

**Spring 2015  
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# AGRIBUSINESS 2015

**ABSTRACT:** Food security is a vital national security interest for the United States (U.S.) because of its implications for global stability and prosperity as described in the February 2015 *National Security Strategy*. Food shortages undermine civil governments by eroding physical security and economic growth. The United Nations (U.N.) predicts the global population will grow from 7 billion today to over 9 billion by 2050. Despite only a 30% increase in population, the world may need up to 70% more food as a growing middle class demands more input-intensive products. Despite compounding challenges including growing water scarcity, climate change, and chronic instability in many places, humanity does have the ability to feed itself now and in the foreseeable future. Solutions to food security challenges require governments, corporations, and other stakeholders to pursue integrated efforts that merge commercial incentives as well as domestic and foreign policy interests. Investing in food security abroad is a low-cost, high-return strategy to advance enduring U.S. national security interests.

This paper discusses five root causes of food security-related challenges: global population growth, climate change, urbanization, water scarcity, and political and economic instability. The paper also details eight opportunity areas to address those challenges: reduce waste, produce more food, increase trade and free markets, optimize development, target infrastructure investments, increase reserves, adapt to climate change, and increase priority of non-traditional security threats.

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## **PLACES VISITED**

### **Domestic:**

Beltsville Agriculture Research Center (BARC), Beltsville, MD  
Chicago Mercantile Exchange (CME), Chicago, IL  
Kraft Food Groups, Inc., Northbrook, IL  
Pinney-Purdue Agricultural Center (PPAC), Wanatah, IN  
Bane-Welker Case – IH Equipment, Wanatah, IN  
Kova Fertilizer, Wanatah, IN  
Schafer Farms, Wanatah, IN  
Archer Daniel Midlands Company, Chicago, IL  
Smithfield Foods, Smithfield, VA  
United Nations World Food Programme (WFP), Washington, DC  
United Nations Food and Agriculture Organization (FAO), Washington, DC  
U.S. Senate Committee on Agriculture, Nutrition, and Forestry, Washington, DC  
Kreider Dairy Farm, Manheim, PA  
U.S. Department of Agriculture (USDA) 2015 Agriculture Outlook Forum, Arlington, VA  
College of Agriculture and Life Sciences, North Carolina State University (NCSU), Raleigh, NC  
Lake Wheeler Field Laboratory Tour, NCSU, Raleigh, NC  
“Breakfast with the State Commissioner of Agriculture”, event NCSU Fairgrounds, Raleigh, NC  
Monsanto Company Biotechnology Center, Durham, NC  
BASF Corporation Headquarters, Research Triangle Park, NC  
Bayer CropScience “Bee Care Center”, Durham, NC

### **International:**

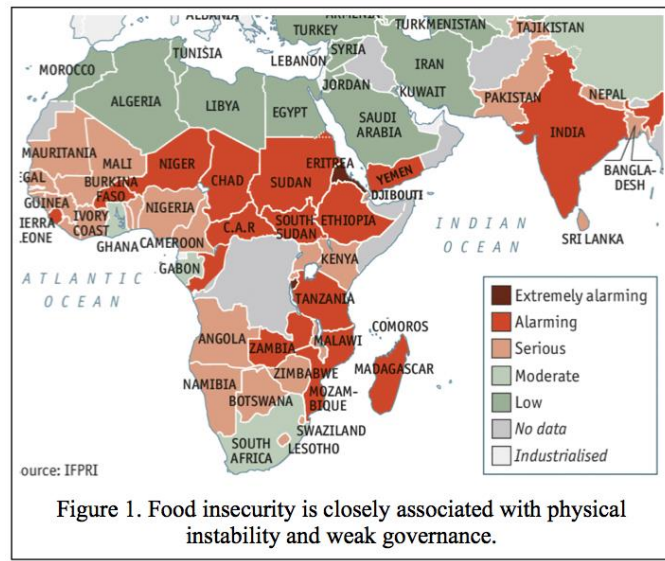
U.S. Embassy, Foreign Agriculture Service, Beijing, China  
Harvest Organic Farm, Beijing, China  
Huaxia Dairy Company, Beijing, China  
China Foods Limited (COFCO)/WOMAI (COFCO’s e-commerce division), Beijing, China  
Syngenta, Beijing, China  
American Chamber of Commerce, Shanghai, China  
Ja-E, Shanghai, China  
Yihaodian, Shanghai, China  
Yurun Food Processing Company, Shanghai, China  
Cargill, Shanghai, China  
U.S. Consulate, Shanghai, China  
Preferred Freezer Services, Shanghai, China  
Tyagi Farm, Badshahpur, New Delhi, India  
U.S. Embassy, New Delhi, India  
The Mosaic Company, New Delhi, India  
Azadpur Subji Mandi (Wholesale market), New Delhi, India  
Azadpur New Subji Mandi (Import market), New Delhi, India  
Cargill India, Gurgaon, New Delhi, India  
PepsiCo India Holdings, Guragon, New Delhi, India



## INTRODUCTION

### Why is food security a national security issue?

As the world's population expands to over 9 billion people during the next 35 years, and a rapidly growing middle class demands more input-intensive food, the world's agribusiness industry must respond to maintain an adequate food supply, proper nutrition for all, and general food safety. Unless the agriculture industry adapts to the demand for a greater quantity and variety of food, access to food will diminish and conflicts among neighbors is likely to rise. In this light food security is a fundamental national security concern for all nations because humans quickly grow desperate when food runs short. This desperation can lead to the violent breakdown of civil authority.<sup>1</sup> The map shown in Figure 1 from 2013 demonstrates the link between food and security: places that suffer from food insecurity tend to be physically insecure as well.<sup>2</sup> Examples include Yemen, Sudan, and Eritrea. Recent history clearly demonstrates sensitivity to food prices. Food prices rose 37% in the Middle East and North Africa between 2007 and 2010 (11% annually). This led to rioting in forty-eight countries, many of which were changed forever in the Arab Spring.<sup>3,4</sup>



Approximately 12% of the global population goes hungry every day (see Appendix A: FAO Hunger Map 2014). Fortunately, substantial progress has been made in reducing hunger over the past several decades. Chronic undernourishment decreased by over 40% in developing countries between 1990 and 2014.<sup>5</sup> However, much work is still required. The world must continue to make progress against hunger. This paper, a product of the Agribusiness Industry team from the Eisenhower School's Class of 2015, discusses challenges associated with maintaining sustainable, global food security and recommends investments and policy changes that can provide sufficient food as the global population grows to nine and a half billion by 2050.<sup>6</sup>

America has the geography, climate, and wealth to produce far more food than the nation needs. Therefore this paper focuses on how the U.S. can improve global food security *while simultaneously furthering U.S. strategic interests abroad*. This paper describes five major drivers of and challenges to global food insecurity (see "Challenges") and how solutions to these challenges can further U.S. enduring strategic national interests. The paper also discusses eight opportunity areas for reducing food insecurity through public policy, assistance, education, and diplomatic/political pressure (see "Opportunities"). Lastly, the paper concludes with prioritized recommendations for U.S. policy makers (see "Recommendations"). Action on these recommendations will greatly increase the probability of providing a growing population with adequate nutrition in the coming decades.



Food security is a fundamental component of U.S. national security writ large. The *2015 National Security Strategy* addresses global agricultural concerns when it states “we will leverage our leadership in promoting food security, enhancing resilience, modernizing rural agriculture, [and] reducing the vulnerability of the poor.” Furthermore, the four U.S. enduring strategic national interests described in the *2015 National Security Strategy* are *indirectly* and *intrinsically* tied to global food security.

- The U.S. allocates significant financial resources toward reducing civil instability abroad that may threaten the “security of the United States, its citizens, and U.S. allies and partner.”
- America responds because “respect for universal values at home and around the world” compels investments in alleviating the conditions of poverty that are at odds with the values of human dignity.
- The agricultural trade surplus the U.S. has run since 1960 is a large component of a “strong, innovative, and growing U.S. economy.”<sup>7</sup> In 2010 the U.S. exported \$108 billion in agricultural goods while the agriculture industry supported nearly a million full-time American jobs.<sup>8</sup>
- International trade is possible largely because of the “rules-based international order” that opens markets and provides a legal framework for businesses to operate.<sup>9</sup>

Furthermore, global food security is a U.S. national security issue because it impacts the financial health of the American taxpayer in several ways. It impacts consumers when prices rise due to supply constraints caused by food shortages or disruptions to trade and transportation. Such disruptions can be brought about by political and social instability caused by food insecurity. The U.S. often leads the global response to such crises for which the U.S. taxpayer bears a significant cost burden. For example, the U.S. responded to food-related crises that began in 2007 and 2008 by committing \$3.5 billion to address worldwide malnutrition and poverty from fiscal years 2010 to 2012. This was part of an overall \$20 billion G8 effort to fight hunger in what became known as the L'Aquila Food Security Initiative (AFSI).<sup>10, 11</sup>

### **What is food security?**

The United Nation's (U.N.) Food and Agriculture Organization (FAO) provides a illustrative definition of food security: “[f]ood security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life.”<sup>12</sup> To put it simply, people need access to enough nutrition to fuel their daily lives. Getting enough nutrition (what we are calling ‘food security’) is built on three pillars: general availability of food, ability of people to afford food, and knowledge to maintain a healthy diet.<sup>13</sup> While food *insecurity* is the absence of any of these three pillars it is most often associated with the unavailability of food. Food scarcity is often due to environmental factors such as drought or flooding, violent conflict, competition over natural resources, or man-made environmental degradation.



## Agribusiness Industry

“Agribusiness” is a broad term used to describe the many market participants including multi-national conglomerates, cross-industry corporations specializing in transportation, financial services, and petro-chemicals. This food-supply chain is often referred to as the agribusiness value chain and is illustrated in Figure 2.

The overlapping nature of agribusiness makes it hard to determine the discreet value of the industry as a whole. The market analysis firm IBIS World provides an insightful partial valuation of the agribusiness value chain focused on those businesses that “produce agricultural commodities, buy agricultural produce, or supply goods and services to farms and the agriculture industry.”<sup>14</sup> The IBIS World agribusiness analysis does not include some components of the agribusiness value chain such as grocery stores and commodity trading (areas that the team nevertheless studied in depth). The agribusiness industry segments covered by IBIS World accounted for \$2 trillion in revenue across 2.4 million businesses in the U.S. in 2014. Those same segments generated \$160 billion in profits and \$165 billion in exports (10% of all U.S. exports). The largest components of the IBIS World analysis comprise over 90% of the industry and include: food and supplies wholesaling (31.8%); services (21.0%); oil, grain, and packaged food manufacturing (19.4%); crop farming (9.3%); and meat, beef, and poultry processing (8.8%).<sup>15</sup>



While the agribusiness industry extends across the global economy, the research team necessarily limited the scope of this paper to issues directly related to U.S. national security or economic policy, trade, diplomacy, science, and agriculture policy writ large. The team members focused their efforts on topics that might reasonably fall under the purview of U.S. Federal agencies including the Departments of Defense (DOD), State (DOS), Commerce (Commerce), Energy (DOE), Agriculture (USDA), the U.S. Trade Representative (USTR), and the U.S. Agency for International Development (USAID).

## ANALYTICAL FRAMEWORK

### Methodology

Within this paper, the term 'agribusiness', 'agriculture market', and 'agriculture industry' are used interchangeably. A team of fifteen students, assisted by Eisenhower School faculty, carried out structured, individual analysis of the international agriculture industry segments to *identify critical global food security challenges and to provide recommendations for how the U.S. can help solve those challenges while simultaneously advancing its strategic national security interests abroad*. The results of the team’s collective analysis are highlighted in this paper.

The team conducted academic research using economic frameworks, management concepts (i.e., Porter's Five Forces, DIME analysis), site visits (U.S., India, China), and interviews with policy makers. Guest lecturers and discussions with subject matter experts in government, non-government organizations (NGOs), and meetings with industry provided firsthand expertise. The





team had the privilege of two domestic couplets: one to the Chicago area and a second to the Research Triangle Area in North Carolina. A full listing of guest lectures, domestic site visits, and international trips is provided at the front of this document (see “Places Visited”).

A number of team members, as well as sections of this paper, focused on Asia (including India) and Africa for the following reasons:

- Nations in Africa and the country of India are projected to be major drivers of global population growth through 2050.
- Many Asian nations’ are developing rapidly and will be key focus areas for U.S. diplomatic, economic, and military strategy throughout the twenty-first century.
- Africa faces difficult human and economic development-related challenges, is home to conflict areas with an active U.S. interest or involvement (i.e., Somalia, Libya, Sudan), and suffers from widespread food insecurity due to geography, climate, poor governance, poverty, and lack of infrastructure.

Michael Porter's *value chain analysis* framework was used to identify and describe each element in the agribusiness value chain. Porter's *Five Forces analysis* was used to explore how agribusiness market forces operate and their related tensions. The *Five Forces analysis* was also used to examine four of the largest firms in the agribusiness space (Monsanto, Bunge, Smithfield, and Kraft) and to identify viable policy levers for U.S. leaders. The team studied business management best practices, financial analysis, and corporate strategic positioning through a number of case studies to understand how large businesses and industrial sectors position themselves to gain and maintain a competitive advantage.

## Challenges

As the global population grows to over nine billion people, humanity faces four major food supply-related challenges: increasing the amount of food; improving health and nutrition; achieving food security; and ensuring that food is safe. This paper discusses five root causes that drive many of the food security-related challenges that must be addressed:

1. Global population growth, especially of the high-consuming middle class, will require greater quantities and varieties of food.
2. & 3. Climate change and urbanization are reducing the amount of arable land available for production.
4. Water scarcity is worsening while agriculture remains the single largest consumer of water. Meanwhile the chemicals that farmers rely on for high yields and pest control also poison the water and damage the soil.
5. These root causes combine with food insecurity to fuel political and economic instability that compromises the security of all countries.

The paper discusses these challenges in the following order: Feeding Nine Billion, Security & Fault Lines for Conflict, Urbanization, Climate Change, and Water Scarcity.



## Challenge 1. Feeding Nine Billion

The global food supply is under pressure and demand is set to steadily increase as the population grows. Violent conflict may erupt over food and water resources if the supply of both cannot keep pace with the growing demand. Compounding this challenge is the fact that population growth will be centered in the developing world as shown in Figure 3.<sup>16</sup> Asia is already home to nearly four and a half billion of the world's seven billion people and is expected to reach at least five billion by 2050. The population in Africa is expected to grow from just over one billion to nearly two and half billion by 2050.<sup>17</sup> Nigeria's 175 million people may grow by more than 2% each year and exceed 440 million by 2050.<sup>18</sup>

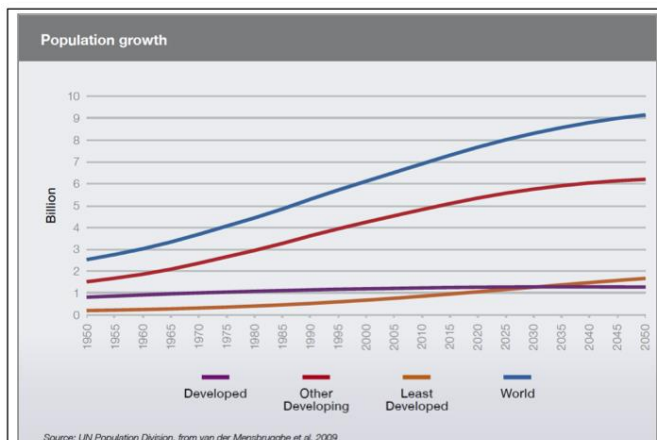


Figure 3: The population of the developing world will soar by 2050.

Analysts estimate that by 2050 the world will need to produce over 70% more food than it does today.<sup>19</sup> Yet the world population is expected to increase by only 30% over the same time period. The disparity in projections is caused by changes in the types of food demanded. As people grow wealthier, they tend to eat more food as well as different types of foods. As illustrated in Figure 4, consumption of *input-intensive* foods such as meat and dairy products will increase faster than other foodstuffs between now and 2050.<sup>20</sup> In fact consumption of some basic staples such as roots will actually decline in the developed world. Meat and more complex foods sought by the middle class require more inputs to manufacture than traditional staples.

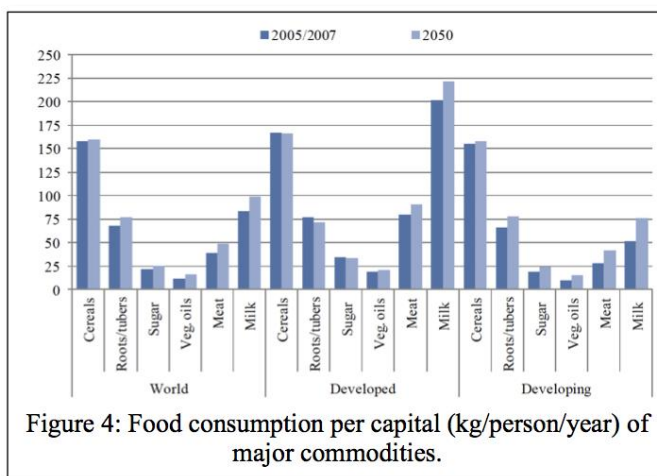


Figure 4: Food consumption per capita (kg/person/year) of major commodities.

[A]s incomes rise, one of the first things that low-income people do with their money is diversify their diets, shifting from a daily menu where a starchy staple such as rice supplied 70 percent or more of calories to a more diverse fare including meat...and eggs, milk, butter, cheese, yogurt, and ice cream.<sup>21</sup>

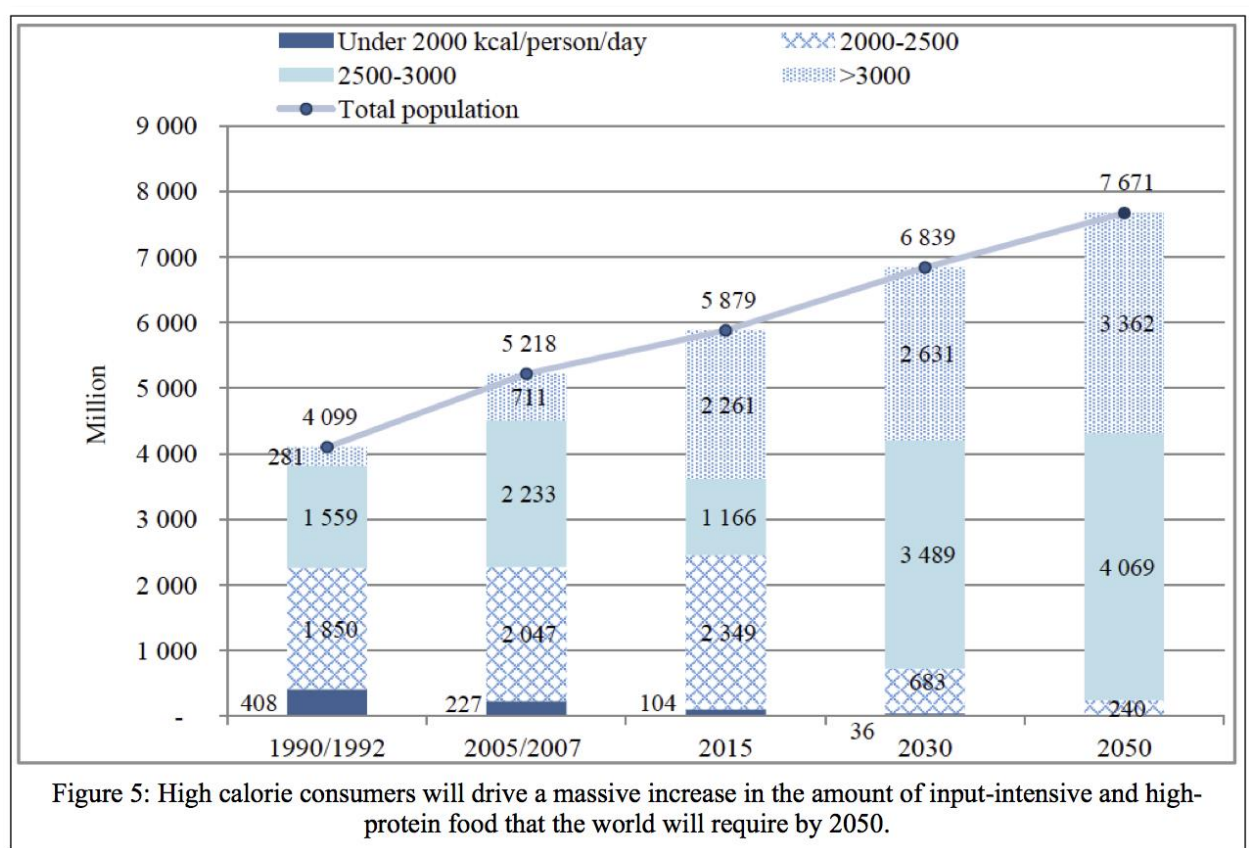
By 2022, up to 630 million Chinese (45% of China's total population) are expected to become wealthy enough to be considered middle class. That is nearly 200 million more than China's current middle class population of 400 million.<sup>22, 23</sup> The phenomenon of the hungry middle class consumer is already impacting China. Increased consumption of meat-based protein driven by





China's economic success also drives increased stress on farmland and feed-grain commodities. While China already consumes more pork than any other country, Chinese per-capita consumption of meat overall in 2011 was 254 grams versus American consumption of 381 grams.<sup>24</sup> When Chinese meat consumption reaches parity with the U.S. it will dramatically increase global demand for the feed-grain consumed by cattle, pigs and poultry.<sup>25</sup>

Figure 5 from the Food and Agriculture Organization (FAO) of the U.N. illustrates how the global growth of high-calorie consumers (30% between 2015 and 2050) will dwarf the growth of low-calorie consumers. On a positive note the chart reflects that the U.N. FAO estimates that malnourishment (< 2000 kcal/person/day) will be a historical relic by 2030.<sup>26</sup>



## ***Challenge 2. Security and Fault Lines for Conflict***

If you desire peace, cultivate justice, but at the same time, cultivate the fields to produce more bread; otherwise there will be no peace.

—Norman Borlaug, Father of the Green Revolution

Competition for arable land, water, and other productive inputs (oil, technology, chemicals, etc.) has been a source of conflict throughout history and has led to many violent conflicts and revolutions. “A bad harvest in 1788 led to high food prices in France, which caused rioting and contributed to the French revolution in 1789; and the wave of political upheaval that swept Europe in 1848 was at least in part a response to food scarcity, coming after three below-average harvests...”<sup>27</sup> Protests over rising food prices were a major driver of the collapse of the Soviet Union in 1990.<sup>28</sup> Food security clearly has an out-sized role in fragile states where a large portion of household income is spent on food.<sup>29</sup> When Egyptians devoted 40% of their household income to food in 2011 it should come as no surprise that civil unrest set the conditions for the Arab Spring.<sup>30</sup>

Food insecurity can result in violence and, in turn, violence can exacerbate food insecurity. Major conflicts often start as food-related skirmishes that end in violence as people compete for water and arable land. These conflicts can quickly escalate to national and regional conflicts, particularly when neighboring governments support warring factions. As violence intensifies and food becomes increasingly scarce, prices increase in a destabilizing spiral that enriches only those nefarious characters willing to control the food supply by force, perpetuating a downward spiral in security and real household incomes.<sup>31</sup>

As conflicts escalate, civil society can start to unravel. Mass migrations begin as people seek food and security. No place is more illustrative of the food insecurity-violence-governance nexus than Sub-Saharan Africa. Food insecurity in this region contributes to civil wars, communal conflicts, the spread of infectious diseases such as cholera, and the dissolution of democratic systems.<sup>32</sup> Across the Mediterranean, Syrian refugees are fleeing to Jordan, Lebanon, and Turkey for food as well as physical security. Such humanitarian crises consume U.S. aid while providing the perfect incubators for the type of violent extremists that pose an ongoing threat to America and other nations.

## ***Challenge 3. Urbanization***

The number of people living in cities exceeded the number residing on farms for the first time in 2008.<sup>33</sup> By 2030 approximately 60% of the world's population will live in cities; by 2050 that number is expected to top 70%, nearly as many people as live on the entire planet today.<sup>34</sup> China will continue to account for much of that growth.

China urbanized rapidly in 1990s for two reasons that continue to transform the Chinese landscape today: government-encouraged resettlement into new commercial zones and movement of rural dwellers to cities in search of higher paying jobs.<sup>35</sup> The effects of urban expansion are evident in the construction of a seventh ring road around Beijing, what *The Economist* has called “The Great Sprawl of China.”<sup>36</sup> The road will be 560-miles long and will push the city boundary into arable



farmland. That pattern should be expected to repeat itself in other regions with growing economies and expanding middle classes. In fact Nigerians are already leaving farms in large numbers for higher paying jobs in cities.<sup>37</sup>

One of urbanization's most significant impacts on the agribusiness value chain is the loss of arable land. As growing cities consume farmland, the price of the land increases giving farmers a strong incentive to sell their land rather than continue farming it. The team witnessed this phenomenon firsthand on a site visit to a farm near New Delhi, India. As cities continue growing in size, wealth, and density, the challenge of delivering food to consumers becomes increasingly complicated.

#### ***Challenge 4. Climate Change***

According to the U.S. Environmental Protection Agency (EPA), climate change “includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer.”<sup>38</sup> Virtually all scientists who study the subject agree that all three variables are changing. Changes in climate-related environmental variables are causing sea levels to rise, shifting rain patterns (leading to desertification or excess rain), and altering the ecosystem in ways that are not fully understood. Furthermore, climate change has reduced yields of rice, soybean, wheat, and maize in many areas around the world.<sup>39</sup> The impacts on agriculture are varied and can be extreme.

Multiple global climate shocks in 2010 directly impacted food security around the world as Sarah Johnstone and Jeffrey Mazo document in *Global Warming and the Arab Spring*. Johnston and Mazo discuss climate-linked events from around the globe. Excessive spring rainfall cut Canada’s wheat exports by almost 25%. Russia, Ukraine and Kazakhstan experienced record drought. Fires in Russia reduced wheat yields by 40% leading Russia to implement an export ban. Similarly, China experienced drought and dust storms that reduced crop yields while U.S. wheat harvests were reduced due to late winter storms. Argentina experienced severe drought that reduced soybean and corn crops. And flooding in Australia drastically reduced the quality of their wheat crop.<sup>40</sup>

The events discussed by Johnston and Mazo, among others, all happening nearly simultaneously, “sent consumer prices in North Africa and the Middle East skyward, contributing to unrest that fed the Arab Spring.”<sup>41</sup> Considering the impact of the Arab Spring it is no wonder that the U.S. officially considers climate change a matter of national security. The *2015 National Security Strategy* states, “[c]limate change is an urgent and growing threat to our national security, contributing to increased natural disasters, refugee flows, and conflicts over basic resources like food and water.”<sup>42</sup> Such disasters lead to U.S. engagement abroad as “...droughts, floods, severe storms, temperature extremes, wildfires, and landslides...emerge in places that constitute threats to the U.S.” and often require employing “U.S. military resources as part of an organized response or because of destabilizing effects in critical regions.”<sup>43</sup>

Halting and reversing man-made climate change—this means reducing CO<sub>2</sub> emissions and other pollutants that cause the earth to warm—is beyond the scope of this paper. But it is important to note that climate change is inseparable from agriculture and food security. In fact the recommendations offered in the Opportunities section for waste reduction and plant nutrition could



significantly impact climate change because agricultural production accounts for 13% of all human greenhouse gas (GHG) emissions worldwide.<sup>44</sup>

### ***Challenge 5. Water Scarcity***

Water use issues and policies date back to at least King Hammurabi's time in Babylonia 3,800 years ago and have been a historical driver of conflict ever since. Water management is closely tied to other components of food security, especially climate change. Conflicts over water are likely to intensify in countries negatively impacted by climate change such as India and Pakistan. Legacy freshwater sources are drying up due to climate change and unregulated industrial and agribusiness use. Large-scale farming will not provide enough food for the world's population without crop irrigation that draws water from rivers, lakes, reservoirs, and aquifers.<sup>45</sup> Unfortunately, many regions around the world are experiencing drought, water pollution, and unregulated water use that damages those water sources. For example, China's water challenges include quantity, quality and policy issues. As Dr. Jennifer Turner of the Wilson Center said, “water is China's biggest burden,” particularly for northern China.<sup>46</sup>

To overcome water shortages, the Chinese government is implementing an ambitious water resource management strategy including the world's largest water transfer infrastructure called the South-North Water Transfer Project (SNWTP). The SNWTP is designed to move 45 billion cubic meters

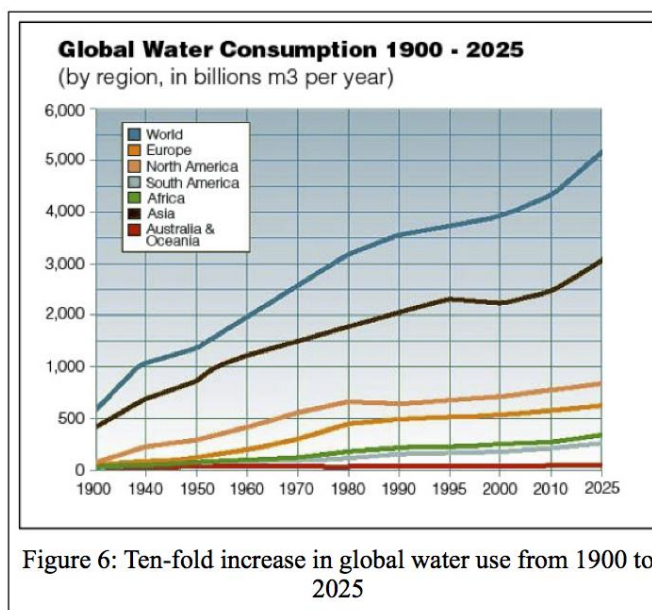


Figure 6: Ten-fold increase in global water use from 1900 to 2025

of water per year from central and southwest China to augment the flow of the Yellow River and meet urban and agricultural water demands in the northeast region.<sup>47</sup> Rather than being an example of successful water management policy, this strategy provides a cautionary tale. Since Chinese water governance is non-existent, this effort risks being undercut by inter-governmental and state rivalries, corruption, and economic incentives that favor development over sustainable resource use. In particular, inter-jurisdictional conflicts over water resources undermine policies to address water scarcity while mismatched incentives between pollution control and economic development at local levels of government threaten to undermine water quality control goals.<sup>48</sup> In parts of China an estimated 35% of the surface water is unfit for human use.<sup>49</sup> Such pollution arises from the misapplication of fertilizers, herbicides, and pesticides in agricultural use and from urban runoff.

As shown in Figure 6, water use is at an all-time high and is projected to increase through at least 2025.<sup>50</sup> Agribusiness wastes a tremendous amount of water (in China and elsewhere) and, since water is often free for farmers, there is little incentive to reduce waste. India has many of the same issues as China. Indian policies actually encourage unregulated water use for agriculture, which severely restricts the amount of water available downstream for urban use. Cross-boundary water



issues are a major problem as well. China and India share many of the same tributaries and have numerous competing claims.

World aquifers are lower now than at any time in recorded history.<sup>51</sup> Water is wasted and highly polluted in many regions around the world, further reducing water resources. Since many people use it, water can be very hard to regulate in a “fair-share” allocation methodology. Regulation varies by country and region. There appear to be either dense legal systems to wade through (e.g., Europe, the U.S.) or there is very little oversight (e.g. India, Africa). Developing countries lack access to water recycling technologies. Poor water recycling policies in other places further exacerbate the situation. Irrigation water only recycles about one-half back to the ground water table; the other half is lost to evaporation or lost in transit through leaking pipes.<sup>52</sup>

Water policies are outdated, driving a need for new policies aimed at making the global agribusiness industry more sustainable to ensure long-term economic viability. Various national laws and policies to manage water rights are highly complex. Water rights are generally based on the water law that applies in a particular country and, at their most basic, are classified as land-based or use-based rights.

## **Opportunities**

The challenges described above are daunting but solvable if the right policies and sufficient resource are put into place. The technology and knowledge exists. The team identified eight opportunity areas that address the most solvable of those challenges given realistic near-term funding projections and the current political climate. There are simple, safe, and effective technologies and methods that can dramatically improve yields in developing countries. Focusing on solutions that are inexpensive and easily implemented will reap the greatest rewards. The paper details eight Opportunity areas in the following order: Reduce Waste, Produce More, Increase Trade & Free Markets, Optimize Development, Target Infrastructure Investments, Increase Reserves, Adapt to Climate Change, and Increase Priority of Non-traditional Security Threats.

### ***Opportunity 1. Reduce Waste***

Waste is endemic at nearly every level of the agribusiness value chain. Fields are over-fertilized, seeds are not planted correctly and never sprout, crops rot in the field or during harvest, food processing produces tremendous volumes of organic waste, food goes unsold, and consumers discard up to a third of what they buy. Over-irrigation wastes countless billions of gallons of water. Chemical runoff from fields as well as excess chemical use creates waste by making groundwater unusable. Despite this litany of tragedies, as discussed below waste is actually the low-hanging fruit in the basket of solutions for feeding over 9 billion people.

#### **a. Reduce Food Waste**

There are two types of 'waste' in the agribusiness value chain: food loss and food waste.

- *Food loss* occurs when agriculture crops never make it to market due to spoilage or pest infestation.





- *Food waste* occurs when products arrive in the market but are never sold, usually due to excess inventory or spoilage. Food waste also occurs when consumers throw food away instead of eating it.

Loss and waste in the agribusiness value chain is so large, prevalent, and preventable that small improvements can produce outsized benefits. In any given year approximately 30 to 40% of food is lost or wasted. Some areas of the pre-consumer value chain, such as production and storage, see waste levels as high as 24% alone. Consumers are estimated to waste approximately 35% of the food they purchase.<sup>53</sup>

Better storage methods and on-site processing offer relatively inexpensive paths to reduce waste. Mud silos have been traditionally used in parts of Ghana and recent studies have proven that if grains are well dried; their use can curb crop loss to near zero.<sup>54</sup> Solar dryers in West Africa and simple mechanical improvements to banana processing in Costa Rica—40% of the banana crop there is lost due to spoilage—are significantly reducing waste.<sup>55</sup> Improved Cava drying methods in Africa are reducing spoilage by over half while also extending shelf life.<sup>56</sup>

Inexpensive improvement in packaging can also produce out-sized benefits. For example, the Purdue Improved Cowpea Storage (PIC) bags use three nested bags with cowpeas stored in the innermost bag. Each bag is tied tightly enough to create an airtight seal, which dramatically reduces spoilage.<sup>57</sup> Waste reduction towards the top of the agribusiness value chain is more expensive. Once produce reaches a market or distribution/production center, reliable cold storage must be available. Cold storage runs on electricity and electrical grids need to be improved. Many countries still under-invest in the infrastructure needed to transport raw inputs to production centers, to store agricultural products so they do not spoil, and to ship food commodities to consumers.

In developing regions, realizing efficiencies in crop production may be as simple as staggering planting to better meet market demands.<sup>58</sup> Using historical data and simple projections (enabled by wireless technology and the right applications), small farmers can stagger plantings to match projected demands for harvests. Biotechnology also has a role in reducing waste across the value chain. Today, even a small blemish due to a pest or physical damage can cause produce to spoil more quickly and make it unattractive to consumers. Biotechnology can make fruits resistant to blemishing and can alter physical traits to allow for longer storage times.

#### ***b. Reduce Water Waste***

Water resource management metrics must come with any meaningful food security reforms. The U.N. is best placed to take the lead on establishing water reduction goals and helping nations achieve them. For example, water cap metrics could be set multi-laterally to drive positive, normative behavior. To meet cap metrics, water use efficiency should be improved to prevent, control, and reduce pollution. Civil society groups could be employed to act as “Watch Dogs” to help countries better monitor water resource metrics.<sup>59</sup> Additionally, international courts should be versed and ready to review and act on trans-boundary water right claims. Water reduction metrics should be consistent internationally. They should be regularly reviewed to improve stakeholder involvement and improve policy buy-in.



One relatively low cost way for central governments to create significant water savings is by strengthening their legal system to make water rights trading and claims processing easier and less expensive. Trading procedures should be codified, special courts for dispute resolution created, and markets made larger and more sophisticated. This effort should be part of a larger framework of legal reforms that strengthen judicial independence and the rule of law.

Aside from regulatory changes, there are a variety of traditional and technologically advanced irrigation methods available. These include field leveling, surge flooding, and runoff capture and reuse. Field leveling uses gravity to transport water. Surge flooding simply releases water onto the level field, at prearranged intervals, to reduce unwanted runoff. Surge flooding remains the most popular low-tech, simple, and cheap method of crop irrigation in the world. Runoff capture and reuse is used in countries that have seasonal monsoon rains such as India, China, and other countries in Southeast Asia and Africa.<sup>60</sup>

More advanced irrigation methods provide better efficiency but tend to be more expensive as well. High efficiency irrigation methods include drip irrigation, spray irrigation (center pivot), and low-pressure application. Drip irrigation (also called micro-irrigation) delivers water through perforated plastic pipes that are either laid along the crop rows or buried along root lines. Evaporation is significantly reduced and up to one-fourth of the water used is saved as compared to flood irrigation. A common type of spray-irrigation system is a center pivot system where metal frames on rolling wheels run through the rows. Low-pressure applications apply water gently from a hanging pipe to use water more efficiently. This method increases irrigation efficiency from about 60% (traditional spray irrigation) to over 90%, however it is more expensive than less efficient options.<sup>61</sup>

## ***Opportunity 2. Produce More***

While reducing waste may be the easiest and most cost-effective way to boost the food supply, it will not by itself provide over nine billion people with the types and varieties of foods they will desire. More food must be produced. The thought of producing more food is daunting. Yet historical examples, including that of China, prove that humanity can dramatically boost yields with targeted investments in five areas: education, yield productivity (e.g., crop output), plant nutrition, workforce empowerment, and biotechnology sciences.

As Lester Brown relates in his 1995 book *Who will feed China? Wake up Call for a Small Planet*, Brown China provides a convincing example that people can vastly increase the food supply. Brown asked the thought-provoking question “Who will feed China?” after studying the conflict between China's growing population and the Chinese industrialization strategy. While meant to alert leaders around the world to a potential food security crisis and the need for worldwide action, Chinese leaders interpreted the question as a direct challenge to their leadership. China's response was understandable considering sensitivity over famines during The Great Leap Forward of 1958-61. Over 30 million Chinese died of starvation during that three-year period.<sup>62</sup> In response to Brown, Chinese leaders responded, “the Chinese people will feed themselves” and quickly enacted agricultural reforms designed to ensure self-sufficiency and national food security.<sup>63</sup>



The World Food Program (WFP) recognized China's progress in 2009 when it reported “per capita daily energy supply reached 2,990 kcal, well above the recommended level of 2,100 kcal in the [Millennium Development Goals].<sup>64</sup>” That number is 14% higher than the average daily energy supply in developing countries and 8% higher than the world average.<sup>65</sup> Today, China is credited with growing “sufficient food to meet the needs of a fifth of the world's population from less than a tenth of its arable land.”<sup>66</sup>

China has made tremendous strides towards food security by investing in yield production (chemicals) and general industrial organization. But China, along with the rest of the world, will need to use the two most highly leveraged tools, education and science, to achieve real long-term food security. Additionally, workforce participation offers much opportunity for increasing production in developing countries.

### **a. Education**

Education underpins all other opportunities and is the key ingredient to reducing waste and increasing productivity while decreasing the negative impacts of farming on the environment. The Department of Agriculture (USDA) is responsible for federal programs at the state and local level; states also help pay for these programs. The Department of State (DoS) and the U.S. Agency for International Development (USAID) fund and manage international assistance programs.

*Analysis suggests that agribusiness education programs provide a high return on investment relative to other forms of development assistance.* The U.S. should prioritize agriculture education on par with emergency assistance and long-term development programs. If budgets remain capped under the terms of the Budget Control Act through 2021, we recommend that agriculture development education programs should receive a greater share of the development budget to be funded through reduction to security assistance and other programs.

Many other countries also have effective agriculture education programs. There are excellent training models from France (Family Farm Schools), Germany (Dual Training Centers), and Switzerland (Agricultural Entrepreneurship Training).<sup>67</sup> There are more than 20 research institutions and several Universities of Agriculture in Nigeria. These research institutions could increase their focus on crops with the highest potential to flourish in Nigeria by focusing on drought-resistant and affordable seedlings of corn, cow peas, sorghum, yams, cassava and many others that could withstand excessive amounts of water.

### **b. Productivity**

Productivity refers to the amount of inputs required to produce a given quantity of output at a specific quality. In terms of agriculture, maximizing productivity means producing the largest volume of crops and food from the least amount of inputs. Examples of productivity increases could be increasing the number of ears of corn on each corn plant as well as increasing the resistance of corn plants to pests and disease.

General productivity enhancement is vital to increasing the food supply; there is only so much arable land for farming, and urbanizing and climate change are reducing that amount each day. Corn provides an excellent example of how far industrialized food production has impacted yields. In 1941, the average yield for corn was 31 bushels per acre.<sup>68</sup> In 2014, it was estimated at 171



bushels per acre.<sup>69</sup> This more than five-fold increase in yield was a result of the work that academic and industry scientists have accomplished over time in developing hybrid seeds, crop protection techniques, more effective fertilizer products, and other technologies. Huge potential exists to realize productivity gains in parts of the world that use minimal amounts of agricultural inputs or use them incorrectly.

Increasing production in the developed world is generally a function of science (biotech and chemistry), smarter irrigation, and maximizing plant nutrition, as good farming practices are widespread compared to the less productive practices in developing nations. Science, smart irrigation, and techniques such as precision farming require large investments and high levels of education to build, implement, and maintain. However, increasing production in the developing world is possible with relatively small investments in education (i.e., better use of fertilizer, planting strategies) and raw inputs (i.e., better seeds and the right chemicals). While increasing productivity in the developing world may require using more chemicals than are used today, yields are maximized when the right chemicals are used efficiently, which decreases damage to the surrounding ecosystem.

### **c. Plant Nutrition**

For millennia, humans struggled to feed themselves in part because only two (phosphorous and potassium) of the three nutrients vital for plant growth naturally exist in sufficient quantities for plants to thrive (nitrogen, phosphorous, and potassium). Synthetic fertilizer led to a productivity boom allowing the population to grow to seven billion people and for those people to live longer and healthier lives. Early in the 20th century, Fritz Haber developed the ability to produce ammonia, the main ingredient in synthetic nitrogen. Several years later Carl Bosch commercialized Haber's work in what has become known as the Haber-Bosch process.<sup>70</sup>

The Haber-Bosch process is still used today to meet 50% of the world's nitrogen fertilizer requirements. Without it the world would not have enough food.<sup>71</sup> However across the world, and particularly in developing countries, fertilizer is often wasted. Developing nations should adapt, with U.S. help, the “**4R** nutrient management concept.” This concept is “the idea of applying the **R**ight source at the **R**ight rate, at the **R**ight time and in the **R**ight place...in [the] application of soil fertility and plant nutrition.”<sup>72</sup>

Another effective technique for optimizing fertilizer use is soil testing. Soil testing determines the types and quantities of fertilizers needed to maximize yields. Soil testing more than pays for itself through higher yields and by allowing farmers to plant winter cover crops. Cover crops protect the soil from erosion and extreme temperatures while increasing biological exchange—the advantageous transfer of nutrients between plant matter.<sup>73</sup> Protecting the soil reduces the amount of fertilizer needed for the next crop cycle, saving money and protecting the environment.

### **d. Biotechnology/GMOs**

Next to reducing waste, biotechnology holds perhaps the greatest potential for humanity to feed itself through 2050. Over fifty years ago Norman Borlaug saved billions using rudimentary biotechnology to double the yields of row crops. Biotechnology subsequently created pest-resistant plants, crops that are immune to certain brands of pesticides, and plants that produce more fruit per plant than their native counterparts. Biotechnology holds the promise of drought-resistant



plants that need far less irrigation than varieties in use today, an essential trait as water becomes increasingly scarce.

Unfortunately, individual countries and even regions within countries have varying levels of acceptance of biotechnology. Some governments actively oppose the use of GMO seeds and the consumption of GMO products because their constituents fear the technology. Others are hostile to technology that is not a product of domestic development. Fear of biotechnology is based on media sensationalism, not science, as science has yet to prove that GMO products present a legitimate health risk. Some countries intentionally hinder acceptance of GMOs. China, for example, allows the media to perpetuate public fear of GMOs because the Chinese government prefers domestic Chinese firms to have market-ready GMO products before the government allows their use—basic protectionist economics.

Even when governments do not interfere and the population accepts GMO technology, cutting-edge GMO products such as seeds can be too expensive for small-scale farmers, especially those who lack access to credit markets. But large productivity gains do not require cutting-edge technology. Many farmers in developing countries would benefit greatly from technology that is several generations old—assuming that the firms that own the intellectual property (IP) would allow seeds based on old technologies to be produced. The U.S. government should explore how it can incentivize or assist U.S. firm to share old and new biotechnology by, for example:

- incentivizing technology transfer to developing countries;
- improving IP protection for U.S. firms;
- educating audiences in the U.S. and overseas that GMOs are safe and effective;
- and supporting existing domestic research efforts through the USDA, land grant universities, and other public-private partnerships.

Considering the potential for GMOs to radically improve yields and provide more food for the people who need it most, U.S. political and academic communities must band together on the international stage to accelerate the acceptance of GMOs.

#### **e. Workforce participation (Women)**

Although women make up about 43% of the farming labor force in developing countries, they continue to face barriers that limit their productivity in comparison to their male counterparts.<sup>74</sup> In one study, women farmers in West Africa produced 18% less than men in the same household. Likewise, in households headed by women, the yield was 35% lower than male-headed households.<sup>75</sup> In many underdeveloped countries woman are a significant portion of the farmers and yet they are not allowed to be land owners and they have no access to credit and products like fertilizers, pesticides and farming tools that could be used to boost productivity.

The World Bank Group found that equal access to resources such as fertilizer, farm labor and training does not always translate into equal returns for women farmers.<sup>76</sup> In many cases, women are simply denied the economic rewards of their work. In many African nations, women have access to land only through their fathers or husbands where men or kinship groups hold land rights. When a women farmer chooses to grow a cash (vs. subsistence) crop, the male owner, not the





women farmer, is legally entitled to any revenue from those crops.<sup>77</sup> Women can lose access to farmland upon the death of their husband.

Indigenous women in Latin and South America face additional obstacles, as many do not have documentation such as birth certificates or identification cards that allow them to take advantage of land reform programs.<sup>78</sup> According to the FAO, approximately 11% of the rural women hold land titles in Brazil, 22% in Mexico, and 27% in Peru.<sup>79</sup> Without title to land a woman will have difficulty accessing legitimate credit markets. Farmers use credit to buy inputs such as seed and fertilizers as well as productivity enhancements such as tractors. Without access to legitimate credit markets, women become prey to operators of illegal credit, often at exorbitant interest rates.

A World Development Report of 2012 on Gender Equality and Development stated that in some countries, labor productivity could be increased by about 25% if countries eliminated barriers that discriminate against women working in certain sectors or occupations.<sup>80</sup> This change could increase national agricultural output by 2.5 to 4.0% and ultimately lift 100-150 million people out of hunger.<sup>81</sup> Therefore the U.S. should increase political support for efforts like the U.N. Food and Agriculture Organization's Gender Equality Policy that advocates for placing the improvement of gender equality at the center of U.N. efforts to boost sustainable agriculture and development. Some countries are making progress in this area and their efforts should be used as an example for other countries to follow. Ethiopia, for example, is reforming inheritance laws and joint titling regulations so that women have stronger legal property rights.<sup>82</sup>

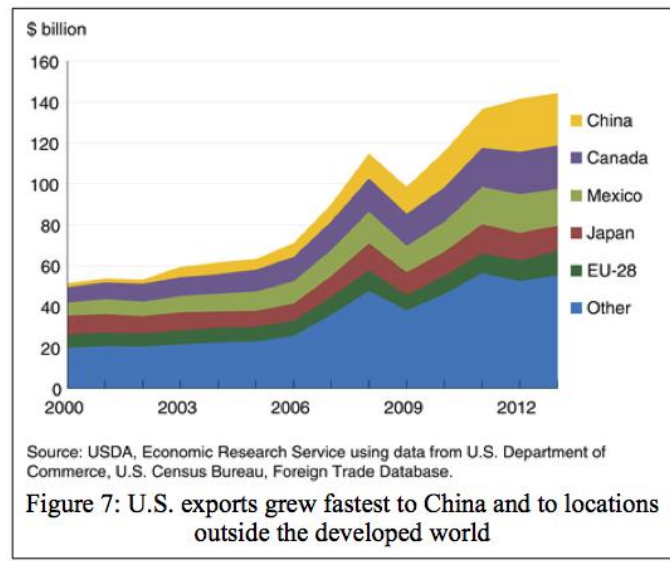
Governments and agricultural assistance organizations should include more women in trial plot studies so they can get first-hand experience and training in best practices, proper utilization of fertilizer and seed selection. The U.S. should insist that its agricultural aid (but not food aid per se) is tied to recipient nations' commitment to expand extension services for women and to include more women in test plots and other programs. U.S. assistance should also promote "Made by Women" initiatives that offer incentives for men to gift land to women and help train women in the production of high-value cash crops to increase their financial security and profitability.<sup>83</sup>



### Opportunity 3. Increase Trade and Free Markets

Agricultural trade provides America with a powerful economic tool. For the past 14 years U.S. agriculture exports have grown faster than imports, pushing the agriculture trade surplus to \$38.8 billion in 2014.<sup>84</sup> America can play on this strength with efforts to expand agricultural trade around the world. The U.S. should focus on expanding trade with developing nations that may not have the economic and diplomatic clout to outmaneuver wealthy competitors such as China. As Figure 7 suggests, growing demand in developing countries is largely responsible for the large U.S. agricultural trade surplus.<sup>85</sup> Free markets

are a core value of capitalism, and the economic system that has lifted people across the world to historically unprecedented levels of wealth and health over the past two centuries.



Based on a free-market model of economics and trade, it is clear that *greater access to markets* and *more efficient markets* are two critical components of improving the global agricultural industry. Unfortunately, efforts to expand free trade—or rather attempts to *optimize global free trade*—are suffering from a shift in attention to regional trade pacts. Regional pacts tend to prevail because it is easier to explain the benefits of free trade with neighbors than to advocate for the relatively abstract principles of comparative advantage on a global scale. But regional trade pacts do not provide as broad a benefit as global agreements if only for the fact that regional pacts bring fewer countries into more liberal trade regimes. Where regional agreements are in place and working well, however, the U.S. should work to expand them and shape them to promote market *efficiency* as well as access.

Critical to U.S. competitiveness is the Trans-Pacific Partnership (TPP) agreement. TPP would eliminate many trade barriers and tariffs between the member countries (Australia, Brunei Darussalam, Chile, Malaysia, New Zealand, Peru, Singapore, Vietnam, and the U.S.). The U.S. Congress should provide the President with fast-track authority to conclude the TPP agreement.

### Opportunity 4. Optimize Development

The destabilizing food crisis of 2007-2008, one of the contributing factors to the Arab Spring, returned agriculture to prominence on the U.S. foreign policy agenda after three decades of neglect.<sup>86</sup> It led the U.S. to revamp its agriculture-related foreign policy agenda for the first time in three decades creating the “Feed the Future” initiative in 2010. As a whole-of-government effort, Feed the Future is the U.S. component of an international effort to reduce food insecurity in an effort to increase global stability. Feed the Future aims to accelerate global agricultural development and food production and to improve nutrition, particularly for women and children.



It harnesses public and private investment, innovation, and research to boost agricultural productivity, mostly through the application of technology. Feed the Future is managed through country investment plans (CIPs) in 19 countries. The program includes eight metrics and three crosscutting priorities: reducing gender inequities, increasing environmental sustainability, and mitigating climate change.<sup>87</sup>

Feed the Future's results speak for themselves. In 2013, the initiative improved nutrition for more than 12.5 million children, increased yields for nearly seven million farmers on over four million hectares of land, helped developing countries reform their agriculture policies, brought rust-resistance wheat varieties to 1.2 million farmers, and empowered nearly a hundred thousand women (in concert with the U.S. Global Health Initiative (GHI)).<sup>88</sup> Feed the Future also created 24 innovation labs at U.S. universities around the country to develop and disseminate agricultural science, technology, and innovation to farmers and agribusiness in the developing world. The labs focus on some of the most difficult food security challenges like reducing post-harvest waste and improving integrated pest management.<sup>89</sup> The labs also created and deployed over 30 new drought-tolerant maize varieties.<sup>90</sup>

Along with implementing Feed the Future, the U.S. has also made important structural changes in how it develops and implements food security diplomacy and assistance. The Department of State stood up an Office of Global Food Security, reporting directly to the Secretary, to coordinate food assistance strategy.<sup>91</sup> Similarly, USAID created a Bureau of Food Security.<sup>92</sup> Both offices have elevated global food security policy on the U.S. national security agenda but could do more to coordinate their activities with other agencies. For example, USDA runs a range of international programs such as the McGovern-Dole International Food for Education and Child Nutrition Program and the Borlaug and Cochran Fellowship Programs, all of which overlap with Feed the Future.<sup>93</sup> The most practical step forward is to authorize a comprehensive strategic approach to reduce global poverty and hunger, achieve food security and improve nutrition, and promote inclusive, sustainable agricultural-led growth. Therefore Congress should pass the Global Food Security Act of 2015 (H.R. 1565), which was recently reintroduced by a bipartisan group.<sup>94</sup>

### ***Opportunity 5. Target Infrastructure Investments (U.S. and foreign)***

Poor infrastructure is a leading cause of food waste and general economic malaise both in the developing and in areas of the developed world. Roads, railways, storage facilities, electricity utilities, and communication systems are inadequate to support the market demand, especially in rural areas. In many places marketing and physical infrastructure are poorly developed while storage facilities are either rudimentary or non-existent.<sup>95</sup> Poor infrastructure decreases the income of farmers, restricts the food supply, and lowers government revenue.

Building roads, bridges, ports, and airways is extremely expensive relative to intangible options such as education, improving market access, and improving market efficiency. Therefore, we recommend that the U.S. target infrastructure aid towards areas with the greatest leverage—for example, educational institutions and scientific research facilities are excellent candidates for investment—particularly if the federal budget remains tight. We also recommend that State and USAID promote and wherever possible prioritize agribusiness infrastructure investments across



their programs consistent with national security objectives, particularly in the opportunity areas of waste reduction and yield improvement.

### ***Opportunity 6. Increase Reserves***

Governments around the world have historically set aside significant amounts of agricultural commodities in order to hedge against a catastrophe or exogenous event that could create food scarcity or increase food prices. “Storing food in times of plenty for use in times of scarcity is a prehistoric idea that still has relevance and importance today.”<sup>96</sup> But world grain carryover reserves have sunk to a critical low level over the last decade due to climate-related issues, decreased production, and increased demand. “With food consumption exceeding the amount grown for six of the past 11 years, countries have run down reserves from an average of 107 days of consumption 10 years ago to under 74 days recently.”<sup>97</sup>

Reserves have, in part, come back onto countries’ policy agenda because some of the alternatives, including a reliance on international trade to guarantee food supply, proved unreliable during the price spikes of 2007-08. Yet there is still no international platform that would allow a thorough debate of whether and how reserves could work. Reserves are like the orphan child at the banquet: not excluded from the guest list, but without a rich parent to bring her forward.<sup>98</sup>

In terms of policy, U.S. leaders should take action to increase U.S. food reserves and work within the international community to increase world grain carryover reserves. “Grain reserves are a tool that can reduce excessive volatility in agricultural commodity markets. Low or uncertain stock levels are a necessary pre-condition for excessive volatility to occur; a transparent, predictable and accountable reserve is a powerful tool against such volatility.”<sup>99</sup>

### ***Opportunity 7. Adapt to Climate Change***

Meeting climate change challenges requires a three-pronged approach: respond, adapt, and mitigate.<sup>100</sup> Government agencies are in the best position to lead efforts to *respond*. In fact the Department of Defense (DOD) would appear to have already volunteered itself for a leading role in fighting climate change. DOD 2014 *Climate Change Adaptation Roadmap* reads:

As climate change affects the availability of food and water, human migration, and competition for natural resources, the Department's unique capability to provide logistical, material, and security assistance on a massive scale or in rapid fashion may be called upon with increasing frequency.<sup>101</sup>

A wide array of public and private institutions can support efforts to *adapt*. There is a major role for academia in developing adaptation strategies that can be used across industries. But it is the global agribusiness industry (think Monsanto, Cargill, etc.), partnered with academic institutions (and land-grant universities in particular) that will likely develop the most innovative and effective adaptation strategies. Profit-driven R&D will continue to be the engine that give us pest-resistant crops that require far less chemical treatment than natural varieties, produce that stays fresh longer



thus reducing waste, and eventually drought-resistant plants suitable for arid climates and adapted to environmental fluctuations from climate change.

*Mitigation* strategies include “...shifting from coal- to gas-fired power plants...developing renewable energy...[and] reducing deforestation and associated emissions...”<sup>102</sup> Geo-engineering and theoretical methods to accelerate removal of carbon dioxide from the atmosphere should be explored as well.

### ***Opportunity 8. Increase Priority of Non-traditional Security Threats***

Historically, governments have considered military hardware, maneuver, and victory on the battlefield (the military instrument of power) as the tool best suited to provide national security. In contrast, today’s U.S. military doctrine recognizes the important role the military plays during the “shape phase...to dissuade or deter” future hostilities. Despite growing recognition of the importance of winning “hearts and minds,” there remains a predisposition to think of security in military terms, which needs to be adjusted to prevent non-traditional security issues from enflaming conflict and war.

Caballero-Anthony and Cook, experts in national strategy based in Singapore, recommend that leaders redefine state security threats in terms of threats to the population versus the traditional notion of threats to sovereignty. They argue such threats, which include food security, water security, health security, energy security, natural disasters, internal conflict, forced migration, transnational crime, and cyber security “are proving to be more severe and more likely to inflict more harm to a greater number of people than conventional threats of interstate wars and conflicts.”<sup>103</sup>

Specifically, U.S. policy makers need to ensure prevention of food insecurity is considered as a funding issue on par with other major security initiatives.

### **Recommendations**

Despite the aforementioned challenges, there is compelling evidence that the world can feed over nine billion people in 2050 and do so better than we feed seven billion today. The evidence is clear: hunger is on the decline, the diversity and availability of food for the wealthiest billion is historically unprecedented, and global agribusiness is *producing* more than enough food to feed every person plus billions of chickens, cattle, and other animals in the human food chain and to support ancillary industries such as biofuels. Fifty years ago, Norman Borlaug’s “green revolution” at least doubled yields of many crops allowing for the production of food for billions more with no additional land.<sup>104</sup> Chemical and genetic engineering has thus far outpaced nature’s unrelenting ability to introduce new versions of bugs, weeds, microbes, and other pests. But a rapidly increasing population, growing desire for complex foods (i.e., meats, processed foods, imports), and the impacts of climate change conspire to create a daunting challenge requiring policy responses that are coordinated across agencies, with the private and non-governmental sectors, and between both developed and developing countries.<sup>105</sup>

Over the past six months the agribusiness industry study research team undertook a thorough study of the agribusiness industry, a study that revealed a landscape of tragedy, deprivation,





overabundance, gross inequality, and waste. Above all, however, we found high-return-on-investment opportunities to advance the welfare of humanity and the planet. There is a disconnect between the need for food and its availability that allows consumers in developed countries to waste nearly half of the food they buy while millions go hungry. This disconnect is based on the simple fact that agribusiness, like all industries, functions on the economic principle of supply and demand. Profit motive is the ultimate resource allocator. If we are to adequately feed the seven billion people alive today and the additional two-plus billion coming by 2050, it must be done through, by, and in conjunction with market forces. Therefore the recommendations in this paper focus on *increasing profit in the agribusiness value chain*. The recommendations help farmers earn more revenue (so they can afford better food), reduce waste in all links in the value chain, and reduce systemic inefficiencies (which yields freer trade, more tech transfer, etc.). The recommendations are also heavily tilted towards investments that have relatively low direct costs. Such investments include education, technical transfers, and free trade initiatives.

These recommendations do come at some cost in financial resources and political energy. In order to justify investing more in agriculture at the expense of other priorities, policy makers must embrace the idea that sufficient nutrition is a fundamental human right with far-reaching benefits. The next U.S. national security strategy should explicitly state that increasing food security around the globe is a top national security priority. This simple change would allow agencies (principally State and Agriculture) to prioritize their annual budget requests around programs that enhance global food security. To optimize food security investments, and allow the bureaucracy to identify the necessary budgetary offsets, the office of Management and Budget (OMB) and the National Security Council (NSC) should establish a food-security crosscut in the President's Budget. The crosscut should include an interagency working group to examine all U.S. federally funded programs related to food security. The working group (not the agencies) should take the lead de-conflicting and prioritizing food security programs in the budget.

U.S. assistance policies should prioritize low-cost, high-yield programs designed to educate poor farmers and reduce waste. These two efforts in particular should be prioritized over more expensive development areas. To reduce waste the U.S. should revisit its domestic policies regarding food safety and import/export of food products. Expiration guidelines should be reviewed to ensure they are scientifically sound and not overly cautious. Policies should incentivize not throwing away agricultural products because of aesthetic blemishes. U.S. food safety surveillance and control methods should be refined to prevent another wasteful episode like the 2008 salmonella scare when 80% of otherwise healthy tomatoes were destroyed due to an erroneous warning from the FDA.<sup>106</sup> The U.S. should also encourage an international body such as the United Nations to take the lead in setting food and water waste-reduction goals for all countries.<sup>107</sup>

There are a number of policies that should be implemented to help secure water resources as well. One recommendation is to hold multi-lateral discussions between countries with large populations and regulatory needs. China, India, Pakistan, many African nations, and the U.S. (at a minimum) should participate in these talks. These meetings should be conducted on a recurring basis and at least semi-annually. These meetings are critical to better understanding each country's issues and the potential solutions to their individual problems.



Finally, industry and academia must be further incentivized to make technology available at a cost that is viable for farmers in developing countries. Sharing technology comes at a relatively small economic cost to developed countries; however, individual firms cannot be expected to sacrifice economically for the greater good. The U.S. government should explore financial and non-financial incentives for companies to share technology in a way that does not negatively impact their business. Farmers in the developing world could benefit from seeds that are several generations behind cutting-edge, for example. In addition, by widening the aperture for sharing technology (and reducing trade barriers), the U.S. will earn political goodwill and create new opportunities for U.S. businesses to export American products and to do business overseas.

These changes are in the best interest of the U.S. Less waste, better yields, and more durable harvests will translate into more profit for farmers (moving them from subsistence farmers to market consumers), children who are better able to learn at school, additional revenue for developing countries (so those countries need less foreign assistance), less risk of expensive problems such as terrorism, ungoverned spaces, and other nontraditional security problems, as well as many other benefits. Nontraditional security risks such as ungoverned spaces and poor education are the *root causes* of many of the most persistent and expensive problems. For example, the spectacular rise of violent extremists in the Middle East and Northern Africa was made possible largely because of droughts, high food prices, and local tribal competition for food and water resources.

In 1948 the world proclaimed that food is a fundamental human right when the U.N. General Assembly adopted The Universal Declaration of Human Rights (Article 25).<sup>108</sup>

(1) Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.

Nearly seventy years later that proclamation remains a lofty goal as few nations honor it even for their own citizens. But it is a goal to which the world, starting with the U.S., must re-commit. The nearly one billion people who suffer from chronic malnutrition are more than a tragedy; they are a drag on the economic wellbeing of all nations and the root of many security problems around the world. *It is therefore in the economic, moral, and political interests of the developed world to redouble efforts to eradicate hunger.*



## Endnotes

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