Agriculture's Role in Combating Global Hunger

Written testimony to the United States Senate Committee on Agriculture, Nutrition, and Forestry

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Introduction

As the Executive Director of the Global Child Nutrition Foundation (GCNF) and as a private citizen, I appreciate the opportunity to submit testimony to the United States Senate Agriculture Committee Hearing on the Role of Agriculture in Combating Global Hunger.

GCNF is a small 501c3 organization with a global reach and reputation. We work with country governments and a number of partner organizations and experts to support developing countries that are implementing school nutrition programs. School nutrition programs are at the nexus of agriculture and nutrition; education and health. Every issue addressed in this testimony is relevant to school nutrition, and smart investments in school nutrition constitute avenues for strengthening agriculture and local economies as well as combating hunger for this and subsequent generations.

The issue of agriculture's role in combating hunger is of keen importance to me personally, as well. From my childhood on the family centennial farm in Michigan, to my service as both a volunteer (in Niger) and staff in the United States Peace Corps and the U.S. Department of Agriculture, through a decade spent working with the United Nations World Food Program and nearly six years in the Agricultural Development section of the Bill & Melinda Gates Foundation, and now, nearly two years into working at the Global Child Nutrition Foundation, my career has been devoted to the interrelated issues of agriculture, nutrition, education, health, and the elimination of hunger.

My testimony at this hearing pulls from all these experiences, though I cannot possibly do justice to the enormous knowledge and experience housed in these entities. The assertions in this document are my own, presented in a simplified manner, with some supporting citations, but without claim that I am expert in all these areas or that each of the issues and examples provided have been exhaustively researched. It is also worth noting that much work is already going on in the areas highlighted herein. I have focused on these areas because they are so critical, in my judgment, and because I feel that a combination of new approaches and more urgency are needed.

Agriculture Must Play a Major Role in Combating Global Hunger

Agriculture—especially American agriculture—can play a major role in combating global hunger. Hunger is a scourge that has negative ramifications both for the hungry themselves and even for those far removed. The hungry suffer the direct anguish and debilitating effects (even death) for themselves and their families; those far removed from hunger also pay a price, through the costs associated with humanitarian assistance and health care as well as the toll of lost education and productivity.

The United Nations World Food Program cites six major causes of hunger: the poverty trap, lack of investment in agriculture, climate and weather, war and displacement, unstable markets,

and food wastage.[1] In fact five of those six causes (all but war and displacement) are directly linked to agriculture. It can therefore be argued that the primary solutions to hunger can also be found in agriculture.

There are moral arguments for dealing with hunger at home and abroad, but moral imperative aside, there is self-interest to consider. American interests are at stake, too. The productivity and competitiveness of American agriculture is closely linked to the issues and changing landscape of agriculture internationally; our own agriculture and the U.S. economy can benefit from progress against global hunger.

Summary Section

This report highlights and explores those issues which closely link agricultural solutions to world hunger and domestic agriculture and broader U.S. interests. The changing global landscape and additional reasons for considering new and relatively urgent strategies are also covered, followed by some actions that could be considered for addressing the issues discussed. This section summarizes the full document; the full document goes into more detail regarding the Key Issues.

Key Issues; why this is not a question of business as usual:

1. Too much food is wasted or lost in and outside the U.S.; experts estimate that a third of the food produced is not eaten. This is a triple loss: There is less food available for those who need it; the entire original investment involved in producing the food is lost; and additional investment is required to replace the amount lost or wasted.
2. Transportation is a major cost and hindrance to addressing hunger both domestically and internationally. Storage is a related challenge. Transportation and storage issues alike contribute to the huge losses described in #1., above. They also can hinder access to inputs and, thus, agricultural production.
3. Food safety threatens the food supply globally as well as for American consumers.
4. Agriculture globally—including American agriculture--does not adequately include women, despite their indisputably important roles throughout the interrelated fields of farming, water use, food handling and preparation, and family wellbeing.
5. Agriculturalists are getting old, the world around. There is a burgeoning youth population; unemployment rates for youth are very high—particularly in developing countries, but youth are not studying nor pursuing careers in farming or other agricultural fields.
6. Markets are weak or broken in key areas of the world (especially in sub-Saharan Africa), resulting in limited access and few incentives for farmers to invest and produce commodities in additional quantities and of higher quality; adoption of improved seed

[1] http://www.wfp.org/stories/what-causes-hunger "What Causes Hunger", United Nations World Food Program (WFP), November 2013

varieties and better farming and post-harvest techniques remain low in the poorest countries of the world.

7. There are crop and animal diseases and pests which—left unchecked and unstudied—threaten the world's and the United States' food supply.
8. Agriculture and nutrition goals and programs are not in sync.
9. The protection of biodiversity and the exploration of plants and animals currently unfamiliar to those outside their indigenous communities are critical to food security.
10. Agriculture affects health and health affects agriculture, but the two sectors work in silos.

Other relevant developments affecting agriculture and global hunger reduction:

A. Investment and developments in agricultural science in China, Brazil, India, and elsewhere have been growing and becoming more sophisticated.
B. Population growth and the buying and pricing policies and practices of middle income countries and commodity market investors are having significant impact on global food supply, prices, and movements.
C. Political and economic pressures, the technical and digital divide, conflict and displacement, and global weather patterns are challenging providers to consider the sustainability of traditional models of development assistance, food aid and humanitarian relief.
D. Better methods for dealing with challenging weather and growing conditions are needed to address domestic food security as well as global hunger.
E. The protection of biodiversity and the exploration of plants and animals currently unfamiliar to those outside their indigenous communities are critical to food security.
F. Economic growth trends in Africa are positive and projected to continue to be positive.

Possible actions to address the key issues presented

The United States Government and its partners could:

1. Address the transport issues by mobilizing private sector players such as vehicle and aircraft manufacturers and public sector actors such as USDA and the U.S. military to develop developing-country appropriate, 21st Century transportation systems to leap-frog outmoded systems through:
    a. Two new interlinking systems:
        i. Farm to aggregation point (consider containerized all-terrain vehicles to navigate from farm-to-market where there are no roads or only tracks that are vulnerable to recurring weather conditions)
        ii. Medium- to long-haul (consider containerized airships or other options to bypass the currently time-consuming, expensive, dangerous, and corrupt

trucking routes and prohibitively expensive and/or infrastructure-intensive air and sea transport systems)

b. Ensuring that the new systems are developed with their intended users and that they are "female friendly" so that they will be adopted and will not limit usage by half the population.

2. Promote proven, smallholder- and female-friendly food harvesting and (clean, secure, easy-to-use containerized) storage systems, drawing from both hard and soft sciences and ensuring that they are female friendly to ensure that they will be practical for and used by the intended populations.

3. Address food wastage and loss issues in the U.S. and other developed countries by:
    a. Educating the public regarding "sell-by" and "use-by" dates and providing guidance for the public to better understand the economics and practices of food use
    b. Clarifying and strengthening laws and rules about food donations by restaurants, grocers, processed food manufacturers, and others who currently dispose of large quantities of perfectly edible food items
    c. Developing cost-effective and/or incentives systems for the use of "Grade B" commodities (which are safe to eat, but unattractive or otherwise deemed to be of less than the highest quality)
    d. Applying fees or other disincentives for particularly egregious or repeated acts involving the waste of food products safe for use.
    e. Support for research and the development and implementation of waste- and loss-reducing measures and technologies.

4. Address food loss issues in developing countries and elsewhere by:
    a. Supporting policies and actions such as those listed in #s 1-3, above by other countries and partners
    b. Supporting the development, implementation, and enforcement of evidence-based food safety standards and control interventions (i.e., through the programs such as the joint USAID-USDA Sanitary-Phytosanitary Standards program and the Partnership for Aflatoxin Control in Africa
    c. Educating farmers and value-chain players in proper post-harvest handling techniques and about specific health threats (such as aflatoxin and other mycotoxins, E-Coli, Salmonella, and Listeria)
    d. Investing in training and professional certification (for women, especially) to perform food safety (laboratory, handling, preparation) and inspection services;

support the development of these professions via U.S. Government-funded programs, including McGovern-Dole and other food aid program

e. Encouraging first-stage processing at the local level to capture some of the value and reduce losses of perishables
f. Promote the use of second grade (blemished, ill-formed, or otherwise not "consumer attractive" but otherwise good quality) commodities in processed products, and (also in transformed state) for meals prepared for national school, military, prison, or hospital feeding programs

5. Effectively include women in agricultural and hunger-reduction programs by:
    a. Investing in programs that involve women in the design and implementation of labor-saving devices (consider programs such as the United Nations Development Program-led "Multi-Functional Platform" program which provides motorized, electricity-producing, post-harvest processing machinery and basic literacy and business training to existing women's groups far off the power grids in African countries).
    b. Encouraging development and humanitarian actors to develop and implement female-friendly and context-specific communications materials and interaction models. The use of methods such as pictography, oral messaging in local language; hands-free phone and other technologies; and safe transport, child care, and other time-conserving and responsibility-relieving means of including women are needed in order to be effective with women in developing countries (who are generally less-literate, less likely to speak an official language, and more involved in time-consuming and labor-intensive daily work then are men).
    c. Investing in programs that educate and incentivize men to support women's full participation in effective agricultural and hunger-reducing activities; expecting ongoing U.S.-funded activities to include these components.
    d. Encouraging humanitarian and development actors to find opportunities to develop new or re-configure former jobs and their titles and descriptions to prevent the positions from labels or expectations that they are closed to women.
    e. Supporting training programs such as proposed in 4.d., above that create new opportunities for women that are directly linked to agriculture and reducing hunger and malnutrition.
    f. Insisting on stringent gender-disaggregated indicators for monitoring, evaluation, reporting, and on evidence-based gender-sensitive interventions as prerequisites for project approval

6. Address the aging of agriculture and create momentum and opportunities for youth to be involved in agriculture and hunger-reducing activities, by:
    a. Investing in accelerated education and training programs targeting particular needs (such as career in farming and agricultural sciences) that incorporate

youth and early-stage professionals from both developing countries and the United States, building on the programs and networks of the following players and programs-- but speeding, improving, and ensuring their immediate relevance to developing countries' agriculture and the domestic need for strong, youthful agricultural talent:

i. 1890s and Land Grant colleges and their linkages to developing country agricultural institutions
ii. Youth program such as 4-H and FFA programs
iii. Private sector training and internship programs
iv. The Cochrane, Borlaug, Aspen and other such fellows programs
v. Private funding and programs (such as those of the MasterCard and the Bill & Melinda Gates Foundation)

b. Establishing new models of training specifically for women and supporting ongoing programs (such as the AWARD program for African female scientists), which incorporate support systems necessary for women to be able to participate.
c. Promoting agriculture and agricultural careers in modern and effective ways, and to a broader set of audiences (i.e., using social media, reaching beyond rural audiences, involving economic arguments, demonstrating the need for cutting edge innovation, etc.)

7. Support activities to engage developing country smallholder farmers in markets and off-farm employment (where relevant), and delve into understanding and addressing the issue of low adoption rates by:
    a. Supporting well-designed local and regional purchase programs such as the World Food Program's (WFP's) "Patient Procurement Platform" in collaboration with large private sector commodity buyers and "home-grown school feeding" programs. These are programs that are specifically structured to patiently work within developing country contexts to ensure that smallholder farmers can learn to access and produce for large-scale markets. These efforts build on the experiences and lessons of:
        i. The pilot Purchase for Progress ("P4P") program funded by the Howard G. Buffet and Bill & Melinda Gates foundations and donor governments and implemented by WFP
        ii. The U.S. Government's pilot Local and Regional Purchase programs implemented by USDA and USAID
        iii. "Home-grown" school feeding activities supported by the Millennium Development Project's Hunger and Education and Gender Task Forces, New Partnership for Africa's Development (NEPAD), the Global Child Nutrition Foundation (GCNF), the Partnership for Child at Imperial

College, WFP, the Government of Brazil, more than ten African governments, and others

iv. The experiences of public procurement programs with specific rural development goals, such those implemented in the U.S. (Farm to School, for example), Brazil, Scotland, and elsewhere

b. Supporting 21st Century knowledge exchange/extension activities that involve meaningful two-way communication between farmers and technical resources; providing incentives for listening, learning, and effective gender inclusion as well as rewarding solutions and adoption

8. Understand, prevent, control or eradicate crop and animal diseases, pests, and threats which—left unchecked and unstudied—threaten the world's and the United States' food supply, by continuing to do what is already done well and by:
    a. Working with international organizations and partners to improve early warning and—especially—early-investment systems to detect and counter threats earlier--upon detection of the problem whenever possible
    b. Mobilizing unique U.S. laboratories and expertise to address outbreaks and potential problems internationally, even if they do not seem likely to directly threaten U.S. agriculture. This can help to ensure relationships and access regarding issues that can unexpectedly become problems for the U.S. and for other issues which are of domestic concern
    c. Investing in strengthening the capacity to study diseases and pests outside of the U.S. so that the problems can be studied in situ and mitigate the need for importing or transporting hazardous material across borders in order to conduct credible research
    d. Learning from and sharing lessons with the human health community (e.g., learning from the experience with Ebola in West Africa)

9. Align agriculture and nutrition goals and programs through:
    a. Prioritizing programs and projects which demonstrate concrete linkages between the sectors, such as research and other activities which:
        i. Support the production, affordability, and consumption of nutritious plants and animal products
        ii. Incorporate nutrition education
        iii. Involve obesity prevention and mitigation measures
        iv. Promote diet diversity
        v. Measure nutritional value of lesser-known edible flora and fauna and make the results known to the general public
        vi. Contribute to public understanding of the nutritional value of locally-available foods

vii. Provide tools and expertise to promote nutrition in developing countries and at home
viii. Measure nutritional impact
ix. Address the root causes of poor nutrition
x. Increase understanding of linkages between certain environmental factors (such as mycotoxins) and nutrition
xi. Support the life-cycle approach to nutrition, which goes beyond the first 1,000 days, with particular attention to the second and third thousand days and adolescent girls

b. Provide incentives for nutrition-sensitive agricultural activities and/or disincentives for activities which do not promote nutrition
c. Prioritize food safety initiatives that address problems such as aflatoxins, which have a known relationship to nutritional status

10. Protect biodiversity and support the exploration of plants and animals currently unfamiliar to those outside their indigenous communities by:
    a. Taking urgent steps to halt the loss of plant and animal species
    b. Supporting seed banks and other efforts to protect and preserve genetic materials
    c. Exploring the nutritional and commercial value of products currently unfamiliar or unexploited in the Northern & Western worlds, such as those listed in the "Lost Crops of Africa" Volumes I (Grains), II (Vegetables), and III (Fruit) and "Lost Crops of the Incas" books and initiatives[2]
    d. Encouraging small teams of young American and developing country scientists to undertake this adventurous, but significant work, with strong technical and political support and guidance
    e. Supporting local community understanding and involvement in protecting indigenous crops and animals

11. Encourage agriculturalists and health workers to collaborate in areas of mutual impact related to combating hunger through:
    a. Providing incentives for relevant activities to be jointly planned and implemented
    b. Supporting specific and relevant collaborative research
    c. Requesting reports on joint activities, learning, and progress

[2] http://www.nap.edu/catalog/2305/lost-crops-of-africa-volume-i-grains Board on Science and Technology for International Development; Office of International Affairs; Policy and Global Affairs; National Research Council, 1996-2008

d. Inspiring universities that offer both relevant health and agricultural programs to offer coordinated or integrated health and agriculture curricula and to support a subset of students to pursue double majors
e. Identify and remove obstacles that deter relevant U.S. Government agencies (i.e., USDA, USAID, HHS/CDC, etc.) from cross-sector collaboration and coordination
f. Promote humanitarian and development projects that involve on-the-ground inter-sectoral coordination

Other possible actions to strengthen agriculture's role in combating global hunger

There are additional cross-cutting issues that affect agriculture's role in combating global hunger which are less about technical subject matter and are more about relationships, bureaucracies, turf, and funding. These are issues of competition when collaboration is needed, about vested interests when objectivity is needed, and working in silos when cross-sectoral coordination is needed.

While it would require tackling some entrenched behaviors and systems, the U.S. Government could play a role in alleviating some of these dynamics which impede progress in reducing hunger. Some possible ways are:

1. Providing incentives for interagency cooperation and other good behaviors
2. Piloting programs that might change the current paradigm of competition between non-governmental actors, that encourage them to cooperate as equal partners and work from their comparative strengths
3. Instituting rewards for programs that can truly demonstrate decreased dependence on outside assistance; that the work has been completed successfully (in most cases, successful completion of the work would mean that there is no longer need for the implementing organization's presence and services to keep hunger at bay in the targeted community)
4. Creating (again on a pilot basis) some safe ways for development and humanitarian players to honestly discuss failures and challenges
5. Continuing the tradition of bipartisan support and jointly-sponsored initiatives for combating hunger

Full Report

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The United Nations World Food Program cites six major causes of hunger: the poverty trap, lack of investment in agriculture, climate and weather, war and displacement, unstable markets, and food wastage.[3] In fact five of those six causes (all but war and displacement) are directly linked to agriculture. It can therefore be argued that the primary solutions to hunger can also be found in agriculture.

There are moral arguments for dealing with hunger at home and abroad, but moral imperative aside, there is self-interest to consider. American interests are at stake, too. The productivity and competitiveness of American agriculture is closely linked to the issues and changing landscape of agriculture internationally; our own agriculture and the U.S. economy can benefit from progress against global hunger.

Some challenges related to ending global hunger are presented in the "Key Issues; why this is not a question of business as usual" section below, with a special focus on those that may not be receiving adequate attention and highlighting the close relationship between agricultural solutions to world hunger and domestic agriculture and broader U.S. interests is discussed. The "Key Issues section also highlights the changing landscape and some reasons for considering new and relatively urgent strategies. Some actions and ideas for innovation to address the Key Issues can be found in the subsequent section, "Possible Actions", followed by "Final Notes".

Key Issues; why this is not a question of business as usual

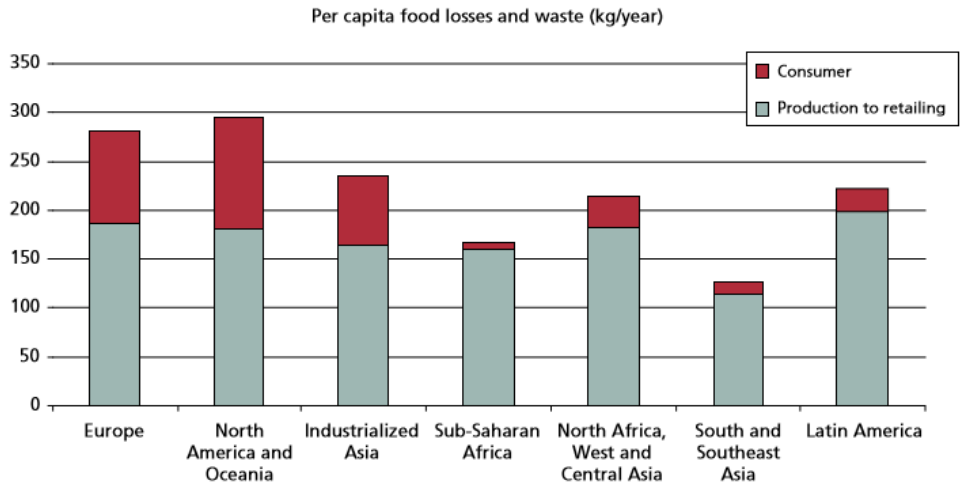
1. Too much food is wasted or lost in and outside the U.S.; experts estimate that a third of the food produced is not eaten. This is a triple loss: There is less food available for those who need it; the entire original investment involved in producing the food is lost; and additional investment is required to replace the amount lost or wasted.

[3] http://www.wfp.org/stories/what-causes-hunger "What Causes Hunger", United Nations World Food Program (WFP), November 2013

Consider:

> "Roughly one-third of the edible parts of food produced for human consumption, gets lost or wasted globally, which is about 1.3 billion ton per year. Food is wasted throughout the food supply chain, from initial agricultural production down to final household consumption. In medium- and high-income countries food is to a great extent wasted, meaning that it is thrown away even if it is still suitable for human consumption. Significant food loss and waste do, however, also occur early in the food supply chain. In low-income countries food is mainly lost during the early and middle stages of the food supply chain; much less food is wasted at the consumer level. (See chart below.)"[4]

Figure 2. Per capita food losses and waste, at consumption and pre-consumptions stages, in different regions



2. <u>Transportation is a major cost and hindrance to addressing hunger both domestically and internationally. Storage is a related challenge</u>. Transportation and storage issues alike contribute to the huge losses described in #1., above. They also can hinder access to inputs and, thus, agricultural production.

   Consider these words of Ambassador Kenneth Quinn, president of the World Food Prize Foundation:

   > "Want to make a dent in world hunger? Build better roads. Roads help farmers get their crops to market and their children to school…As we confront the greatest challenge in human history—whether we can sustainably feed the nine billion people who will be on the planet in 2050—the importance of upgrading rural roads

[4] http://www.fao.org/docrep/014/mb060e/mb060e00.htm
"Global Food Losses and Food Waste" , Food and Agriculture Organization of the United Nations (FAO), 2011

> has never been more evident, nor more in need of emphasis by global leaders. Today, road penetration in Africa is only about 35 percent. In most other parts of the world, where there are lower rates of hunger and malnutrition, road penetration is 95 percent."[5]

Landlocked countries and countries with large land areas, dispersed populations, and weak infrastructure are the most vulnerable: In the saddest of realities, transport issues—combined with other factors—have played a role in hunger occurring in one part of a country even as there is surplus in another part of the same country. Examples include, but are not limited to, Ethiopia:

> "In 2002, despite good harvests in the previous years, Ethiopia was hit by another famine: Production was insufficient, and food did not flow from surplus to deficit areas."[6]

We know that transport infrastructure is essential to economic growth, and that it is particularly important for the movement of agricultural goods and services. The large-scale investment in the interstate highway system in the U. S. in the 1950s and 1960s greatly expanded is credited with boosting U.S. productivity thereafter; China's investment in its tremendous trunk road system over the past twenty years has resulted in internal trade gains, even a reported increase of 6 percent of China's aggregate real income in 2007. [7]

Trucks, trains, ships, and planes move food around the world. But even in developed countries, time, expense, corruption, politics, and/or cross-border issues of these 20th Century mechanisms can have devastating effects. Consider:

> "[The 2014/2015 slowdown by workers in West Coast U.S. ports] has created a bottleneck at container ports along the West Coast. Chilled beef and pork, poultry, apples, frozen and dehydrated potato products, frozen vegetables, hay, forest products, Christmas trees, nuts and rice all have suffered combined sales losses in the hundreds of millions of dollars. The U.S. beef and pork industry just obtained access to South Korea's market only to lose it because of the slowdown…But even after a new contract is signed, the fallout will continue to hurt the region's agricultural exporters and the farmers who depend on them…It will take months to clear congestion at ports and restore shipments to normal, and there will be the

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[5] http://news.nationalgeographic.com/news/2014/10/141014-fight-poverty-hunger-ambassador-quinn-agriculture-environment-ngfood/ Kenneth Quinn for National Geographic, October 14, 2014

[6] http://cip.cornell.edu/DPubS?verb=Display&version=1.0&service=UI&handle=dns.gfs/1200428184&page=record Joachim von Braun, Tolulope Olofinbiyi (2007). Case Study #7-4, "Famine and Food Insecurity in Ethiopia". In: Per Pinstrup-Andersen and Fuzhi Cheng (editors), "Food Policy for Developing Countries: Case Studies." 11 pp. URL: http://cip.cornell.edu/dns.gfs/1200428184

[7] http://www.african-review.com/Vol.%204%20(2)/Ethiopia%27s%20Investment%20Prospects.pdf African Review of Economics and Finance, Vol. 4, No.2, June 2013, which cites also Fernald (1999) and Nadiri and Mamuneas (1996) regarding U.S. road construction, and Faber (2012), Roberts et al. (2010), Sahoo et al. (2010) and Banerjee et al. (2012), regarding the impact of road construction on China's economy.

long-term loss of overseas customers, said Peter Friedmann, executive director of the Agriculture Transportation Coalition."[8]

Another example is fertilizer. The quote below refers to the fertilizer market in Africa, but transport is significant portion of fertilizer cost all around the world.

> "The fertilizer market is dependent on the logistics management expertise required to move large quantities of a bulky product. Generally, freight represents the second highest portion of total cost after procurement. These costs can reach astronomical levels when the transport infrastructure is inefficient, in disrepair, or non-existent...To survive and thrive in the fertilizer industry, firms must be logistics gurus, if not magicians."[9]

3. Food safety threatens the food supply globally as well as for the American consumer.

Again, the problems are most acute in the poorest families and communities of the poorest countries:

> "Food production, processing, and marketing systems are complex. In many developing countries they are also highly fragmented and dependent upon a large number of small producers. While this may have socioeconomic benefits, as large quantities of food pass through a multitude of food handlers and middlemen, the risk of exposing food to unhygienic environments, contamination and adulteration increases. Problems occur as a result of poor post-harvest handling, processing and storage of food and also due to inadequate facilities and infrastructure such as the absence or shortage of safe water supply, electricity, storage facilities including cold stores, and transport facilities and networks, etc. Furthermore, a majority of food producers and handlers lack appropriate knowledge and expertise in the application of modern agricultural practices, food hygiene, and good food handling practices."[10]

Consider the long-neglected situation in developing countries regarding aflatoxins, for example. The following summary was prepared by this author in 2011.

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[8] http://www.capitalpress.com/Nation_World/Nation/20150205/port-slowdown-has-damaged-western-ags-export-markets "West Coast Port Slowdown has Damaged Western Ag Export Markets", by Dan Wheat, Capital Press, February 5, 2015

[9] http://www.inter-reseaux.org/IMG/pdf/IFDC__ChemonicsFertilizerSupplyandCostsinAfrica_Study_for_BMGF-2.pdf Chemonics, 2007

[10] http://www.fao.org/docrep/006/y8705e/y8705e06.htm "Assuring Food Safety and Quality: Guidelines for Strengthening National Food Control Systems", FAO, 2003

Aflatoxins are highly toxic, cancer causing fungal metabolites—very potent microscopic poisons produced by a widely disbursed family of fungi (Aspergillus) which can often be found in soil, and which can remain and thrive in food crops as they move from fields to consumers. Because of its toxicity and prevalence, aflatoxin contamination is a public health and food safety issue. Aflatoxins are considered to be one of the most potent naturally occurring toxic substances. Aflatoxins are known to cause liver disease and, in high concentrations, death in both humans and domestic animals. According to the US Center for Disease Control (CDC) about 4.5 billion people in the developing world are chronically exposed to dangerous levels of aflatoxins through diet.

Chronic dietary exposure to low doses of aflatoxins is a known risk factor for liver cancer and may also affect protein metabolism and immunity, thus worsening infectious diseases and malnutrition. A 2004 outbreak in Kenya resulted in 317 people seeking hospital treatment for symptoms of liver failure, and 125 deaths from acute poisoning. Similar events occurred in 2005 and 2008. Chronic exposure to aflatoxin is also strongly linked to immune-system suppression, increased susceptibility to diseases, and growth retardation. Children are particularly vulnerable, with exposure significantly hindering growth and resulting in micronutrient deficiencies, while newborns of exposed mothers have low birth weights.

Because of food safety concerns, aflatoxin impairs trade as contamination prevents major commodities such as groundnuts, maize, sorghum, cassava, yam chips, cotton seeds, cocoa, copra, and oils from meeting international, regional and local agricultural trade and food safety standards. Farmers suffer economically due to the loss of or lack of access to formal markets resulting from food safety concerns. In 2001, a study estimated that African food exporters lose $670 million per year by not meeting European Union safety standards alone. Contamination also wastes investments in seeds, tools, and fertilizers, as well as finance, credit, and other programs intended to boost agricultural development and trade.

The handling of contaminated products is also a safety hazard. In Africa, much of the post-harvest manual labor for smallholder farm households falls on women, meaning that they suffer disproportionately from exposure to aflatoxin.

Beyond affecting crops, aflatoxin contamination also impacts the production of healthy livestock through contaminated feed. Animal exposure causes decrease in milk and egg yields and serious illness. Aflatoxin is carried in the milk of animals that have been exposed to the toxin. Among some 200 mycotoxins identified, aflatoxins are the ones of major concern to dairy producers. When feed contaminated with aflatoxins is consumed by lactating cows, they not only can be toxic to the cow but also can appear in the milk within 24 hours… While ruminant animals such as dairy cows are more resistant to aflatoxins than non-ruminants, toxicity does occur with disastrous results. Chronic exposure to aflatoxins has caused decreased breeding herd efficiency, birth of smaller

and unhealthy calves, and more. Calves are particularly sensitive, and aflatoxins can cause noticeable reductions in milk production and appetite."[1] Similar issues are reported by the University of Kentucky and others regarding beef cattle, sheep, and swine.

Poultry also suffer from exposure to aflatoxin: "Aflatoxins have produced severe economic losses in the poultry industry, affecting ducklings, broilers, layers, turkeys, and quail. While it takes high levels to cause mortality, very low levels are detrimental if fed continuously.

Presenting at a March 2, 2011 meeting in Brussels, Dr. Sarah A. H. Olembo, Sanitary-Phytosanitary and Food Safety Technical Expert for the African Union reported "One third of all maize stores--maize is one among the major staple diets in sub-Saharan Africa--contain concentrations of aflatoxins that are higher than 20ppb, the allowable health safety limit for most countries. The effect on human health is even more exaggerated because the aflatoxin-free foods tend to be exported, whereas aflatoxin-contaminated food is retained in the local food chains."

Kenya is the most-studied example of aflatoxin contamination in Africa. A report from CDC described tests they conducted of maize flour from 20 large millers in 6 Kenyan provinces in 2010. While the majority of the millers reported taking various precautions to prevent aflatoxin contamination, CDC found 100% of the samples from four of the provinces tested above the government standard of 10ppb; in fact the median was above 20ppb in all those four provinces. Only the Rift Valley province samples showed no contamination above 10ppb; 17% of the samples from the fifth province tested at levels of 10ppb or higher. The conclusion: "Aflatoxin contamination of commercial maize flour was widespread, representing a significant source of exposure for all Kenyan residents, both urban and rural."

Aflatoxin occurrence is influenced by environmental factors (especially heat and humidity), so that the extent of contamination varies greatly within and across geographic locations, according to production practices, damage by pests, and the susceptibility of crops to fungal infestation during harvest, storage, and/or processing periods.

Because it is realized that absolute safety is never achieved, most developed countries have attempted to limit exposure to aflatoxins by imposing regulatory limits on commodities intended for use as food and feed. Aflatoxin contamination is, in general, not appropriately controlled and regulated in developing countries unless the product is exported, however. Aflatoxin contamination is particularly wide-spread and acute in Africa because of its climate, the fact that there are so many dispersed, small-scale farmers, and challenging drying and storage conditions in the region. As a result, millions of people living in sub-Saharan Africa are chronically consuming high, unsafe levels of aflatoxin through their diets.

There has been little or no investment in poor countries for developing alternative uses for contaminated products. This means that infected food supplies are not re-purposed for safe use as is often the case in developed countries: Depending on the level of contamination, and within prescribed guidelines, infected commodities can be diluted by the addition of sufficient quantities of uncontaminated product, used for ethanol production, and/or used for animal feed (especially when treated with toxin-eliminating binders). Without the knowledge and implementation of such measures in developing countries, the contaminated commodities are eaten by people or animals, or--in very rare occasions—are confiscated and/or destroyed, undermining the welfare of those concerned.

Local and regional purchase programs such as the World Food Program's Purchase for Progress (P4P) program are also undermined when contaminated crops do not meet required food safety standards. Sampling, testing, and diagnostic measures are complicated, expensive, and time-consuming. There is a lack of awareness and regulatory controls, and price differentiations rarely exist between crops that are contaminated and those which are not. These are barriers to incentivizing local control methods, and result in contaminated commodities remaining in the food chain.

According to the United Nations Food and Agriculture Organization (FAO), 25% of world food crops are affected and countries situated between the 40ºN and 40ºS are most at risk. Small producers, most often women, food consumers, and vulnerable groups, particularly young children, are hardest hit. (Citations for this summary are available on request.)

4. <u>Agriculture globally—including American agriculture—does not adequately include women, despite their indisputably important roles throughout the interrelated fields of farming, water use, food handling and preparation, and family wellbeing.</u>

Consider:

"When women are economically and socially empowered, they become a potent force for change. In rural areas of the developing world, women play a key role in running households and make major contributions to agricultural production. But the inequalities that exist between women and men make it difficult for women to fulfil their potential.

Women rarely have access to the resources that would make their work more productive and ease their heavy workload. Ultimately, it is not just women who are held back, but also their families, their communities and local economies. Rural women have many roles, and they have responsibilities and knowledge that differ from those of men. As farmers, they plant, weed and harvest food crops and tend livestock. As caretakers, they look after children and relatives, prepare meals and manage the home.

> Many women earn extra income by working as wage laborers, producing and selling vegetables, or engaging in small-scale trading and enterprises. Added to these multiple tasks, they spend long hours fetching water and collecting firewood. In developing countries in Africa, Asia and the Pacific, women typically work 12 more hours per week than men. In poor and marginal areas and…where men have been forced to migrate in search of work, women often have the sole responsibility for farming and raising the children.
>
> Despite their many responsibilities, women have significantly less access to the resources and services they need to increase their productivity and their income and ease their burden of household duties. Women are held back by lack of education, unequal property rights and limited control over resources. Labor-intensive and time-consuming activities further hinder women's ability to improve their income-earning potential. In order for poor communities to prosper and grow, women's needs and rights must be addressed."[11]

This is an economic issue, and one directly related to agricultural productivity and hunger.

> "Closing the gender gap in agriculture would generate significant gains for the agriculture sector and for society. If women had the same access to productive resources as men, they could increase yields on their farms by 20–30 percent. This could raise total agricultural output in developing countries by 2.5–4 percent.
>
> Production gains of this magnitude could reduce the number of hungry people in the world by 12–17 percent. The potential gains would vary by region depending on how many women are currently engaged in agriculture, how much production or land they control, and how wide a gender gap they face."[12]

5. <u>Agriculturalists are getting old, the world around. There is a burgeoning youth population; unemployment rates for youth are very high—particularly in developing countries, but youth are not studying nor pursuing careers in farming or other agricultural fields.</u>

   Regarding the greying of agriculture, consider the situation in the United States, where the average of American farmers was 58.3 in 2012 (see the chart below, "Average Age of Principal Operator"); a full one third were over 65. Assuming the historical trend has continued, the average age of American farmers is now over 60. The average age of African farmers is reported to be over 55 as well[13].

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[11] http://www.ifad.org/pub/factsheet/women/women_e.pdf "Women and Rural Development", International Fund for Agricultural Development (IFAD), March 2011

[12] http://www.fao.org/docrep/013/i2050e/i2082e00.pdf "The State of Food and Agriculture 2010-11", FAO

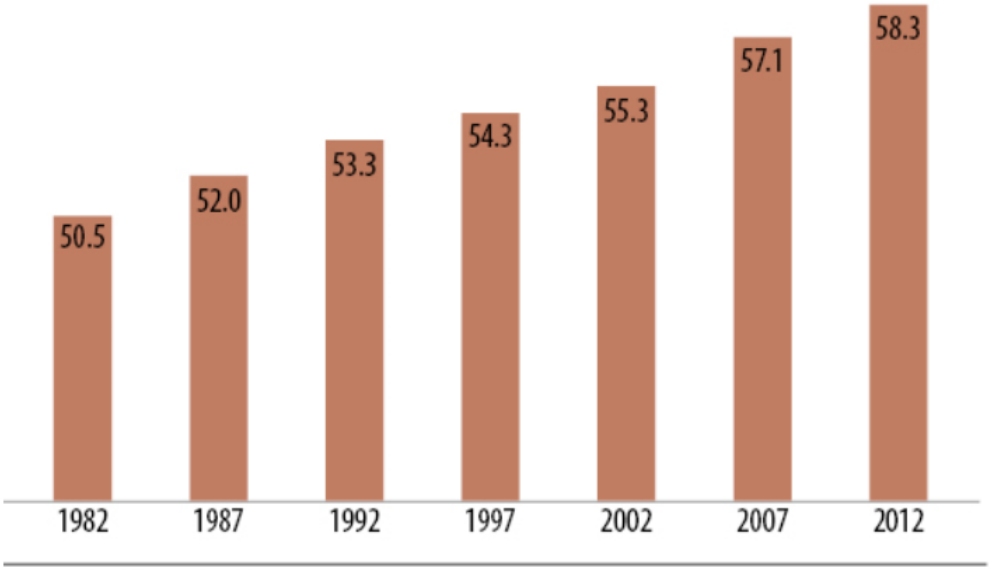
[13] http://ensia.com/voices/2014-the-year-of-family-farming/ "The Year of Family Farming", January 2, 2014

Average Age Rising

Consistent with a thirty-year trend, farmers average age continued to increase (Fig. 2). For principal operators, average age increased 2 percent between 2007 and 2012. Although second and third operators are younger, their average ages increased 4 and 3 percent respectively (Table 5). Among principal operators, 6 percent are under 35 years old, 61 percent are 35 to 64 years, and 33 percent are 65 and older. The older age groups all increased in number. (Fig. 3)

Figure 2

Average Age of Principal Operator, 1982 - 2012



Source: USDA NASS, 2012 Census of Agriculture.

Looking at the issue of age in agricultural scientist circles, the picture is equally grey (See Figures 5.1., 5.2., and 5.3. in the chart on the next page)[14]

[14] http://www.asti.cgiar.org/pdf/AfricaRegionalReport2014.pdf

FIGURE 5.1 | Distribution of public researchers by age bracket and country, 2011

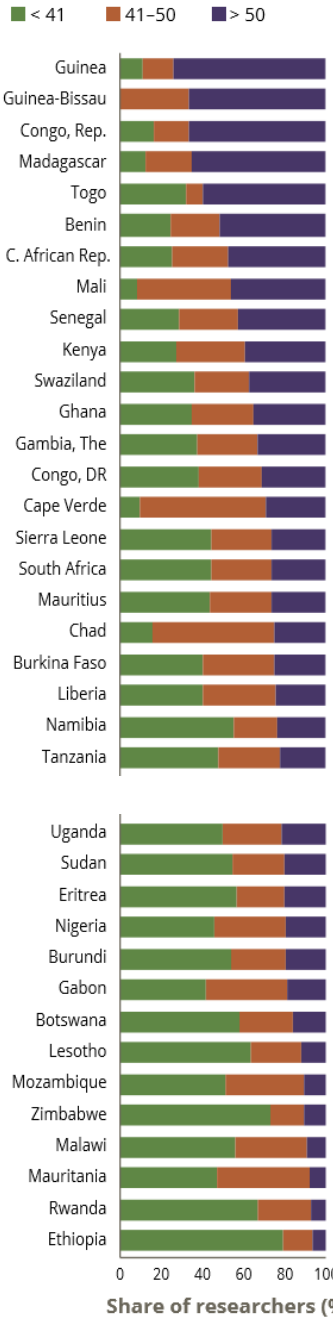


FIGURE 5.2 | Share of PhD-qualified researchers over 50 years old, 2011

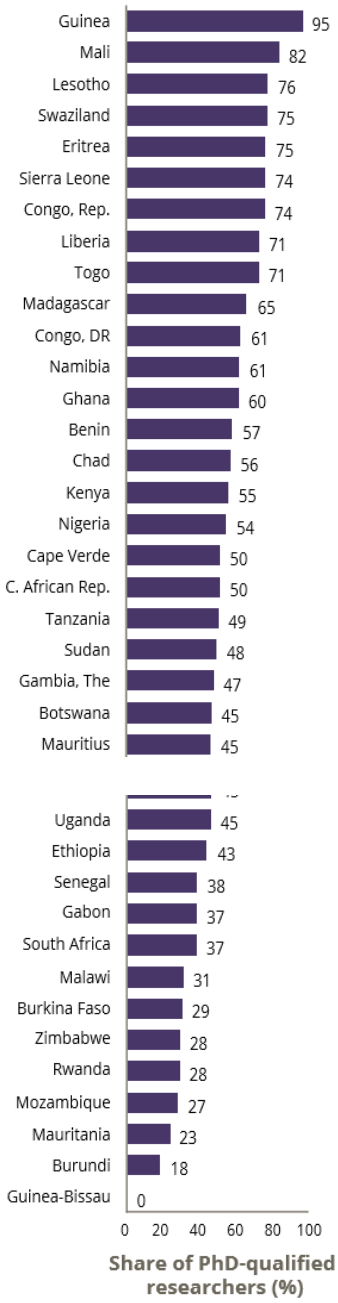


TABLE 5.1 | Official retirement age of researchers by country and sector, 2011

Country	Government	Higher education
Zambia	55	
Gabon	55	65
Chad	60	
Ethiopia	60	
Gambia, The	60	
Ghana	60	
Guinea-Bissau	60	
Lesotho	60	
Liberia	60	
Madagascar	60	
Malawi	60	
Tanzania	60	
Zimbabwe	60	
Benin	60	65
Botswana	60	65
Burundi	60	65
Congo, DR	60	65
Congo, Rep.	60	65
Namibia	60	65
Swaziland	60	65
Togo	60	65
C. African Rep.	62	64
Mozambique	60 for women/65 for men	
Burkina Faso	65	
Cape Verde	65	
Eritrea	65	
Mali	65	
Mauritania	65	
Mauritius	65	
Nigeria	65	
Rwanda	65	
Sierra Leone	65	
Sudan	65	
Guinea	65	70
Kenya	65	70
Senegal	65	70
Uganda	65	70

Sources: Constructed by authors from ASTI data.

Notes: Data for Nigeria and South Africa only include institutes under the Agricultural Research Council of Nigeria (ARCN) and the Agricultural Research Council (ARC), respectively. Data on age distribution in the higher education sector were not available for Burkina Faso, Malawi, Senegal, Sudan, and Tanzania.

Meanwhile, how many young people are there, and what are they doing?

> "With 200 million people aged between 15 and 24 (the youth bracket), Africa has the youngest population in the world. The current trend indicates that this figure will double by 2045, according to the 2012 *African Economic Outlook* report prepared by experts from the African Development Bank (AfDB), the UN Development Programme (UNDP), the UN Economic Commission for Africa (ECA) and the industrialized countries' Organization for Economic Cooperation and Development (OECD), among others.
>
> The story of Africa's worrisome youth unemployment is often told alongside the story of the continent's fast and steady economic growth. While six of the 10 fastest-growing economies in the world are in sub-Saharan Africa, the unemployment rate for that region is 6%, according to the AfDB. Compared to the world average of about 5%, its rate may not seem that high. But the problem is that in most African countries, youth unemployment "occurs at a rate more than twice that for adults," notes the AfDB.
>
> Youth account for 60% of all African unemployed, according to the World Bank. In North Africa, the youth unemployment rate is an eyebrow-raising 30%. It is even worse in Botswana, the Republic of the Congo, Senegal, South Africa and several other countries.
>
> Young women feel the sting of unemployment even more sharply. The AfDB found that in most countries in sub-Saharan Africa and all of those in North Africa, it is easier for men to get jobs than it is for women, even if they have equivalent skills and experience."[15]

A PhD in agriculture currently takes between 9 and 12 years of post-secondary school work to complete. The attainment of a PhD also requires significant amounts of money[16] and family sacrifices, as a rule. Few developing country aspirants (and almost no women) can afford the time, money, and family sacrifices required.

Furthermore, few Masters and PhDs in agricultural fields are offered by developing country universities; the technical divide is so great that very few programs anywhere turn out agriculturalists geared to addressing developing-country agricultural challenges. If they are employed in developing countries, well-trained agriculturalists are often hired into positions with development agencies or companies; if they are

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[15] http://www.un.org/africarenewal/magazine/may-2013/africa's-youth-"ticking-time-bomb"-or-opportunity "Africa's youth: Ticking time bomb or opportunity?" by Kingsley Igebhor, May 2013

[16] A quick review of MasterCard Foundation scholarships programs for undergraduate and graduate studies for African students in just two American universities (Michigan State and Arizona State) shows an average per-student cost of over $235,000. http://www.afterschoolafrica.com/7110/scholarships-in-usa-for-african-developing-countries/

employed in government institutions, they may encounter environments that are less than supportive because of the lack of infrastructure, weak management systems, inadequate compensation and other discouraging conditions.

The U.S. Agency for International Development's once robust investments in agricultural training for African agriculturalists, implemented in coordination with the U.S. Department of Agriculture and Land Grant and 1890s agricultural colleges, ground to a halt in the 1990s. Many working in the field have remarked over the years that these training programs represent one of the best investments the United States has ever made in African agriculture and African-American cooperation in agriculture. Few scholarships are currently available to developing country nationals to study agriculture, although there has been some improvement in recent years, primarily via private funding, especially from the Bill & Melinda Gates and the MasterCard foundations and their grantees and partners.

6. Markets are weak or broken in key areas of the world (especially in sub-Saharan Africa), resulting in limited access and few incentives for farmers to invest and produce commodities in additional quantities and of higher quality; adoption of improved seed varieties and better farming and post-harvest techniques remain low in the poorest countries of the world.

   Small-scale farmers are extremely vulnerable to the vagaries of weather and markets as well as the availability of communications and logistics infrastructures.

   > "… lack of participation in the markets is a common feature of small-scale farming systems worldwide and has also been identified as a constraint by Bie´nabe and Vermeulen (2011). Small farmers generally have low incomes and lack capital, and their attempts to market their products, is adversely affected by poor infrastructure and communication (Bie´nabe and Vermeulen, 2011)."[17]

   Adoption of new varieties remains a major challenge in sub-Saharan Africa. The following excerpts are from the Bill & Melinda Gate Foundation's DIIVA Project, carried out by the International Food Policy Research Institute (IFPRI)

[17] http://academicjournals.org/article/article1380899833_Berg.pdf "Socio-economic factors affecting adoption of improved agricultural practices by small scale farmers in South Africa", by J. Van den Berg School of Environmental Sciences and Development, North-West University, South Africa. August 2013

“The Consultative Group for International Agricultural Research’s (CGIAR’s) Diffusion and Impact of Improved Varieties in Africa (DIIVA) project collected data on improved crop varieties in Africa south of the Sahara. The project focused on 20 crops and 30 countries – 152 crop-country combinations, together representing over 70 percent of the region’s total agricultural production value.

The project generated three datasets:

- Scientific strength of breeding program. [Not reported in this section]
- The number and type of scientists focused on crop improvement for each country/crop combination.
- Varietal releases. [Summarized below] The number of new varieties released per country/crop combination per decade from the 1960s until the 2000s.
- Adoption. [Summarized below] Estimates of the share of area under each variety in 2009/10; where available, estimates for 1998 are also presented for the purposes of comparisons over time.

…the continued growth in area under Modern Varieties (MVs) indicates that research is continuing to provide farmers with useful technologies – and that farmers are continuing to find ways to take up these new technologies, in spite of the constraints that they face. Of course, there are crop-country combinations where adoption of MVs is still quite low – 14 of the crops are characterized by a mean adoption rate below 35%.

The DIIVA study team looked at this and found the area-weighted mean age of varieties in the field was 14 years across all crops – not much change from the earlier period. More analysis is clearly needed here to understand the causes of this. Some older ‘modern’ varieties are proving to be remarkably robust in the face of many new varieties being released – or, alternatively, recent research has not always succeeded in producing genuinely useful technologies.

The historical data on varietal release across the 20 crops approaches 3,600 entries. About 90% of these have information on the year of release. Maize leads all crops with over 1,000 entries. Rice is a distant second. Both rice and maize in ESA have benefited from multiple institutional sources of modern genetic materials. By contrast, low research intensities in pearl millet, sorghum, and cowpea in West Africa have translated into low output intensities.

About 45% of 3,194 dated entries had been released since 2000. The mid-point date for varietal release was 1998. Decade by decade, the incidence of release has increased steadily over time. Varietal output rose exponentially in maize in ESA between the 1990s and the 2000s because of surging private-sector releases. However, not all crops in all countries fit the pattern of a steady rise in varietal output over time. Between one-

fifth to one-quarter of the 146 crop-by-country observations were characterized by more releases in the 1980s than in the 2000s…

The area-weighted grand mean adoption level of improved varieties across the 20 crops is 35%. The distribution of adoption of improved varieties is skewed as 14 of the crops are characterized by a mean adoption level that falls below 35%. Crops with an estimated adoption performance superior to the overall average included soybean, wheat, maize, pigeon pea, cassava, and rice. About 23% of the 35% – i.e. a share of 65% – of MV adopted area is related to International Agricultural Research Centers (IARC)-contributed genetic materials. The IARC-related share in adoption is about 20% higher than its 45% contribution to released varieties.

The problem of lagging countries was also evident in the cross-sectional adoption estimates based on 152 crop-by-country observations. Adoption of MVs was uniformly low in Angola, Mozambique, and Niger across all crops."

Commercial commodity markets are dynamic of necessity, but market unpredictability is a major risk for poor farm families with few resources to help them weather a bad harvest or depressed prices.

"For small-scale producers, like anyone else, feeding the family is the primary concern, not feeding the world; raising and sustaining a livable household income matters far more than GNP levels or changes in trade statistics. Of course, the economic health of the wider community that, ideally, is providing services such as health care, education and infrastructure for both household life (water, energy) and for productive activities (roads, warehouses, banking, etc.) is intimately linked to household welfare.

For small-scale producers, the questions might be framed more in terms of: should I get big? Get out? Diversify? Should I work with others to maximize what can be achieved from a small base (of land or other resources)? Which leads to such questions as: what opportunities are there to increase sales? Add value? To protect the market I have? Will proposed developments bring new customers, new competition, or both? Am I equipped, or can I equip myself, to take advantage of the new market? Can I get the goods to the market? Can I meet the quality standards the buyers impose? If I can't, can I do it collectively? Can I afford collective action (time, money, effort)? Can I define new markets that play to my strengths?

> To exercise agency, small-scale producers will need to think through both the global and national context, to understand where policy-makers are coming from, and to think through their own position in their local context."[18]

It is small wonder, therefore, that they tend to manage their resources tightly and to be conservative in their investments and fearful of change. In fact, there is evidence to suggest that small-scale farmers in developing countries are more astute managers of their resources than are some larger-scale farmers.

> "While yields on family farms are sometimes lower than those on large farms, family farm costs are often lower than large farms. For example, a study of major rice exporters that found that small Vietnamese farms had half the yield per acre, but produced each ton of rice at half the cost as large farms in Uruguay. Smallholder cultivation is also more equitable. Small farmer income is two times to ten times higher than the income from wage employment.
>
> The export growth witnessed in Vietnam, Thailand and Peru following clarification of the property rights system illustrates the production boost prompted by secure property rights alone…
>
> Large farmers tend to plant only one crop (monoculture production) because that is simplest to manage with heavy machinery. Small farmers, especially in the third world, are more like to intersperse crops and diversify their risk. Monoculture usually requires more pesticide use or higher labor costs.
>
> Broadening land access sparks sustainable economic development. A 21-country analysis showed that a decrease in land concentration by one-third leads to a one-half reduction of the poverty level within 12 to 14 years."[19]

7. <u>There are crop and animal diseases, pests, and threats which—left unchecked and unstudied—threaten the world's and the United States' food supply</u>.

   Two current examples demonstrate the importance of this topic:

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[18] http://www.ictsd.org/downloads/2012/08/changing-perspectives-small-scale-farmers-markets-and-globalisation-murphy-iied.pdf "Changing Perspectives: Small-scale farmers, markets, and globalization", by Sophia Murphy, International Institute for Environment and Development/HIVOS, 2012

[19] http://www.landesa.org/wp-content/uploads/Is-Bigger-Better-Issue-Brief.pdf "Is Bigger Better? A Fact Sheet on Large-Scale Corporate Farming Versus Small Family Farms in Developing Countries" (with source references) Landesa, May 31, 2011

The UG99 wheat stem rust, that originated in Uganda "…poses a real challenge because it has taken hold in the developing world and it's leaping across international borders at an alarming pace," according to Hans Braun, head of the Global Wheat Program at the Mexico-based International Maize and Wheat Improvement Center (CIMMYT) and the CGIAR Research Program on Wheat, "Ug99 is extremely difficult to wipe out. The migration of the disease indicates it's widespread and can affect wheat production and food security on a global scale. No wheat-growing nation is safe – all governments must unite to invest resources to tackle it."[20]

Citrus Greening caused by a tiny Asian insect is having a devastating effect on Florida's citrus industry. "It imperils the state tradition of backyard citrus and the national habit of orange juice with breakfast…Consumption has fallen by nearly one-third in the past decade, partly thanks to higher prices caused by greening. Annual orange production in Florida is down... Acreage planted in citrus dropped by more than a third since 2000, mostly because of greening. Citrus remains a huge industry in the state, with a total economic impact of nearly $11 billion per year, but greening has cost growers in the juice business $7.8 billion since 2006…"[21]

Again, the poorest countries are often the most affected by crop and animal diseases, and are least equipped to combat such problems.

8. <u>Agriculture and nutrition goals, policies, and programs are not in sync.</u>

An article in The Economist covered the issue in 2011:

"Agriculture…is no magic solution [to malnutrition]. But farming could do more to improve nutrition—as is clear from countries' widely varying records. Malawi, Bangladesh and Vietnam all increased agricultural value-added by roughly $100 a head from 1990 to 2007, and cut malnutrition by 15-20 percentage points. Egypt, Guatemala and India pushed up agricultural value-added more—yet their malnutrition rates rose.

The success stories are instructive. In 1990 a charitable organization called Helen Keller International started to encourage market gardens in Bangladesh, providing women (mostly) with seeds and advice. By 2003 (the year of the latest available research), four-fifths of families in the target area had gardens, against 15% in the whole country. Almost all women and children were eating green vegetables three times a week,

[20] http://oklahomafarmreport.com/wire/news/2015/09/09611_Ug99StemRustUpdate09032015_055324.php#.VlZinTZdE2w Oklahoma Farm Report, September 3, 2015

[21] http://www.tampabay.com/news/business/agriculture/florida-lab-has-one-objective-stop-citrus-greening/2217619 Tampa Bay News, February 13, 2015

compared with only a third beforehand. And vitamin A intake had soared. Projects like this work because they improve what people like to eat anyway.

Changing the mix of crops works, too. Many countries' food policies are essentially about providing cheap grain, which is just a start. When people do not have enough calories, staples such as rice and wheat are vital: they provide the most calories per dollar. But when people have enough calories they need to diversify towards vegetables, pulses and meat. In many places, irrigation and fertilizer subsidies, government marketing and other schemes implicitly or explicitly favor cereal farmers. So poor countries go on encouraging cereals longer than they need to. And plant breeders tend to raise cereals which maximize calories, not nutrients."[22]

Jeff Waage, technical adviser to the Global Panel on Agriculture and Food Systems for Nutrition last year wrote:

"…just producing more nutritious food does not mean it will be consumed by people suffering from malnutrition. Similarly, efforts to address unhealthy, energy-dense and nutrient-poor diets have had some promising results, but research is still limited and methods need improvement.

Most agriculture interventions for nutrition have focused on specific foods and communities… But there is another, complementary approach to this problem which has been profoundly under-explored. This approach involves understanding how existing national agricultural and food policies affect nutrition and how they might be changed. Not all policies are nutrition-enhancing…

Even the most successful policies can have their downsides. For example, the global investment in improving productivity of cereal crops in the last century, now known as the green revolution, lifted millions of people in Asia from poverty and undernutrition, but also focused research investment on energy-dense rather than micronutrient-rich crops. This led to differences in price that make nutritious foods more expensive today.

It is encouraging to see a growing global commitment to improved nutrition, with better interventions and more evidence on what works. However, even the best technical interventions are not going to make a difference until policymakers fully understand and play their role in making agriculture work for nutrition."[23]

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[22] http://www.economist.com/node/18438289 "How much can farming really improve people's health?" the Economist, March 24, 2011

[23] http://www.theguardian.com/global-development-professionals-network/2014/jan/22/agriculture-nutrition-improving-policy "Agriculture and Nutrition: You are what you sow", by Jeff Waage, director of

9. <u>The protection of biodiversity and the exploration of plants and animals currently unfamiliar to those outside their indigenous communities are critical to food security.</u>

"A global synthesis reveals biodiversity loss as a major driver of ecosystem change", a study coordinated by the University of Michigan concluded:

> "Loss of biodiversity appears to impact ecosystems as much as climate change, pollution and other major forms of environmental stress, according to a new study. There has been growing concern that the very high rates of modern extinctions -- due to habitat loss, overharvesting and other human-caused environmental changes -- could reduce nature's ability to provide goods and services like food, clean water and a stable climate."[24]

More specifically related to food security:

> "Rural populations in developing countries, especially in the low-income areas with high biodiversity, are continuing to increase and are still largely dependent on local food production and agriculture-related incomes. Protected areas are inadequate to maintain long-term wild species populations and habitats, without a surrounding matrix of land use that is compatible with ecosystem health. Moreover, local people effectively control a high share of resources and have the greatest capacity and responsibility for environmental husbandry.
>
> We draw three conclusions from assessing these inter-linkages:
>
> • One of the root causes of hunger today is biodiversity loss associated with ecological deterioration; restoring ecosystem services and biodiversity will be essential in many regions to meet the MDG on hunger;
>
> • Biodiversity will not be conserved in many ecosystems unless efforts are explicitly linked to increasing food security for large and growing rural populations.
>
> • There is compelling evidence that integrated strategies for biodiversity and food security can work; these need to be scaled up dramatically.
>
> …it is essential to reposition agricultural, forestry and fisheries policies in food-insecure regions to recognize the crucial role of biodiversity, and to reposition biodiversity conservation policies in such regions to prioritize strategies that explicitly support hunger

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the London International Development Centre and technical adviser to the Global Panel on Agriculture and Food Systems for Nutrition, The Guardian, January 22, 2014

[24]"A global synthesis reveals biodiversity loss as a major driver of ecosystem change", a study by David U. Hooper, E. Carol Adair, Bradley J. Cardinale, Jarrett E. K. Byrnes, Bruce A. Hungate, Kristin L. Matulich, Andrew Gonzalez, J. Emmett Duffy, Lars Gamfeldt, and Mary I. O'Connor, and coordinated by the University of Michigan. *Nature*, 2012; DOI: 10.1038/nature11118

and poverty reduction. The synergies between food security, poverty reduction and biodiversity conservation could be greatly expanded by investing in programs and technologies that explicitly seek such synergies. Even in places where the challenges are less acute, such linked approaches will often be more cost-effective in meeting policy objectives. In regions that are "hotspots" for both rural poverty and biodiversity, such as the Mesoamerican Biological Corridor, montane Southeast Asia and the east African highlands, such direct program linkages and policy harmonization will be essential."[25]

From a two year, multi-partner review conducted in Asia:

"Traditional and indigenous food resources constitute the bedrock of the diversity in traditional and indigenous food systems of communities in developing country. The underutilized food resources have a much higher nutrient content than globally known species or varieties commonly produced and consumed. With climate uncertainty, there is an urgent need to diversity our food base to a wider range of food crops species for greater system resilience. Traditional and indigenous food crops are less damaging to the environment and address cultural needs; they also preserve the cultural heritage of local communities. Successful food systems in transition effectively draw on locally available food varieties and traditional food culture. Although many traditional subsistence systems depend on one or more staples such as cassava, sago, rice or maize, such diets are kept diverse and balanced through small but complementary amounts of animal source foods including birds, fish, insects and molluscs (sic), as well as sauces and condiments obtained from forest plants.

It is imperative to collect and document local knowledge, encompassing all aspects of indigenous and underutilized foods, from traditional beliefs to utilization and agronomic practices. Promoting the use of underutilized species needs to be achieved by highlighting their importance in their current production areas as well as exploiting further opportunities to extend their production and consumption. This information should be useful for both product development and awareness-raising."[26]

10. Agriculture affects health and health affects agriculture, but the two sectors work in silos.

A 2011 review of studies conducted at the request of the Bill & Melinda Gates Foundation revealed that the linkages between agriculture and health have not received comprehensive attention and the reviewers recommended that more research be conducted, but nonetheless arrived at the following conclusions:

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[25] http://ieham.org/html/docs/Hunger_Poverty_and_Biodiversity_in_Developing_Countries.pdf "Hunger, Poverty and Biodiversity in Developing Countries", by Sara J. Scherr, June 2003

[26] http://www.fao.org/3/a-i3685e.pdf "Promotion of underutilized indigenous food resources for food security and nutrition in Asia and the Pacific", edited by Patrick Durst and Nomindelger Bayasgalanbat. Khon Kaen University, Thailand, the Food and Agriculture Organization of the United Nations and other partners 2014

"Agriculture underpins the health of rural households. It provides income that makes households resilient to health shocks; it provides food to meet their nutrient and energy needs; and it provides medicinal plants for treating ailments. But agricultural systems can also have negative effects on health.

Agricultural development may lead to environmental change with adverse health impacts: for example, irrigation dams that create suitable conditions for mosquitoes may lead to increased incidence of malaria locally. The use of agricultural inputs such as pesticides by untrained farm personnel often causes illness. Improper food harvesting and storage practices allow mycotoxins to flourish. Lack of diet diversity can lead to malnutrition. Certain animal diseases also can infect humans. Labor migration (including agricultural labor migration) can contribute to high incidence of HIV infection.

The effects of ill health on farm households include three broad impacts: absenteeism from work due to morbidity (and eventual death); family time diverted to caring for the sick; and loss of savings and assets in dealing with disease and its consequences. The long-term impacts of ill health include loss of farming knowledge, reduction of land under cultivation, planting of less labor-intensive crops, reduction of variety of crops planted, and reduction of livestock. The ultimate impact of ill health is a decline in household income and possible food insecurity—that is, a severe deterioration in household livelihood.

The research found that the household's ability to cope with a shock reflected both its asset portfolio—including human, physical, and financial assets—and its intangible social resources. Good health must be seen as both an investment and consumption asset, like agricultural production, in that it has compounding returns. Health problems, conversely, may trigger a cycle of lowered agricultural productivity and poor health. At the household level, the investment in health can improve resilience and enhance the ability to cope with emergencies, including ill health. But an investment in health in turn requires an adequate livelihood. Access to appropriate inputs (knowledge, land, tools, fertilizer, and seeds) and remunerative markets is necessary to improve the productivity, health, and resilience of farm households."[27]

In 2008, three researchers with the International Food Policy Research Institute wrote:

"Strategic utilization and strengthening of the linkages between agriculture and health offers particularly strong opportunities for achieving poverty reduction and health goals in many low-income countries. This requires a new initiative for evidence-based and

[27] http://www.ifpri.org/publication/interactions-between-health-and-farm-labor-productivity "Interactions between health and farm-labor productivity", by Kwadwo Asenso-Okyere, Catherine Chiang, Paul Howard Thangata, and Kwaw S. Andam, International Food Policy Research Institute, 2011

research-intensive action across the agriculture and health sectors – allied with effective communications, capacity strengthening, and social mobilization."[28]

Other relevant developments affecting agriculture and global hunger

These developments are reported here because they raise questions relevant to global hunger and agriculture, but are not explored as deeply as the Key Issues discussed above.

A. Investment and developments in agricultural science in China, Brazil, India, and elsewhere have been growing and becoming more sophisticated.

For more than ten years since 2000, China's investment in agricultural science grew more than 20% per year; by 2012 it was second only to the U.S. [29]

"…while Brazil and the United States compete in the global market, the two nations are also close collaborators in agricultural research and the advancement of science-based policies to govern international trade in food and agricultural products."[30]

"India has one of the largest and well-coordinated public agricultural research systems in the world. Its primary agencies are organized under the Indian Council of Agricultural Research (ICAR) and state agricultural universities (SAUs). Strong government commitment has resulted in a near doubling of public investment in agricultural research and development (R&D) since the mid-1990s. Funding is expected to increase further in the coming years…Private investment in agricultural R&D has increased fivefold since the mid-1990s."[31]

- How do those scientific investments and achievements translate to developing countries?
- To American agriculture and business interests?

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[28] "Bridging the Gap: Linking Agriculture and Health to Achieve the Millennium Development Goals, by Joachim von Braun, Marie T. Ruel, and Stuart Gillespie, International Food Policy Institute, June 4, 2008

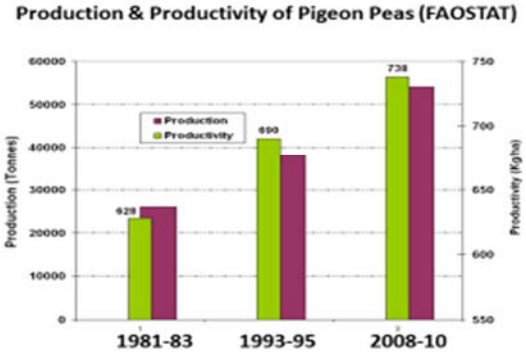
[29] http://www.nature.com/news/china-s-budget-backs-science-1.10209 Nature, March 13, 2012

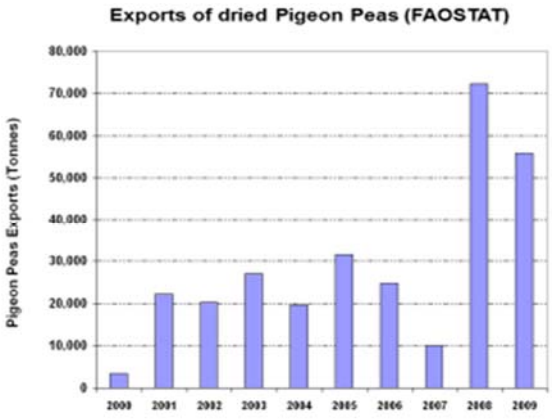
[30] http://www.fas.usda.gov/regions/brazil USDA/Foreign Agricultural Service November 2015

[31] http://www.asti.cgiar.org/pdf/India-Note.pdf "Agricultural Science and Technology Indicators" (IFPRI) June 2012

B. <u>Population growth and the buying and pricing policies and practices of middle income countries and commodity market investors[32] are having significant impact on global food supply, prices, and movements.</u>

The food purchases of India and China affect global commodity availability and prices on both a large and a micro scale, and well beyond their own borders. As a more micro example, bean production and sales in Tanzania are up, but bean consumption is down and prices are lackluster because Indian traders buy beans from Tanzania in quantity, but on their own terms.





--From "Tanzania Legumes Value Chain" presentation
by Victor Kongo, local advisor to the Bill & Melinda Gates Foundation

As another example, food flows from poorer neighboring countries into Nigerian markets on a regular basis, sometimes threatening food security in the exporting countries. This is especially problematic when populous Nigeria has food shortages due to weather or other conditions. Food prices spike and availability can become an issue for the whole sub-region.

- How does the United States factor into the changing market dynamics?
- What are the implications of population growth and changing market demands (particularly in Asia) for global hunger?
- Do these "food drains" from poor to richer countries pose particular risks and/or opportunities?

[32] http://necsi.edu/research/social/foodprices.html "The Food Crises: A Quantitative Model for Food Prices including Speculators and Ethanol Conversion", by M. Lagi, Yavni Bar-Yam, K.Z. Bertrand, and Yaneer Bar-Ya, of the New England Complex Systems Institute (partly funded by the U.S. Army) September 21, 2011

C. Political and economic pressures, the technical and digital divide, conflict and displacement, and global weather patterns are challenging providers to consider the sustainability of traditional models of development and food aid and humanitarian relief.
    - What are the implications of factors such as the technical/digit divide and conflict for aid workers?
    - Does the U.S. adequately prepare its international development and humanitarian workers to operate successfully under these conditions?
    - Can political will be sustained in support of food aid? Development assistance?
    - How do wars and population shifts impact agriculture, the need for assistance, and our ability to reach people in need?
    - How long can donor countries afford to provide food aid, especially to countries with the potential to grow their own food?

D. Better methods for dealing with challenging weather and growing conditions are needed to address domestic food security as well as global hunger.
    - What can we learn from drought conditions and coping mechanisms in Kenya that can be shared with California, or the Pacific northwest, or vice versa?
    - What can be shared as drought- , flood-, insect-, and disease-resistant crops are developed?
    - Are there currently unknown or under-utilized crops which are naturally hardy?
    - Are there effective traditional or new methods for coping with natural phenomena that be learned from or shared with developing countries?
    - What is at stake in terms of food availability and nutrition and health solutions in relation to crops native to developing countries but currently unknown to us/unused by us or other parts of the world?
    - What is the “next quinoa”?
    - What potential is lost through the rapidly decreasing biodiversity?

E. Economic growth trends in Africa are positive and projected to continue to be positive.
    - As these economies develop, will they turn to the U.S. as a supplier and trading partner?
    - How can countries best ensure that the positive growth trends are benefiting the hungry?
    - To what extent does agriculture factor into the growth trends?
    - What changes in markets and consumer choices will accompany economic growth?

Possible actions

To address the challenges and opportunities discussed in the previous sections, the United States Government and its partners could:

1. Address the transport issues by mobilizing private sector players such as vehicle and aircraft manufacturers and public sector actors such as USDA and the U.S. military to develop developing-country appropriate, 21st Century transportation systems to leap-frog outmoded systems through:
    a. Two new interlinking systems:
        i. Farm to aggregation point (consider containerized all-terrain vehicles to navigate from farm-to-market where there are no roads or only tracks that are vulnerable to recurring weather conditions)
        ii. Medium- to long-haul (consider containerized airships or other options to bypass the currently time-consuming, expensive, dangerous, and corrupt trucking routes and prohibitively expensive and/or infrastructure-intensive air and sea transport systems)
    b. Ensuring that the new systems are developed with their intended users and that they are "female friendly" so that they will be adopted and will not limit usage by half the population.

2. Promote proven, smallholder- and female-friendly food harvesting and (clean, secure, easy-to-use containerized) storage systems, drawing from both hard and soft sciences and ensuring that they are female friendly to ensure that they will be practical for and used by the intended populations.

3. Address food wastage and loss issues in the U.S. and other developed countries by:
    a. Educating the public regarding "sell-by" and "use-by" dates and providing guidance for the public to better understand the economics and practices of food use
    b. Clarifying and strengthening laws and rules about food donations by restaurants, grocers, processed food manufacturers, and others who currently dispose of large quantities of perfectly edible food items
    c. Developing cost-effective and/or incentives systems for the use of "Grade B" commodities (which are safe to eat, but unattractive or otherwise deemed to be of less than the highest quality)

d. Applying fees or other disincentives for particularly egregious or repeated acts involving the waste of food products safe for use.
e. Support for research and the development and implementation of waste- and loss-reducing measures and technologies.

4. Address food loss issues in developing countries and elsewhere by:
    a. Supporting policies and actions such as those listed in #s 1-3, above by other countries and partners
    b. Supporting the development, implementation, and enforcement of evidence-based food safety standards and control interventions (i.e., through the programs such as the joint USAID-USDA Sanitary-Phytosanitary Standards program and the Partnership for Aflatoxin Control in Africa
    c. Educating farmers and value-chain players in proper post-harvest handling techniques and about specific health threats (such as aflatoxin and other mycotoxins, E-Coli, Salmonella, and Listeria)
    d. Investing in training and professional certification (for women, especially) to perform food safety (laboratory, handling, preparation) and inspection services; support the development of these professions via U.S. Government-funded programs, including McGovern-Dole and other food aid program
    e. Encouraging first-stage processing at the local level to capture some of the value and reduce losses of perishables
    f. Promote the use of second grade (blemished, ill-formed, or otherwise not "consumer attractive" but otherwise good quality) commodities in processed products, and (also in transformed state) for meals prepared for national school, military, prison, or hospital feeding programs

5. Effectively include women in agricultural and hunger-reduction programs by:
    a. Investing in programs that involve women in the design and implementation of labor-saving devices (consider programs such as the United Nations Development Program-led "Multi-Functional Platform" program which provides motorized, electricity-producing, post-harvest processing machinery and basic literacy and business training to existing women's groups far off the power grids in African countries).
    b. Encouraging development and humanitarian actors to develop and implement female-friendly and context-specific communications materials and interaction models. The use of methods such as pictography, oral messaging in local language; hands-free phone and other technologies; and safe transport, child care, and other time-conserving and responsibility-relieving means of including women are needed in order to be effective with women in developing countries

(who are generally less-literate, less likely to speak an official language, and more involved in time-consuming and labor-intensive daily work then are men).

c. Investing in programs that educate and incentivize men to support women's full participation in effective agricultural and hunger-reducing activities; expecting ongoing U.S.-funded activities to include these components.
d. Encouraging humanitarian and development actors to find opportunities to develop new or re-configure former jobs and their titles and descriptions to prevent the positions from labels or expectations that they are closed to women.
e. Supporting training programs such as proposed in 4.d., above that create new opportunities for women that are directly linked to agriculture and reducing hunger and malnutrition.
f. Insisting on stringent gender-disaggregated indicators for monitoring, evaluation, reporting, and on evidence-based gender-sensitive interventions as prerequisites for project approval

6. Address the aging of agriculture and create momentum and opportunities for youth to be involved in agriculture and hunger-reducing activities, by:
    a. Investing in accelerated education and training programs targeting particular needs (such as career in farming and agricultural sciences) that incorporate youth and early-stage professionals from both developing countries and the United States, building on the programs and networks of the following players and programs-- but speeding, improving, and ensuring their immediate relevance to developing countries' agriculture and the domestic need for strong, youthful agricultural talent:
        i. 1890s and Land Grant colleges and their linkages to developing country agricultural institutions
        ii. Youth program such as 4-H and FFA programs
        iii. Private sector training and internship programs
        iv. The Cochrane, Borlaug, Aspen and other such fellows programs
        v. Private funding and programs (such as those of the MasterCard and the Bill & Melinda Gates Foundation)
    b. Establishing new models of training specifically for women and supporting ongoing programs (such as the AWARD program for African female scientists), which incorporate support systems necessary for women to be able to participate.
    c. Promoting agriculture and agricultural careers in modern and effective ways, and to a broader set of audiences (i.e., using social media, reaching beyond rural audiences, involving economic arguments, demonstrating the need for cutting edge innovation, etc.)

7. Support activities to engage developing country smallholder farmers in markets and off-farm employment (where relevant), and delve into understanding and addressing the issue of low adoption rates by:
    a. Supporting well-designed local and regional purchase programs such as the World Food Program's (WFP's) "Patient Procurement Platform" in collaboration with large private sector commodity buyers and "home-grown school feeding" programs. These are programs that are specifically structured to patiently work within developing country contexts to ensure that smallholder farmers can learn to access and produce for large-scale markets. These efforts build on the experiences and lessons of:
        i. The pilot Purchase for Progress ("P4P") program funded by the Howard G. Buffet and Bill & Melinda Gates foundations and donor governments and implemented by WFP
        ii. The U.S. Government's pilot Local and Regional Purchase programs implemented by USDA and USAID
        iii. "Home-grown" school feeding activities supported by the Millennium Development Project's Hunger and Education and Gender Task Forces, New Partnership for Africa's Development (NEPAD), the Global Child Nutrition Foundation (GCNF), the Partnership for Child at Imperial College, WFP, the Government of Brazil, more than ten African governments, and others
        iv. The experiences of public procurement programs with specific rural development goals, such those implemented in the U.S. (Farm to School, for example), Brazil, Scotland, and elsewhere
    b. Supporting 21st Century knowledge exchange/extension activities that involve meaningful two-way communication between farmers and technical resources; providing incentives for listening, learning, and effective gender inclusion as well as rewarding solutions and adoption

8. Understand, prevent, control or eradicate crop and animal diseases, pests, and threats which—left unchecked and unstudied—threaten the world's and the United States' food supply, by continuing to do what is already done well and by:
    a. Working with international organizations and partners to improve early warning and—especially—early-investment systems to detect and counter threats earlier--upon detection of the problem whenever possible
    b. Mobilizing unique U.S. laboratories and expertise to address outbreaks and potential problems internationally, even if they do not seem likely to directly threaten U.S. agriculture. This can help to ensure relationships and access regarding issues that can unexpectedly become problems for the U.S. and for other issues which are of domestic concern

c. Investing in strengthening the capacity to study diseases and pests outside of the U.S. so that the problems can be studied in situ and mitigate the need for importing or transporting hazardous material across borders in order to conduct credible research
d. Learning from and sharing lessons with the human health community (e.g., learning from the experience with Ebola in West Africa)

9. Align agriculture and nutrition goals and programs through:
    a. Prioritizing programs and projects which demonstrate concrete linkages between the sectors, such as research and other activities which:
        i. Support the production, affordability, and consumption of nutritious plants and animal products
        ii. Incorporate nutrition education
        iii. Involve obesity prevention and mitigation measures
        iv. Promote diet diversity
        v. Measure nutritional value of lesser-known edible flora and fauna and make the results known to the general public
        vi. Contribute to public understanding of the nutritional value of locally-available foods
        vii. Provide tools and expertise to promote nutrition in developing countries and at home
        viii. Measure nutritional impact
        ix. Address the root causes of poor nutrition
        x. Increase understanding of linkages between certain environmental factors (such as mycotoxins) and nutrition
        xi. Support the life-cycle approach to nutrition, which goes beyond the first 1,000 days, with particular attention to the second and third thousand days and adolescent girls
    b. Provide incentives for nutrition-sensitive agricultural activities and/or disincentives for activities which do not promote nutrition
    c. Prioritize food safety initiatives that address problems such as aflatoxins, which have a known relationship to nutritional status

10. Protect biodiversity and support the exploration of plants and animals currently unfamiliar to those outside their indigenous communities by:
    a. Taking urgent steps to halt the loss of plant and animal species
    b. Supporting seed banks and other efforts to protect and preserve genetic materials
    c. Exploring the nutritional and commercial value of products currently unfamiliar or unexploited in the Northern & Western worlds, such as those listed in the

"Lost Crops of Africa" Volumes I (Grains), II (Vegetables), and III (Fruit) and "Lost Crops of the Incas" books and initiatives[33]

d. Encouraging small teams of young American and developing country scientists to undertake this adventurous, but significant work, with strong technical and political support and guidance.
e. Supporting local community understanding and involvement in protecting indigenous crops and animals

11. Encourage agriculturalists and health workers to collaborate in areas of mutual impact related to combating hunger through:
    a. Providing incentives for relevant activities to be jointly planned and implemented
    b. Supporting specific and relevant collaborative research
    c. Requesting reports on joint activities, learning, and progress
    d. Inspiring universities that offer both relevant health and agricultural programs to offer coordinated or integrated health and agriculture curricula and to support a subset of students to pursue double majors
    e. Identify and remove obstacles that deter relevant U.S. Government agencies (i.e., USDA, USAID, HHS/CDC, etc.) from cross-sector collaboration and coordination
    f. Promote humanitarian and development projects that involve on-the-ground inter-sectoral coordination

Final Notes

The United States has both the need and the opportunity to actively engage in sustainable solutions to hunger in developing countries, with American agriculture at the forefront of the effort. This cannot be done through a "business as usual" approach, however. The U.S. is itself encountering major challenges in addressing hunger and maintaining its leadership role in international agriculture.

The challenges and opportunities outlined in this paper signal how innovative approaches can benefit the American economy and address pertinent domestic issues while also re-positioning the United States as the leader in achieving sustainable global solutions to hunger.

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[33] http://www.nap.edu/catalog/2305/lost-crops-of-africa-volume-i-grains Board on Science and Technology for International Development; Office of International Affairs; Policy and Global Affairs; National Research Council, 1996-2008