivity and yield, we need advanced research and outreach. Developing new technologies must go hand in hand with education and extension services to share improved production practices and technologies with farmers. To be effective, technologies must be appropriate to place and people, recognizing the unique characteristics of growing regions, cultures, and economic and political conditions. And local production is key. As Figure 2 shows, about 85 percent of food is eaten in the same country in which it is grown. Only a
small proportion of food is traded internationally or provided as food aid.

Estimates are that global average yield growth in the major cereals must accelerate to 1.75 percent per year, even in the face of climate change and weather fluctuations, in order to spare vast tracts of currently uncultivated lands from being put into agricultural production. Putting that much into production could cause serious environmental problems, from habitat and biodiversity loss to greenhouse gas emissions.7

But danger signs are looming. For years, yields had been increasing for the world’s three major cereals (maize, rice, and wheat). But beginning in the mid-1990s, the pace of yield gains began to slow, from about 2.9 percent in 1966 to 1.3 percent in 2006.8 This slowdown of yield growth is compounded in Africa and Asia by lower yields overall. Agricultural yields in Africa and Asia are low by global standards, only one-third those of the highest-income nations.9 Lower yields generally result from technical, policy, and economic factors that constrain access to land, water, nutrients, high-quality genetic material, extension services, storage facilities, transportation infrastructure, finance, and markets.10

In countries where most crops have not yet reached 70 to 80 percent of their biological yield potential (the point at which yield growth rates often begin to decline), public investment in research, education, and extension can result in sizable improvements.11

Helping farmers in developing countries increase yields will be the most important strategy to meet growing demand. Increasing yields is particularly important to farmers in sub-Saharan Africa and South Asia, where the gap between current and potential yields is large. And this must all be done using techniques and technologies that conserve soil, water, and habitat and that avoid negative impacts on public health.

The United States can provide research, education, and technical assistance to help developing countries grow more food. U.S. agriculture can also increase its own productivity and spur technological innovations more broadly by strengthening its domestic research efforts to feed a growing domestic population and export food to those countries unable to grow enough themselves. Investing in R&D is a powerful strategy for economic development. Agricultural research investments consistently generate average annual rates of return across the economy of 30 percent to 75 percent.12 Moreover, given that most of the poor in developing countries live in rural areas and derive significant income from agriculture, growth in agriculture is two to three times as effective in reducing poverty as growth in other sectors, making agricultural investment especially “pro-poor,” development that ensures the poor benefit as well.13

Although investments in research have been on the wane in recent decades, recent signs suggest investment in the development of agriculture in low-income countries has begun to rise.14 In 2009, the U.S. government launched “Feed the Future” to allocate additional resources and better align efforts across government departments and donors. The program (www.feedthefuture.gov) focuses explicitly on nutrition and agricultural development, which are in many, if not most, countries central to pro-poor economic progress. Feed the Future, which acknowledges that agricultural development does not automatically result in nutritional benefits, has made explicit programmatic links that help translate agricultural productivity into food security and nutritional improvement.

It should not be forgotten that although most food is consumed in the country where it is produced, not all countries can grow enough food to support their populations. In countries without fertile soil or that face harsh growing conditions, trade—often in the form of imported food from the United States and other surplus-producing countries—is a lifeline. Therefore, as demand continues to grow, U.S. agricultural productivity must also keep pace. R&D at home is needed as well.
Meeting the Challenge:  
On the Ground in Uganda

In eastern Uganda, Katie Saram worked alone, cultivating a small plot of land using traditional methods. Like other Ugandan women, she balanced farming with caring for her children, hauling water, and preparing food. The hectare of land she was able to farm was barely enough to sustain her family.

Despite its harsh conditions, Uganda's agricultural potential is tremendous. The land is fertile, the climate is mild, there is enough rain for two growing seasons, and nearby markets are nowhere near saturated.

Five years ago, Saram heard about a Ugandan NGO – supported by a U.S.-based development NGO – that was helping smallholder farmers form farmer groups, grow better crops, reduce post-harvest waste, and sell their surplus. Saram signed up and was soon learning new techniques, such as proper spacing and weeding of crops, how to cultivate better varieties of vegetables, and how to use simple technologies such as maize cribs and elevated cassava-drying racks to reduce post-harvest losses. She also now grows vitamin A-rich foods in her kitchen garden to improve her children's health.

Today Saram no longer farms in isolation. As the contact farmer for her group, she—and her farm—serve as a model of good farming, health, and hygiene. Her farm now has a pit latrine, shower, and tippy tap (a simple device for washing hands), which reduce the risk of diarrhea, typhoid, and cholera.

It is these basic, yet needed, adjustments—learned through exchange and education between farmers—that producers around the world will need to make if they are to move from growing barely enough for themselves to growing enough to help feed 9 billion people in the near future.

Adapted from ACDI/VOCA success story, Female Farmers Gain Knowledge, Respect in Uganda,  
http://www.acdivoca.org/site/ID/ugandaKatieSaram

photo courtesy of ACDI/VOCA
Water Scarcity and Climate Variability Add to the Challenge

Climate change is expected to have a disproportionate impact precisely on those regions where demand growth is expected to be greatest and the capacity to adapt the weakest. Climate change is predicted to affect precipitation rates and patterns, resulting in both more droughts and increased catastrophic flooding in various parts of the world. Sub-Saharan Africa is particularly vulnerable, as 95 percent of its crop production area relies entirely on rainfall. Climate change also is expected to affect temperature, growing season, soil moisture levels, rates of pest invasion, and other critical agricultural production factors. A central objective of agricultural research, extension, and education, as well as rural credit systems, must be to help farmers and producers successfully adapt to changing conditions.

Fluctuating temperatures, variable rainfall, and changing seasonal patterns elevate risk for farmers. Recent innovations in commercially viable index insurance may offer new opportunities to reduce reliance on government-funded risk management mechanisms. Nonetheless, much of the necessary adaptation will come in farming and natural resources management practices as well as in crop and livestock genetic material. Agricultural strategies, such as new seed varieties, technologies, and innovative practices, as well as greater diversity of crops, are needed to increase resilience to variability in weather, pathogen and pest pressures, and market fluctuations.

As crops fail or yield declines because of hotter or colder growing conditions or changing precipitation patterns, a pernicious feedback loop begins when food availability fails to meet demand. Food prices rise as a result. With crops more valuable, the incentive is great to convert carbon-rich rainforests, wetlands, and grasslands to crop and livestock production. This only accelerates greenhouse gas emissions, aggravating climate change and putting further pressure on agriculture. Land use change currently accounts for about one-third of human-caused CO₂ emissions.

Farmers also must have access to water, but in many regions of the world water is scarce. Nearly half a billion people around the world currently suffer from water shortages, and by 2025, it is estimated that two out of every three people will live in water-stressed areas. Climate change may further exacerbate water scarcity by altering rainfall patterns and the availability of water resources. Irrigated agriculture is the dominant user of water, accounting for approximately 70 percent of global water use and 80 percent of water consumption in the United States. Irrigation has helped boost agricultural yields and has been a critical component in increased food production in the past 50 years. However, with increasing water scarcity, agriculture will compete with other sectors seeking water, which may affect producers’ ability to provide food security for a growing population.

New technologies may help alleviate the pressures. Modernized storage and water delivery infrastructure, high-efficiency irrigation, water reuse/storage, atmospheric water harvest, and desalination of ocean and brackish water are all possibilities to address water shortages.

Significant investments in research, technology development, education, and extension appropriate to place and people will be needed to assist farmers around the world in producing food under changing climatic conditions and in conditions of water scarcity—and to avoid the need for emergency food aid. However, even with significant progress, we can anticipate that droughts, floods, pests, and other natural disasters that disrupt food supplies, as well as economic variability and military conflict, will necessitate emergency food aid from time to time. The United States is the largest provider of donated food to developing countries. To avoid being counterproductive in the long term, emergency food aid must be provided in a manner that avoids distorting local markets and undermining productivity gains in developing countries.
A Kink in the Chain: Post-Harvest Waste and Poor Market Access

Reducing post-harvest waste is another crucial element in meeting the challenge of feeding 9 billion people. Although there are few reliable estimates of the magnitude of food lost between harvest and consumption, experts believe the volumes are huge: 15 percent to 50 percent worldwide. In the high-income countries, most losses are at retail and post-consumer waste stages. Indeed, developed countries waste as much food as sub-Saharan Africa produces. In addition to this waste, increasing amounts of potential food and animal feed are being diverted to produce biofuels.

In the developing world, post-harvest losses occur primarily on the farm, often because poor infrastructure inhibits the farmer's ability to get the harvest or animals to market. Significant losses also occur on farms from pests, disease and poor storage. These losses are also closely linked to food safety concerns related to biochemical contamination – by mycotoxins, for example. In large parts of Africa, how food is stored can expose it to moisture, which contributes to the development of aflatoxins.

Reducing post-harvest waste will require strengthening regional food systems by improving physical transport and communications infrastructure, as well as by making institutional improvements in grades, standards, and contracting arrangements. Reducing administrative barriers to intra-regional and international trade will also help. A further benefit of better market chains and regional food systems is the improved flow of surpluses to areas of need—a major challenge in many countries with high rates of food insecurity. More cost-effective delivery of high-quality, low-priced foods to consumers can help smallholder farmers raise their standard of living as well.

Ensuring that supply lines are open, ensuring that farmers have appropriate implements and access to seeds and fertilizer, and providing access to markets are all critical to success. Ultimately, improving infrastructure can help promote both intra-national and international market integration. Unless the necessary infrastructure is in place, even a top producer will fail; and productivity will be a moot point.

International Trade Will Continue to Fill a Need

Even though domestic production is and will remain the workhorse in meeting food demand globally, international trade is vital. Trade helps meet sudden and unexpected food demand and supply imbalances. It provides staples to countries that do not have the natural resource base to produce enough to meet their needs. Trade creates opportunities for economic development through exports of cash crops, drives increases in efficiency and productivity, and provides access for consumers around the world to the full diversity of foods grown globally.
The poor in low-income countries spend a large share of their incomes on food, typically buying the cheapest available staples to make ends meet. When a price shock hits, they have little capacity to substitute among commodities. Even in countries where the majority of the population is rural and in farming, the poor tend to be “net purchasers” of food; that is, they are not currently in a position to benefit from higher prices. Rather, the combination of higher prices and the large share of food in their total budget reduces their purchasing power, driving more families into poverty.31

For more than a century, the cost of basic food commodities had been declining steadily with rising productivity.32 But this trend reversed itself recently owing to the convergence of several factors: demand for food crops, rising energy costs, growing global population, changing diets and rising affluence in historically poor countries, and nonfood uses such as fuel.33 On top of these higher prices came two severe price shocks in the late 2000s and early 2010s, which hurt low-income consumers in particular.34 Global and local trade (imports and exports) play a key role in stabilizing national food supplies, and the United States plays a central role in that process and will likely remain a prime source of agricultural products, food, food aid, and agricultural technologies for the world.35

Looking ahead, as global demand continues to grow and the impacts of climate change on agriculture are felt in many regions, cross-border trade in food will have an important role to play in creating more stable and resilient international food markets. The trading system will have to address politically difficult new issues such as the need for discipline on export restrictions. During the 2007-2008 food price crisis, more than 40 countries around the world rushed to curtail or completely close down exports of food commodities as they struggled with the crisis, further narrowing markets and driving prices still higher.36 Food surpluses in some countries were unable to reach hungry people just a border away. In a situation of overall higher prices and increased volatility, a transparent, predictable, and rules-based system governing trade in agriculture will only become more important. Policy will also need to catch up with rapidly unfolding innovations in markets, such as the adoption by major food companies of ever-more-integrated global supply chains.

### Obstacles and Opportunities to Meet the Challenge

The challenge of feeding 9 billion people is not an easy one. Several obstacles remain to be bridged, ranging from political to institutional to scientific. Yet the obstacles, while significant, also point to opportunities to address the issues. In that spirit, we outline below some of the issues and obstacles that have prevented us from moving forward in meeting these challenges, and the opportunities they present for coming together to solve them. The obstacles underscore why this challenge is difficult, but not insolvable.

#### Current investments in R&D are misplaced and inadequate.

The institutional capacity for agricultural research and development should be strengthened and priorities shifted. For example, a major priority for R&D efforts should be developing technologies and production systems that enable significant intensification of production while conserving and enhancing soil, water, and habitat. Production systems must be developed and adapted for long-term productivity under the specific ecological and social conditions of those regions with lagging yields, such as sub-Saharan Africa and south Asia. And we need to better understand how climate and ecological conditions are likely to change, the impacts on agriculture, and effective strategies for adaptation. R&D efforts should be targeted within countries as well as regionally and internationally. In addition, more public and private-sector investments are needed to develop and affordably transfer agricultural production and processing technologies. Effective extension programs are critical, as are strong educational institutions to train agricultural scientists. Key public institutions and private-sector firms in this effort should include life sciences firms, U.S.-based research institutes, universities, and development NGOs. In addition, U.S. policy places a disproportionate emphasis in its foreign
assistance portfolio on food aid; more focus is needed on aid for agricultural development.\textsuperscript{37}

Initial steps in this direction include recent reforms to and expansion of the National Science Foundation, the U.S. Department of Agriculture, and USAID programs for competitively funded research on international agriculture. Their impacts must be monitored going forward. The Obama administration’s Feed the Future initiative is a step in the right direction, but much more remains to be done to leverage necessary private capital and philanthropic dollars. Foreign assistance policies have also grown increasingly decentralized and incoherent, and as a result too often work at cross-purposes. They beg for strategic reconciliation into a coherent whole.

**Policies can impede development.** Policies that impede agricultural development assistance are often shortsighted; agricultural development is vital to the development of poor countries’ economies. When these economies grow, demand for U.S. exports usually increases, including for agricultural products. Yet the Bumpers Amendment, an annual provision in the foreign operations appropriations bill since 1986, sharply limits the U.S. government’s ability to use foreign assistance to support agricultural development in developing countries. Although it was revised in 2011 to exempt the lowest income countries\textsuperscript{38} from the restrictions, it remains an obstacle to technology transfer.

The U.S. government can also promote and support environments conducive to private-sector agricultural development, entrepreneurship, and the formation of public-private partnerships. Policies, for example, could target business regulations, governance, rule of law, property rights, farmers’ access to market information, and transportation networks. The United States can further support agricultural productivity in low-income countries through targeted technical assistance, including farmer-to-farmer programs.

**Credit is often limited for small farmers.** Greater productivity will also require adequate and equitable access to credit for producers and others in the agriculture chain. Currently, access to credit is most limited in those very countries where productivity growth is most vital. Foreign, direct investment in those markets can result in both attractive returns for U.S. investors and agricultural productivity gains in the target countries. Of course, the investments must recognize and fairly reward pre-existing (and sometimes informal) property rights in land and water. Capital scarcity is compounded in some cases by insecure land rights and other legal and institutional obstacles that discourage both domestic and foreign investors.

**Scientific evidence on agricultural systems is insufficient.** Without better evidence for the relative merits of various strategies for agricultural intensification, formulating new policies will be challenging. We need to know more about how best to use land and water to accelerate yield growth and improve resilience in the face of climate variability and other stresses on critical natural resources. We must balance this with efforts to reduce agriculture’s environmental impacts.\textsuperscript{39}

We also need to know more and share more about what makes agricultural systems resilient and what strategies might be effective in promoting resilience to market fluctuations and to variability in weather and in pathogens and pests.\textsuperscript{40} Some evidence suggests that diversity may be an important factor in resilience, but the science remains unsettled as to the optimal scale at which diversification should occur: plot versus farm versus landscape. The science is also unsettled about
how much diversification is required and its effects on land use.

We also need better information on how various technologies, agricultural system designs, and policy options fare across multiple policy objectives (i.e., increasing production and reducing environmental impact). In particular, we must expand our understanding of when and in which context to promote one or another approach, such as reduced or no tillage, precision agriculture, the use of transgenic crop cultivars, and/or agroecological approaches. A recent U.S. National Academy of Sciences report identified numerous examples of innovative, more diverse farming systems that contribute to sustainability goals and show promise for more widespread development. These systems include conservation agriculture, agroforestry, organic farming, integrated (hybrid organic/conventional), alternative livestock production (e.g., grass-fed), and mixed crop/livestock systems.

**Agricultural production is too often at odds with environmental protection.** We need better methods and incentives to conserve and enhance the full range of natural resources on which agricultural production depends. Traditionally, we have focused more often on improving plant cultivars and livestock breeds than on managing natural resources in agriculture. As natural resource scarcity imposes greater constraints on agricultural productivity and risk, more work on integrated approaches will be needed. This will require prioritizing strategies and ensuring that investments in production, conservation, and resilience complement one another.

**Food aid could be more effective.** Food aid was developed initially as a surplus disposal mechanism in support of domestic U.S. farming and shipping communities, with a secondary objective of addressing the needs of poor countries. Yet certain policies that secure benefits to the farming and shipping communities have been widely criticized for their negative impact on the ability of U.S. food aid to satisfy emergency food needs. For example, monetization—in which commodities purchased in the United States are shipped to less developed countries and sold on the market to fund development projects—can distort markets and reduce the food’s value by one-third or more owing to price differentials between countries plus shipping and other transaction costs. Likewise, “tied sales,” that is, the requirement that U.S. food aid be purchased in the United States, also reduces cost-effectiveness. The U.S. Cargo Preference laws that require at least 75 percent of U.S. food aid be shipped on U.S. flag carriers can raise the cost of shipping by as much as 40 to 50 percent, or $150 million a year and result in shipping times that take months.

In addition to cost-effectiveness, food aid policy should deliver more targeted, nutritious foods based on the nutritional needs of the target population. The scientific evidence is clear that sufficient amounts of safe, nutritious food for mothers and infants during pregnancy and the first 1,000 days of a child’s life are critical to prevent wasting, stunting, childhood morbidity, and mortality, as well as to promote healthy growth and development.

The United States is in the process of expanding the range of foods that can be procured for food aid to include foods effective in preventing mortality from wasting in the acute phases of an emergency. This expansion should be further developed, and more should be done to target specialized nutrient-dense foods to young children and pregnant women.
Critical Issues and Questions

No single strategy or sector can meet the impending challenge of feeding 9 billion people by 2050. It will require creative and collaborative efforts among governments, farmers around the world, private companies, universities, and civil society. Meeting this challenge is our collective responsibility. We must work together to ensure that our grandchildren and great-grandchildren do not confront chronic global food crises of the sort that our grandparents so skillfully averted on our behalf.

Following are some of the critical questions1 that must be addressed for the United States to continue providing leadership in meeting the demand for food of a growing and increasingly wealthy global population:

- What is needed to increase production and reduce loss to feed at least 9 billion people in 2050 with no net increase in land or water use?

- How do we shift U.S. policy and resources to increase production abroad and dramatically reduce the need for U.S. food aid for chronically hungry populations overseas?

- What mix of agricultural systems is needed to meet expected future demand for food? To what extent can more diversified systems help meet the demand?

- Should U.S. foreign agricultural development and emergency food programs continue to include restrictions favored by U.S. producers and transporters at the expense of poor people in developing countries?

- Is the U.S. intellectual property regime inhibiting increased production in developing countries?

- How can the environmental footprint of agriculture be improved?

- How can civil society, government, and the private sector leverage their respective resources and strengths to improve productivity, ensure access to nutritious food, and sustain the environment in developing countries?

- How can we design systems that have the resilience needed to handle variability in weather, shifting climatic zones, and pathogen and pest pressures that agriculture may face in the coming decades?

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1 These questions are illustrative of the types of issues AGree will address; they are not exhaustive.
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2 Compounding the population growth effect, between 2005 and 2050 today’s low- and middle-income countries’ economies are expected to grow at an average annual rate of 5.2 percent – versus just 1.6 percent for today’s high-income countries. This will drive up their share of global income from 20 percent to 55 percent. See van der Mensbrugge, Dominique, Israel Osorio Rodarte, Andrew Burns, and John Baffes. (2009). How to Feed the World in 2050: Macroeconomic Environment, Commodity Markets – A Longer Term Outlook, produced for the Expert Meeting on How to Feed the World in 2050. Rome: Food and Agriculture Organization. However, income growth predictions are generally imprecise and contested.


5 Reijinders and Soret find that the average conversion of vegetable to animal protein is 10 to 1. For chicken production, the protein conversion efficiency is about 18 percent, for pork about 9 percent, and for beef about 6 percent See Reijinders, Lucas, and Sam Soret. (2003). Quantification of the Environmental Impact of Different Dietary Protein Sources. American Journal of Clinical Nutrition 78(suppl):664S–85. Smil finds similar rates, from 5 percent for beef to 20 percent for chicken on a protein basis. See Smil, V. (2000). Feeding the world: a challenge for the 21st Century. Cambridge, MA: MIT Press.


9 Tilman et al. (2011).


12 Alston, Babcock, and Pardey (2010). The precise return on investment is difficult to estimate due to attribution problems and temporal lags.


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18 Cassman, Grassini, and van Wart (2010).


25 Gustavsson et al. (2011).

26 Fafchamps, Marcel. (2004.) Market Institutions in Sub-Saharan Africa: Theory and Evidence. Cambridge, MA: MIT Press Book; Barrett, Christopher B. (2008), Smallholder Market Participation: Concepts and Evidence from Eastern and Southern Africa. Food Policy 33(4): 299-317. Food grades and standards describe the attributes that make individual food products safe, useful, and valuable. They can be set by government, the private sector, multilateral organizations, and non-governmental organizations, and compliance can be mandatory or voluntary, depending on the standard. A well-known example is the Codex Alimentarius Commission, a joint FAO-WHO body that has created voluntary, harmonized international food standards, guidelines, and codes of practice for the food trade. In cases where national standards are missing, or conflict exists between the standards of the exporter (or donor) and the importer (or recipient), Codex standards may be adopted. The increasing harmonization of national and international standards and the development of standards for emerging food products can help to reduce food waste by reducing trade barriers and promoting better understanding among trading partners of the food quality and safety requirements desired or demanded by the market.


36 Countries eligible for the World Bank’s International Development Association.
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44 Lenz, Barrett, & Gomez (2012) Recent studies demonstrate that the use of local and regional purchase results in more cost-effective use of food aid funds as well as timelier delivery in emergencies
