

**Spring 2012
Industry Study**

**Final Report
*Agribusiness Industry***



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AGRIBUSINESS 2012

ABSTRACT: The United Nations predicts the world population will reach 9 billion people by the year 2050. Food production and availability will have to increase by as much as 70% in order to provide for this massive increase in population. The United States must use its considerable agricultural production base to ensure that food security exists throughout the world. This must be a concerted and integrated effort where commercial interests and foreign policy initiatives work in tandem in order to increase agriculture production while simultaneously reducing food loss that occurs due to post harvest waste and spoilage. American agribusiness is an essential aspect of our national power that will be even more valuable in the coming decades.

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PLACES VISITED

Domestic:

United States Department of Agriculture (USDA) 2012 Outlook Forum, Arlington, VA
International Food Policy Research Institute (IFPRI), Washington, DC
Development Alternatives International (DAI), Bethesda, MD
US Senate Committee on Agriculture, Nutrition, and Forestry, Washington, DC
Office of United States Trade Representative, Washington, DC
Food and Agriculture Organization of the United Nations, Washington, DC
United Nations World Food Programme, Washington, DC
Smithfield Foods, Smithfield, VA
Purdue University College of Agriculture, West Lafayette, IN
Purdue University Archer Daniels Midland (ADM) Agriculture Innovation Center, West Lafayette, IN
Purdue University Agronomy Center for Research and Education, West Lafayette, IN
Purdue University Animal Science Research and Education Center, West Lafayette, IN
Purdue University Wood Products Laboratory, West Lafayette, IN
Huffman Farms, Lafayette, IN
SYSCO Foods, Salinas, CA
Gills Onions, LLC, Salinas, CA
Smart Wash, Salinas, CA
Tanimura & Antle - Artisan Lettuce, Broccoli and Cauliflower field tour, Salinas, CA
Central California Irrigation District HQ, Los Banos, CA
Port of Stockton, Stockton, CA
Castle and Cook Cold Storage Facility, Port of Stockton, CA
University of California Davis (UCD), Agricultural & Environmental Sciences, Davis, CA
UCD, Western Center for Food Security and Safety, Davis, CA
UCD, Foundation Plant Sciences Research Facility, Davis, CA
BenDen Farms, Colusa, CA
Lundberg Farms, Richvale, CA
Sunsweet Coop, Oroville, CA
Monsanto Vegetable Seeds, Woodland, CA
Rominger Brothers Farms, Winters, CA
Benziger Winery, Glen Ellen, CA
Cowgirl Creamery, Petaluma, CA
Revolution Foods, Oakland, CA

International:

Tyagi Farm, Badshahpur, New Delhi, India
Ballabhgrah Grain Mandi (Wholesale market), New Delhi, India
Indarpuri Market, New Delhi, India
Indian Council for Agricultural Research, New Delhi, India
Federation of Indian Chambers of Commerce and Industry, New Delhi, India
Cargill India, Gurgaon, India

Lemp Brewpub & Kitchen, Gurgaon, India
Azadpur Subji Fruit & Vegetable Market, New Delhi, India
IP Cold Storage, New Delhi, India
Khari Baoli / Chandni Chowk Wholesale Nut Market, New Delhi, India
Thai Rice Exporters Association, Bangkok, Thailand
Thailand Development Research Institute (TDRI), Bangkok, Thailand
Ministry of Agriculture and Cooperatives, Office of Agricultural Economics, Bangkok, Thailand
Central Foods Retail Company, Ltd., Bangkok, Thailand
United States Embassy, Bangkok, Thailand
Saha Farms Company Limited, Chaibadal Lopburi, Thailand
United States Consulate General, Hồ Chí Minh City, Viet Nam
Cần Thơ University, Aquaculture and Fisheries College, Cần Thơ, Viet Nam
Cần Thơ University, Agriculture and Applied Biology College, Cần Thơ, Viet Nam
Mekong Delta Rice Institute, Cần Thơ, Viet Nam
Cần Thơ City Department of Agriculture and Rural Development (DARD), Cần Thơ, Viet Nam
Gentraco Rice Company, Thốt Nốt District, Viet Nam
Southern Horticultural Research Institute (SOFRI), Châu Thành District, Viet Nam
Hồ Chí Minh City DARD, Hồ Chí Minh City, Viet Nam
Bến Thành Retail Market, Hồ Chí Minh City, Viet Nam
Institute of Agricultural Science for Southern Viet Nam, Hồ Chí Minh City, Viet Nam

Organizations that Provided On-Campus Presentations:

Croplife America
United States Department of Agriculture, Economic Research Service (ERS)
United States Department of Agriculture, Foreign Agricultural Service (FAS)
American Farm Bureau
National Cotton Council
National Cattlemen's Beef Association
Wilson International Center for Scholars
Nestle Foods
Kraft Foods
United States Department of State, Senior Advisor for Biotechnology and Agriculture Trade
Monsanto Company
Cargill Incorporated
Bunge North America
Agriculture Coalition for Immigration Reform
McCormick and Company

Introduction

The United Nations Food and Agriculture Organization (FAO) predict that by 2050, food availability and access must increase by as much as 70% in order to provide for a dramatic spike in population.¹ This is premised on their forecast of a future global population of 9 billion people—two billion additional people within four decades.² The most significant growth will occur in the developing world, specifically in Africa and Asia. In these regions, the food access must increase even more—by as much as 120%.³ The failure to ensure sustainable food security may impact global security, and could adversely affect the national interests of the United States.

Food security is defined as a situation “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.”⁴ The ability of the United States and other nations with heightened food production capacity to help feed the world will be one critical component of national power in the future. However, developing nations must become more sustainable and self-sufficient so that they can provide for their own population’s needs. Conversely, this competition for food and resources could result in instability and conflict if it is not addressed strategically and realistically.

Our industry study takes an expansive look at global agribusiness, the future of food security and identifies the potential fault lines for conflict, especially in Asia. This analysis will begin with a definition of the industry, a synopsis of the current domestic and international industry conditions, and challenges that impact national interests and national security. Next the report briefly describes the outlook for meeting the 2050 challenge and then will transition to a more detailed analysis of government policy. We propose a range of realistic and integrated approaches to maintain a healthy U.S. agribusiness productive base, maximize food security for the world population, while mitigating sources of strife and conflict over the most basic human need, namely food and water. Finally, discrete topics such as climate change infrastructure and fisheries will be analyzed in short essays.

Our international analysis focuses on Asia because our national strategy has pivoted towards Asia.⁵ Additionally, during our industry study we conducted field studies to Asia and met with industry and government officials who are designing programs and businesses to address the current and future food needs for the Asian region.⁶ After careful analysis, we have concluded that an integrated approach that incorporates twin solutions such as increased production as well as sharply decreased waste and spoilage holds the most promise to address the challenge of food security in the future. Development goals can be attained through complementary efforts between government funded and sponsored programs along with commercial investment. Our proposals are pragmatic as well as culturally and commercially viable. We examined traditional agricultural challenges such as genetically modified seeds and trade protection but we also considered the impact of climate change and water resources. We included the fisheries industry in Asia since it is an important source for the protein needs of that region. Finally, we examined the impact of infrastructure on agribusiness, because food storage and distribution are vitally important aspects of this problem.

Our analysis revealed that the greatest potential for vulnerability and insecurity lies in the periphery of agribusiness such as access and availability of water, trade and export policies, acceptance of biotechnology, and improvements in infrastructure. These are also the areas that hold tremendous potential for progress and may be the key components for the coming food security challenges.

Industry Defined

Agribusiness in the United States is a widely diversified sector with segments across the value chain. Inputs of seed, feed, water, land, machinery, fertilizers, and pesticides transform into food-crops, livestock, fish, and forest products. The products might be processed and stored, transported, and sold.⁷ The Agribusiness industry is one of the largest and most diverse markets in the U.S. economy, involving over 2.1 million businesses bringing in \$2.3 trillion in revenue in 2011. In 2011 agriculture production alone contributed 10% of U.S. 2011 exports, and a net \$32.5 billion in agricultural trade surplus, contributing to the recovery of the U.S. economic base and global food security.⁸

Domestically, agribusiness is considered a mature industry, subject to relatively narrow margins. It is capital-intensive, and firms and farms continue to consolidate and integrate vertically to achieve economies of scale in production and supply chain management.⁹ This is reflected in average farm size of 418 acres with fewer than 2% of Americans farming for a living.¹⁰ Globally, the industry ranges from similar, large-scale farming operations to the smallest subsistence farmer who relies on intensive manual labor rather than machinery. For example in Brazil two thirds of farms have fewer than 247 acres, while India boasts an average farm size of only 3.3 acres.¹¹

Looking at Michael Porter's Five Forces model, the industry faces both threats and opportunities.¹² As developing nations emerge, the number of new entrants into agribusiness will likely increase. However as this occurs, demand is expected to increase mitigating any threat to those already in the market. Related to new entrants is the threat of substitutes. As incomes rise across the globe, preference for protein and processed foods over grains will rise.¹³ Without a shift in production toward protein and more processed products, food security is threatened. Food preference and nutrition are key components of the definition of food security. Shifting to the bargaining power of suppliers and buyers, farmers are price-takers when it comes to inputs such as land, fertilizer and seed. In addition commodity prices limit farmers' position in the marketplace. Value is added and margins are gained during the processing and distribution portions of the value chain.

Strategic Game Board analysis for where, how, and when companies or industries should compete suggests that Asian markets should lie at the heart of the mid-long term strategy of U.S. agribusiness across most of the sector's value chain, from producers of inputs (seeds, equipment), livestock and grain producers, processors, and logistics firms.¹⁴ Further market analysis indicates that innovation and differentiation is one strategy for higher value growth, pursued for instance by Monsanto in its biotech-driven seed business.¹⁵ Globalized operations, whether through exports, joint ventures, or foreign direct investment, is a second critical component for value creation, given increased international demand and increasingly global supply chains.¹⁶ Asian markets are pursuing similar strategies. Thailand competes well in the

rice market by differentiating with its high quality aromatic hom mali (jasmine) rice. Vietnam is seeking to expand exports of high-value fruits and vegetables.

Current Situation

Domestically, the United States remains food secure and will remain so for the foreseeable future; the global food security outlook is less certain. Agribusiness is on a positive short to mid-term track as growing corporate interests supply resources to push productivity higher. Domestic and export demand are expected to continue rising as consumer income, sentiment, and spending around the world rebound out of the global recession. Starting in 2007, U.S. agribusiness revenues boomed as a result of high commodity prices. Certain factors such as government support for biofuels as well as increased export opportunities contributed to the revenue growth in U.S. agribusiness. The higher prices meant profit for certain segments of the agribusiness industry, but the higher prices contributed to food security concerns in some developing nations that import basic food grains such as rice or wheat.¹⁷

The policy incentives for biofuels combined with a global spike in oil and energy prices drove commodity prices higher. Implementation of the Energy Policy Act of 2005 increased the requirement for biofuel production supply, which boosted demand and prices for inputs such as corn and soybeans. World grain shortages were caused by adverse weather in key farming countries. Although American agribusiness has increased supply to meet the increased demand to date, its ability to maintain high-levels of growth indefinitely are limited by land available for cultivation and additional yield gains. The sharp rise in prices meant boom years for many American farmers, but it may have exacerbated the global food crisis as the price for basic sustenance grew at an accelerated pace just as most low and middle income people were struggling economically.

Export markets for U.S. agribusiness are likely to continue to grow.¹⁸ Agribusiness processors have an extensive global presence and are actively looking to expand even further. “Only 1.3% of food is processed in India, compared to 60-80% processed in the developed world, despite India being the world's largest holder of livestock, milk and spices, and the second largest producer of fruit, vegetables and oilseeds.”¹⁹ In the fruit and vegetable market, Thailand only processes 30% as compared to Brazil's 70%.²⁰ Large firms such as Archer Daniels Midland, Kraft, and Cargill are resident in dozens of countries and are looking towards Asia to expand even more; the attention of U.S. farmers and livestock producers is focused on Asia as well, as China overtook Canada in 2011 as the single largest market, with Japan and South Korea in the top six markets.²¹ Pork producers are exporting large amounts of meat to Asian markets. Meat processing and feed production are likely to see the greatest boost in food demand growth as the emerging middle class in India and China consume more animal protein. U.S. products are trusted and are a sought after value-added commodity.²² The U.S. Grains council published an extensive report focusing on export opportunities in Asia in the upcoming decades.²³

American Agribusiness' continuing trend of corporatization and vertical integration continues. Many remaining family farms are tied to exclusive contracts with downstream processors. Corporatization in agribusiness has led to consolidation into larger, more capital-intensive farms, with access to new, expensive technology enabling a competitive edge. The use of agricultural consultants and experienced farm managers, along with greater use of crop-

enhancing inputs such as biotech seeds and fertilizers, has resulted in output increases which boost total available supply. Today a smaller number of farms account for a greater share of total farm output because of the continued corporatization of the entire farming supply chain. Stated differently, the business structure of U.S. farms contributes to their productivity and is a positive trend for the industry from a perspective of market analysis.

The scope of this study includes the production of food but also includes policy-related food availability, accessibility, and safety-related issues as well. The industrial and natural resource concerns that agribusiness is either dependent upon or codependent with in order to improve food security are included in the study. Increasing food security will require efforts that touch the ends of the agribusiness value chain. Use issues related to inputs such as water and land, as well as efforts to reduce food spoilage through productivity, processing, storage, infrastructure, and distribution improvements in the food-supply chain must be addressed to ensure global food security.

Challenges - Major Agribusiness Issues that affect National Security²⁴

There are a number of significant issues related to Agribusiness that impact the national security and economic interests of the United States, some of which may not be obvious. These include international issues such as: food crises and social unrest; competition for water in Asia; and population growth; plus domestic issues such as labor and immigration issues; supply chain infrastructure; and the federal debt's restraining impact on federal spending. Both domestic and international issues will impact our national interests but the international issues pose a larger concern because of the dynamic nature of the problems as well as the limited ability of the United States and international organizations to influence foreign governments in an integrated and complementary fashion. In this section we identify areas of concentration and concern and will propose policy options later in the paper.

International Issues

A. Food Crises and Social Unrest: In our global economy, it is practically impossible to divest one economic trend from another. The same high commodity prices that benefited U.S. farmers caused a "food crisis" in developing nations. U.S. consumers spend very little of their income to purchase food; current estimates indicate that it is less than 10% of household income, compared to over 40% in some countries, up to 70% among the poorest social strata.²⁵ In those parts of the world, even a modest increase in food prices can have a disastrous impact. Simply put, hunger and violence often occur together. This can lead to political instability and threaten a nation's security. A nation's security can even be threatened when a country is concerned about its ability to feed its people in the future. The U.S. will often provide military and humanitarian assistance to locations facing famine. Food aid is an important failsafe, but it cannot be the solution for the anticipated population spike for a large number of reasons. The primary U.S. policy response is the Presidential "Feed the Future" initiative, which utilizes innovation, research, and development to improve agricultural productivity, enhance nutrition, and build safety nets.²⁶ These investments will increase the supply of food where it is needed and help vulnerable people withstand price shocks better.²⁷

B. Resource Competition: Competition for resources is often a source for strife.²⁸ Competition for precious water resources will be a significant factor for many nations. There will be

domestic competition for water as the population shifts to urban areas and diverts water from irrigation of agricultural lands, in competition with industrial and urban population usage. In the Asia region we visited during our international field studies, there are many infrastructure projects that could cause friction between nations. Irrespective of climate change, the projection for adequate water supplies for irrigation throughout the world is a cause for concern. In China, the majority of agricultural production is in China's semi-arid northern region, which is heavily dependent on irrigation as opposed to natural rainfall or subterranean aquifers.

As a result, China has several ambitious projects that could impact neighboring countries. For example, in Southeast Asia, countries such as Cambodia, Laos, Thailand, and Vietnam are dependent on the Mekong River for their own irrigation, consumption, and industrial purposes.²⁹ However, the Mekong River originates within China's borders, high in the mountains of Tibet. China's growing need for water and energy resulted in a plan to build a series of dams along the Mekong, which in China is called the Lancang, in order to generate hydroelectricity and reroute flow to the north. These dams have already impeded the flow of water to those Southeast Asian countries, which have begun to protest the plan.³⁰ A similar situation exists with India and the Brahmaputra River, which originates in the Chinese Himalayan Mountains and in Chinese is called the Yarlung Tsangpo River.³¹ China is building dams along this river for the same purposes.

C. Population Growth: According to the FAO, future population growth by 2050 is projected to be the highest in Asia, India and China in particular.³² These two countries share one of the most rugged and heavily militarized borders in the world, and the population growth will further exacerbate the competition for resources.³³ As these countries become more populous, they will become more prosperous, which will drive demand for animal derived protein even higher.³⁴ The correlation to U.S. national security is very real as the U.S. is sometimes viewed as a counter-balance to China's influence in the region. As the United States continues to strengthen ties within the Asia-Pacific region, it must have full situational awareness of issues that could lead to tension and even conflict among Asian nations. Any regional conflict could have significant impact on our economy and in an extreme circumstance could lead to military involvement. Conversely, if the U.S. remains actively engaged, there could be tremendous market opportunities for Western agribusiness in these countries, especially as these economies grow.

D. Immigration/Labor Issues: Immigration in the United States has become a hot button political issue affecting both security and agribusiness. Border security is an important component of our national security, and recent measures to secure the border have reduced the flow of migrant workers from Mexico to the U.S. This is a significant issue for Agribusiness as migrant workers currently serve as the only productive labor pool for U.S. farmers. As the Department of Homeland Security has put more effort into securing borders and halting the flow of illegal aliens, there has been a reduction in availability of skilled migrant farm laborers. There is a potential to experience reduced yields of fresh fruits, vegetables, and other commodities that cannot be machine harvested. This could result in a shift of agricultural production in horticulture and potentially cause downward pressure on some U.S. farm incomes.³⁵

It has become too difficult and too dangerous for many migrant farm laborers from Mexico to come and go with the agricultural seasons as they did in the past, due to the violence associated with drug cartels and human trafficking organizations. Although staple crops such as wheat, sorghum, and corn are reliant on mechanized planting and harvesting, fresh fruit, vegetables, and nut crops are as heavily reliant on manual, migrant labor. Discussions with farmers in Indiana and California illuminated the distinction between securing the borders and a skilled migrant labor force. They agreed that border security is a priority but they were intimately familiar with the permutations that our current policies have in their local communities—from the danger that current border crossings pose for an ordinary migrant worker to the proliferation of counterfeit documents and the degradation of the available labor force.³⁶ This is a significant challenge that the federal government must address so that we have an affordable, diverse food supply. The Federal government has not yet achieved a balance between immigration, agribusiness and national security

E. Supply Chain/Infrastructure: Supply chain infrastructure is an area of agribusiness that is vital to the distribution of food and food security. According to the World Food Programme, there is enough food produced in the world today to feed the global population of approximately 7 billion people; food insecurity sometimes results from poor, insufficient or unreliable supply chain infrastructure. The shortfalls of the infrastructure include insufficient storage (to include cold storage), inadequate transportation networks for timely distribution, and insufficient outlets to deliver the food to the people who need it the most.

F. The Budget: Our overall federal budget and the Department of Defense budget will be drastically cut in upcoming years. This could have a debilitating effect on certain defense related industries. Fortunately, agribusiness is a robust, largely private commercial venture all across the globe. Unlike other industries such as fighter aircraft or space satellites that are wholly dependent upon government customers, agribusiness sells to literally every person in the globe.³⁷ Therefore, there are also opportunities to leverage commercial interests that are congruent with our foreign policy objectives. These will be achieved largely through trade and other international agreements, but responsible, sustainable commercial development could greatly alleviate the pressure to feed large portions of a growing, hungry world. The federal debt-driven need to cut the budget is a significant challenge for any foreign assistance program, and it is certain that we will need to fashion strategies that are economically viable.

Outlook - Meeting the 70% more food by 2050 Challenge

The widely-cited FAO statement about food security in 2050 asserts that the world needs to increase food production by 70%. This report takes a broader approach to ensuring food availability and accessibility through a variety of mechanisms, including reduced waste and spoilage; improved infrastructure; expanded use of biotech crops, particularly in drought affected areas; increased export and trade opportunities; and expanded cooperative extension efforts to improve yields and quality.

A. Reduced Waste and Spoilage: As we attempt to increase production over the coming decades we must also do better to provide basic access to food and to reduce the food loss caused by waste and spoilage. Improved infrastructure is an important part of the solution to this

problem. Most experts agree that there is probably enough food today to feed the world³⁸ yet recent estimates by the World Bank show nearly 10 million people die of hunger and hunger-related diseases each year.³⁹ The tragedy occurs between production and consumption. The problem concerns access, economics, infrastructure, poverty, cultural differences, waste, and spoilage.⁴⁰

While production will need to increase to support the growing population, “tensions between production and access to food can also be reduced by tapping into the potential to reduce food losses.”⁴¹ In developing nations, food spoils before it reaches the consumer; in developed nations, food is wasted after it is purchased by the consumer. The FAO recently reported that western nations waste as much food as sub-Saharan Africa produces.⁴² We need to pursue concerted efforts to reduce food waste in the affluent areas while developing infrastructure to minimize spoilage in developing nations.⁴³ In order to address food spoilage, there must be significant improvement in infrastructure.

India is a huge developing nation and can be an exemplar of the spoilage problems as well as a test bed for a comprehensive approach to solutions for the problem. The food spoilage problem in India is in our national security interest to address because of their global political significance. They are a nuclear power with tense relations with some of their neighbors.⁴⁴ We do not want to have instability in this area due to food shortages. India made tremendous strides in food security in the so-called “green revolution” of the 1960s and 1970s because they incorporated new strains of wheat and rice into their agribusiness. We should work with India to encourage and enable them to enjoy similar success in reducing spoilage.

Recent reports about India’s food spoilage contain alarming numbers. The Indian government estimated that one tenth of the total harvest, or 20 million tons of wheat rotted in open storage.⁴⁵ This loss occurs whilst India ranks 66th out of 88 countries on the Global Hunger Index.⁴⁶ This situation is even more tragic because the government actually has to expend precious resources to get rid of the excess grain in order to avoid an even bigger public health crisis that could have resulted from disease-carrying rodents. In 2008, the Indian government spent tremendous sums to get rid of approximately 130,000 truckloads of grain that decayed in storage.⁴⁷ Thus the tragedy of waste and spoilage is compounded by the use of government assets needed to remove improperly stored grain.

Western companies such as Walmart are eager to gain access to India’s markets and would inevitably improve infrastructure if they were allowed to operate.⁴⁸ They are viewed suspiciously in India just as they are in towns in America because they are perceived to be a threat to local and small businesses.⁴⁹ Currently they are restricted to operating as a joint venture due to Indian law, but they are reported to be pursuing a more significant presence throughout India.⁵⁰ There are increasing demands to allow Western type markets in India to greatly decrease spoilage with better infrastructure.⁵¹

During the course of our industry study, all of the profitable, efficient, and innovative multinational corporations that we have studied or heard from emphasize the primacy of infrastructure. Whether it is Archer Daniels Midland, Cargill, Nestle, or Kraft, there is consensus that profitability results from infrastructure and logistics systems that can deliver food

and foodstuffs to all corners of the globe with the greatest efficiency.⁵² Therefore, we should extrapolate from their commercial calculus that the best foreign policy goals and objectives should focus on the infrastructure necessary to capture food while it is still fit for human consumption, to store it safely and to procure those portions necessary for provision rather than focusing solely on increased production if it will not result in increased edible foodstuffs.

Awareness, education, technology, investment, and change of behaviors are all key to attacking the issue. It will take involvement by all: government, universities, educators, companies, the industry and individuals. It will also take action along the entire supply chain, not just in one area. Lastly, it will take time and effort on behalf of all those just mentioned.

B. Biotech Innovations and Biofuel Initiatives: With rising population leading to higher food, feed, and fuel demands, responsible use of biotech crops should be encouraged in order to more effectively meet growing needs. Biotech innovation is on the rise. However many areas of the world view biotech unfavorably for several reasons, such as concerns about gene transfer and allergens.⁵³ With the right impetus, biotech crops can be re-marketed to target certain growth areas such as fuel crops in order to help solve the impending crisis.

Biotech Food and Feed: The farming and scientific community have evolved from the use of an open-pollination process to hybrid seed to genetically modified (biotech) seed in an effort to stay ahead of the growing population. According to statistics provided by the USDA National Agriculture Statistics Service, the introduction of hybrid and biotech seeds resulted in a six-fold increase of corn yield per acre from approximately 40 bushels per acre in 1940 to an estimated 150 bushels in 2010.⁵⁴ Hybrid seed introduced thicker plant stocks and stronger root systems, enabling farmers to plant crops closer together and mechanically harvest their yield. Biotech seeds further enhanced the corn seed by incorporating resistance against plant disease caused by pests and viruses, reducing the amount of yield lost.⁵⁵

In 2010, 29 Countries across the globe planted approximately 148M hectares of biotech crops. Yet nearly 90% of the crops were planted by only five countries: namely the United States (66.8M), Brazil (25.4M), Argentina (22.9M), India (9.4M) and Canada (8.8M) with the 24.1M hectares spread across the remaining 25 countries.⁵⁶ Unfortunately, not all countries welcome the import of genetically modified products or seed. Whether it is opposition surrounding the use of modified organisms or protectionism of their own agriculture base is unclear. Regardless, many developed and undeveloped countries are still skeptical of the benefits touted by the Agriculture Biotechnology industry.⁵⁷

For example, the European Union's (EU) concerns over consumer health and environmental risks, in particular the long-term effects, resulted in an approval process for biotech products that is long and laborious, creating external economic impacts on countries that rely on trade with the EU. Countries wanting to take advantage of the benefits of biotech seeds risk the loss of trade with the EU as a result. They then must choose between growing EU approved products for export or increasing their crop yields through the use of biotech products. This tradeoff reduces their flexibility and ability to improve their economic conditions.

Development of new crop varieties for marginal areas of the globe needs to continue. As of 2009, production was increasing by a scant 2% per year.⁵⁸ This will not provide sufficient food for the future population. The seed must be easy to use, increasing the productivity and sustainability of agricultural resources, and affordable, enabling poor and underdeveloped growers to purchase and grow the crops. Governmental cooperation with non-government organizations working with underdeveloped countries to establish and improve their biotech approval process is critical and must continue.

Biofuels: Biotech crops are widely employed in the production of biofuels as well. The 2007 United States (U.S.) Energy Security and Independence Act directed mandatory energy requirements for future years. Unfortunately there were adverse consequences attendant to the requirement for 36 billion gallons of ethanol usage within the U.S. by 2022. Of that total, corn ethanol is limited to 15 billion gallons. While energy independence affects national security strategy, the impact to the world food supply is widely chronicled and criticized. The National Academy of Sciences observed that “Only in an economic environment characterized by high oil prices, technological breakthroughs, and a high implicit or actual carbon price would biofuels be cost-competitive with petroleum-based fuels.”⁵⁹

Moreover, a renewed focus on genetically modified plants could help produce crops that are better for both consumption and fuel use.⁶⁰ Combining traits that lead to more useable cellulosic biofuel material as well as food crops will help farmers obtain two sources of revenue off of one crop. In addition, plants with high cellulosic content such as miscanthus, wood, and switchgrass should be the focus of government subsidy in order to lessen the impact of the food versus fuel rivalry. Without an adequate balance the U.S. could diminish national security due to food shortages with only marginal improvement in energy independence. By utilizing innovations in biotech technology and directing marketing and information sharing to the public, the U.S. could in fact, create a form of balance between fuel, feed, and food in the coming decades.

C. Cooperative Extension: Another initiative to enhance global food security would be the expansion of cooperative extension efforts in Asia. Cooperative Extension has been a primary reason behind American success in agriculture and has played a dominant role in making the American farmer the most effective and efficient producer of agricultural goods.⁶¹ It is a proven method of knowledge transfer and it should be an important foreign policy tool for the U.S. as part of the Asia pivot.

During our field studies, the viability and efficacy of cooperative extension was apparent in the United States as well as in countries such as India and Vietnam. American universities have enduring partnerships in foreign universities such as the Cần Thơ University College of Agriculture and Applied Biology. These partnerships should be an important part of our menu of foreign policy options as we address the challenge of food security in the upcoming decades. Ideally, these education and extension activities will also involve the private sector. Private sector sponsorship could maximize the opportunities for integrated commercial development along with improved agricultural practices so that production is increased while spoilage is decreased. A few examples can highlight the significant advantages of these extension efforts.

Recently, the University of Illinois College of Agricultural Consumer and Environmental Sciences (ACES) teamed up with USAID to lead a five year project entitled “Modernizing Extension and Advisory Systems (MEAS).”⁶² This on-going project involves renowned U.S. agricultural universities such as UC Davis and Cornell as well as non-governmental organizations such as Catholic Relief Services and the International Food Policy Research Institute.⁶³

The Indian Agricultural Research Institute, the hub of the “Green Revolution” continues to provide critical research for India’s farmers. They have conducted highly successful agricultural extension and knowledge transfer programs for decades and directly contributed to India’s sharp increase in productivity and yield. They collaborate extensively with national and international agencies, including U.S. universities and the UN’s Food and Agricultural Organization.⁶⁴

In Vietnam, the Cà Thơ University is the hub of agricultural expertise for the Mekong Delta Region. They have successful enduring partnership with international universities including Michigan State University. Their research and extension efforts have produced variants of rice that are uniquely suited to the Mekong Delta and its changing environment. They also enjoy an extensive partnership with the University of California Davis that has resulted in increased research grants and Fulbright Scholarships for Vietnam.⁶⁵

A final example of current cooperative extension efforts is the U.S.-India Agricultural Knowledge Initiative (AKI).⁶⁶ This is an agreement signed in 2005 by President Bush and Indian Prime Minister Dr. Singh. Through the public-private model of partnership, it is focused on four areas; food processing and marketing, biotechnology, water management, and university capacity building.

Cooperative extension programs can assist farmers and others along the agribusiness value chain to become reliable and efficient farmers in both commodities as well as high value cash crops such as coffee or cocoa. These programs, along with enhanced commercial involvement will produce more foodstuffs and enhance the local and regional economies of the countries that participate in these programs. It is a cost effective and proven method to increase production and educate farmers about responsible, sustainable farming practices.

Government Goals and Role

The proper government role in ensuring a healthy U.S. agribusiness sector and a sufficient world food supply is to address market failures, via both domestic and international policy, using regulation, negotiation, subsidies, and taxes. As we employ economic policy options we must ensure that we are utilizing the proper tool for the intended outcome or effect. In so doing we can safeguard an agribusiness base that provides a secure and safe food supply, contributes to U.S. overall economic well-being, and helps meet global food demand. Domestically, labor and immigration issues, subsidies and crop insurance, and food safety are the primary policy challenges to retaining a healthy agriculture base. Internationally, free trade and export promotion and international cooperation on food security require additional effort; the corn-based ethanol fuel mandate and type of U.S. food aid—in kind or cash—should also be re-examined.

Domestic Policy

A. Labor Reform: Perhaps the greatest policy issue facing U.S. farmers is potential shortfalls in labor and the current inadequate legal framework for migrant workers. As noted earlier, U.S. specialty crop cultivation, as opposed to mechanized row crops, is largely dependent on non-citizen labor, due to the required skill sets, and the difficulty of the work compared to the available wage rates; a large portion of the agriculture labor pool lives in the shadows, never an ideal situation. For both security and productivity rationales, we recommend implementation of a new immigration structure. The new program should consider a process for those who have been working on U.S. farms for the past several decades, combined with an expanded, streamlined guest worker program allowing legal travel back to Mexico and other labor source countries, akin to the pre-1965 *paseo* program.⁶⁷ The current migrant registration program is extremely limited in scope, overly bureaucratic in requirements, and cannot meet the labor supply needs of the agriculture sector.⁶⁸ Additional safeguards on labor, safety, and compensation issues could address concerns of those opposed to expanded migration while meeting the agriculture sector's labor needs within a fully legal, regulated framework.

B. Subsidies/Crop Insurance Reform: A second key producer concern is the threat of extreme weather such as drought or floods, particularly in an era of climate change. As the current Farm Bill expires in 2012, the U.S. has the opportunity to revisit financial support to the agriculture sector. With 2011 farm incomes at an all-time high, commodity prices expected to remain high in the near future due to increased demand from Asia, and pressures to reduce federal spending, there is general consensus that the time has come to end the direct payment production subsidies for certain row crops that have been a core part of U.S. agriculture policy since the 1930s. We see the appropriate role of the U.S. government in ensuring the continued viability of a healthy agriculture base going forward to be support for adequate crop failure insurance as a hedge against catastrophic natural disasters.

C. Ending the Corn-Based Ethanol Mandate: The 2005 legislative requirement mandating a 10% ethanol blend for the U.S. gasoline supply has had a subsequent unfortunate crowd-out effect on agriculture production diverted from the food and feed supply, as well as unintended food price rises in developing countries, a classic example of a market distortion due to mandated regulation. Biofuel demand drives up the price of food commodities; the resultant higher prices make it more difficult for poor people in developing countries to buy enough food. With the recent discovery of additional domestic natural gas/oil energy resources, particularly through fracking and continued high worldwide demand for U.S. corn, we recommend an end to the ethanol mandate, shifting to support of cellulosic biofuels that do not affect the food or feed supply, such as switch grass and biomass.

International Policy

D. Food Aid vs. Development: The U.S. is currently the largest single food aid donor to the World Food Program at \$1.2 billion/year, four times greater than the next largest donors. Our current policies focus on eliminating food insecurity once it occurs, or preventing it by moving food aid to anticipated problem spots if conditions allow for early forecast of crop failures. As critical as this assistance is to meeting emergency food aid, the U.S. provision of in-kind assistance bought from U.S. farmers and shipped overseas on U.S. flagged ships is not cost efficient, can distort local and regional market mechanisms by swamping struggling agricultural

bases with cheaper products. Given high world-wide demand for U.S. commodity crops, plus the need to increase productive capacity in at-risk regions to promote better mid-long term food security, the U.S. should consider phasing out in-kind assistance and transition to full cash contributions.

The United Nations Food and Agriculture Program define capacity as “the ability of people, organizations and society as a whole to manage their affairs successfully.”⁶⁹ Rather than continue policies largely oriented toward alleviating the effects of food insecurity once it occurs, we should invest in policies that develop local capacity with respect to agricultural production. Shifting our policy more toward capacity development better serves our national security interests by preventing destabilizing food insecurity issues over the long haul.

Changes in three aspects of our foreign aid policy will better achieve our desired effects. First we should invest in programs that teach better farming methods in areas prone to food insecurity, ideally by employing the proven cooperative extension measures described earlier. Next we should fund programs that increase the responsible use of fertilizers in the developing world. Significant productivity gains are possible if farmers in developing countries have access to the right kinds of fertilizers and are taught to apply them in a sustainable and environmentally sound manner. Lastly, we should encourage the use of pest and drought resistant genetically modified crops (see section on biotech above). This last effort will require working with European partners to reduce the stigma associated with these crops and a general strengthening of intellectual property rights enforcement in developing countries.

E. Food Safety: Multiple agencies, most importantly United States Department of Agriculture, Environmental Protection Agency, and Food and Drug Administration, have regulatory oversight over different parts of the food industry, leading to some frustration among farmers, producers, and consumers. In addition, major U.S. agribusiness, wholesale, and retail concerns invest heavily in food safety mechanisms to protect brand integrity.⁷⁰ As a result of public and private measures, we believe the U.S. food supply is likely the safest in the world, and continued regulation in the interests of health and safety necessary, though consolidation among multiple regulators could reduce confusion and increase transparency for all. As Asian agribusiness continues to expand into export markets, they should likewise be encouraged to rigorously enforce recognized safety and quality standards. This will enhance their domestic food safety and overall stability as well as providing value added to any export commodities.⁷¹

F. Trade and the Trans-Pacific Partnership (TPP): The appropriate international policy to promote U.S. exports, growth, and jobs is to break down trade barriers in global markets through trade agreements. Agriculture is often the most sensitive area in trade negotiations, and the last bastion of protectionist policy. Asia-Pacific countries represent nearly 60% of the world’s GDP and 50% of world trade; in 2010 the region accounted for 72% of U.S. agricultural exports.⁷² In the absence of U.S. economic engagement in the 2000s, Asian integration moved forward, and the U.S. lost its leading position in bilateral trade to China. The Trans-Pacific Partnership (TPP), endorsed by President Obama and leaders of TPP partners (Australia, New Zealand, Chile, Peru, Singapore, Malaysia, Vietnam, Brunei) in November 2011, aims to conclude negotiations in 2012 and restores an economic component to the U.S. strategic pivot to Asia.⁷³

Significant challenges to achieving a commercially meaningful TPP in the short term remain, however: protectionist sentiment in key markets like Japan; long-standing U.S. refusal to dismantle its own protectionist sugar and dairy regimes; and the lack of Trade Promotion Authority (TPA) ensuring streamlined Congressional review.⁷⁴ If it appears politically impossible to secure TPA by the end of 2012, the Administration should initiate intensified negotiations with Japan and Canada with an aim of achieving a commercially meaningful TPP agreement in 2013.

G. International Cooperation for Food Security in Asia: Regional food security, particularly in the wake of the 2007-08 food price crisis, is one of the greatest challenges facing Southeast Asia, a region holding increasingly important economic and political importance for the United States.⁷⁵ We should work closely with the Association of Southeast Asian Nations (ASEAN) to ensure its member nations' food supplies become more secure and safe, and their economies and people more prosperous.

The 2007-08 global food crisis shed light on the existing discrepancies between ASEAN's member countries and a tendency to put national economic interests above regional cohesion.⁷⁶ Policy responses at the national level not only contributed to further global food price volatility, but also undermined food security in the region.⁷⁷ The United States could work collaboratively with ASEAN to adopt the following food security policy recommendations:

1. Implement national food security policies that promote and strengthen regional cooperation.
2. Establish greater coordination to reduce policy discrepancies at the national and regional levels.
3. Make use of, improve, and expand existing food security mechanisms, especially ones that stress better water management and account for adaptation to climate change.
4. Establish a knowledge database that can map and track food insecurity hot spots.
5. Establish a food security coalition that can develop indicators to guide decision-making and to track progress in improving food security, at the national, sub-regional and regional levels, and suggest appropriate pre-emptive and remedial action.

These policy recommendations amplify our priorities in the Feed the Future initiative and are consistent with the recommendations adopted by the World Summit on Food Security. Within the United States we should ensure that we are using an integrated interagency approach so that we have a consistent approach to foreign policy, commercial opportunities and food security.

Essays on Major Issues

The following essays discuss peripheral issue in the agribusiness value chain and they highlight the challenges and opportunities in the larger sphere of food production, access and availability. Issues such as climate change, infrastructure development and protein sources are all important aspects of the analysis as we look to future food requirements.

Climate Change - Lieutenant-Colonel Jim Jensen

The relationship between our changing climate and agriculture is not a simple one. Although global food production has kept well ahead of growing human numbers due to technological advances in agriculture, human activities in this sector have also induced changes

in the global climate. There is an abundance of research on the subject of global warming, climate change and the effects on the planet which inextricably states that climate change is a reality. The U.S. Intergovernmental Panel on Climate Change (IPCC) has developed scenarios in terms of the future and climate change, and they foretell a world in which people are threatened by massive food and water shortages, natural disasters, and disease outbreaks.⁷⁸ Moreover, the European Commission for Agriculture and Rural Development characterizes climate change, “as one of the most serious challenges facing the world – its people, the environment and its economies.”⁷⁹

Climate change modeling indicates vast array of predictions. One perspective is outlined as follows: the earth is warming and there is ample evidence and scientific proof, however, in the last 50 years the warming effect has been mainly attributed to the atmospheric confining of human induced heat trapping gases or green house gases (GHG). This warming over the past century has only resulted in an approximate elevation of 1.5°F, while by the year 2100 estimations of an increase between 2 to 11.5°F could occur.⁸⁰ Agriculture and climate change are inextricably linked with the agriculture industry, contributing 13.5% of annual global GHG, in comparison to 13.1% from all sources of transportation.⁸¹

Given the direct linkage outlined above, some estimates from the United Nations Environment Program (UNEP) do not support a stable agricultural industry of the future. By 2050, conditions related to climate change could threaten production: a loss of 8% to 20% of cropland to urbanization or diversion to production of biofuels; a large melt of portions of the Himalayan glacier could reduce 25% of the world cereal production in Asia; water scarcity; land degradation; increased oil prices impacting farm operations and species infestations. Taking all considerations into account, food production could come up 25% short of predicted demand by 2050.⁸²

These challenges will need to be examined on two fronts; first, cut the emissions of GHG responsible for warming (mitigation); and second, adapt to current and future climate change in order to reduce the impacts (adaptation). Mitigation describes the options to limit the effects of climate change by implementing policies or options that reduce GHG emissions. Adaptation, on the other hand, refers to changes made to anticipate present or future climatic or environmental changes, thus reducing the harm or taking advantage of opportunity.⁸³

The majority of mitigation potential exists in reducing soil CO₂ emissions or sequestering CO₂ in the organic matter of soils. The IPCC has considered some 60 GHG mitigation options for the agriculture industry. These can be grouped into several broad categories, including cropland management (nutrient, tillage and residue management and better use of manures), grazing land management, the restoration of cultivated organic soils (such as peats), the restoration of degraded lands, and livestock management.⁸⁴ We can look to the European Union (EU) as a demonstration to what can be achievable. Between 1990 and 2003 the Common Agriculture Policy (CAP) and the Nitrate Directive have resulted in approximately a 20% reduction of both methane and nitrous oxide from livestock management and the use of organic fertilizers, and a reported further 23% reduction by 2010. A second pillar that the CAP has taken sees the “next step” to contribute to mitigation by providing additional aid to farmers for

modernization (energy efficient equipment and buildings), training on climate mitigation, and a policy on rural development.⁸⁵

Turning to Asia, we see that in most parts of Asia the forest is shrinking, agriculture is gradually expanding to marginal lands, urbanization is robbing fertile land, and significant soil nutrient loss is being experienced. In fact, 20% of Asia's agricultural land has been degraded over the past few decades, and it is worse in fragile areas such as the mountains.⁸⁶

As an illustration, there is little doubt that climate change is going to bring increased risks of disasters to Viet Nam. In the last 50 years, there have been more and longer droughts in the south; the temperature has risen by 0.5°C prior to 2000 and by another 0.5°C in the last 10 years; the sea level has raised approx 25 centimeters; and weather events have become more intense.⁸⁷ These changes would also put key areas such as the Mekong Delta in severe jeopardy with 90% of the Delta inundated every year and 45% subjected to salinisation which would destroy crops (rice, and orchards), alter the soil nutrient composition, and damage the fresh water supply.⁸⁸ These circumstances can be replicated across Asia and SE Asia. Therefore, as a result of climate change, agriculture and food security in these regions will definitively be at risk.

The challenges of mitigation and adaption cannot be considered in isolation or simply by one nation. The most prevalent international response to climate change has been the Kyoto Protocol, which expired in 2012.⁸⁹ Although the U.S. is not a signatory to the Protocol, we can conduct scientific collaboration in an effort develop the best courses of action.⁹⁰ On a separate policy front, the U.S. Government (USG) must re-examine the unintended consequences of decisions they have made to reduce GHGs. It appears that there are presently greater negative second and third order impacts on both climate change and food security resulting from the production of biofuels. For example, it is estimated that the corn equivalent of energy in "a full tank of ethanol in a large 4WD SUV could almost feed a person for one year" and that "food prices could rise between 20 and 50% by 2016 partly as a result of biofuels."⁹¹ In order to continue with a significant contribution to feeding the world the USG will need to determine their priority vise-a-vis GHGs, climate change and the diversion of cropland to the production of biofuels. It is essential that a collaborative international effort continue to proactively develop a portfolio of strategies that includes adaptation, mitigations, technology development and research to combat the effects of climate change.

Infrastructure Improvement - Harry Parent

Transportation infrastructure is a critical element of the food supply chain management and especially critical to avoid post-harvest spoilage. The United States transportation infrastructure although once state of the art, is in need of repair. Funding is required to repair, sustain, and grow the infrastructure. A very cursory review of capabilities in the U.S. and three countries of interest, India, Thailand, and Vietnam, suggest where and how infrastructure could be improved in order to thwart food spoilage. The following table presents statistics extrapolated from The World Bank⁹² country information data base.

Source: The World Bank	U.S.A.	India	Thailand	Vietnam
Population (2011)	313161000	1210193422	66700000	90549390
GDP Growth (2011)	1.5	7.8	1.5	5.8
Land Area (Millions of Square Kilometers)	9.1	2.9	0.5	0.3
Percent of Arable Land	17.8	53.1	29.9	20.3
Cereal Yield (Thousand of Kilograms per Hectare)	7.2	2.4	2.9	5
Food Production Index (2007-2009)	115	119	126	138
Percent of Paved Roads	67.4	49.3	* 97.5	47.6
Kilometers of Paved Roads	4209835	2100000	62985	2406
Kilometers of Rail	226,205	63,273	4,429	2,347
Navigable inland waterways (km) CIA Factbook)	40000	14500	3701	5000
Container Port Traffic (Millions of TEUs)	34.2	7.8	5.8	4.7
* Thailand paved roads 86% in rural areas				

Roads: The U.S. has approximately .462 kilometers of paved road per square kilometer of land area; India has approximately .762 km of paved road per sq km of land area; Thailand has approximately .125 km of paved road per sq km of land area; and Vietnam has approximately .008 km of paved road per sq km of land area. Barring factors including geography, passenger vs. freight traffic, and return on investment, it appears that Thailand and Vietnam require investment in highway infrastructure. Significant improvement may be gained by paving unpaved roads in the U.S., India, and Vietnam.

Rail: The U.S. has approximately .024 kilometers of train track per square kilometer of land area; India has approximately .021 km of track per sq km of land area; Thailand has approximately .008 km of track per sq km of land area; and Vietnam has approximately .007 km of track per sq km of land area. Barring factors including geography, passenger vs. freight traffic, and return on investment, it appears that Thailand and Vietnam require investment in rail infrastructure.

Inland Waterways: The U.S. has .004 km of navigable inland waterways per square mile of land, India .005, Thailand .007, and Vietnam .016. Vietnam has a potential comparative cost advantage if it exploits its network of navigable inland waterways.

Container Port Traffic: The U.S. ships or receives .109 twenty-foot-equivalent (TEU) containers per capita, India .006, Thailand .086, and Vietnam .051. Relative to GDP, India and Vietnam should expand their capabilities.

Food provides security. Infrastructure development promotes sustainable agriculture and a host of other economic opportunities. Policy decisions must take into account social issues as well as industrial contributions to the gross domestic product. The percentage of people moving from agriculture to industry and services is on the rise in all countries studied in this report. Infrastructure improvements would benefit all segments of the population if planned and executed wisely.

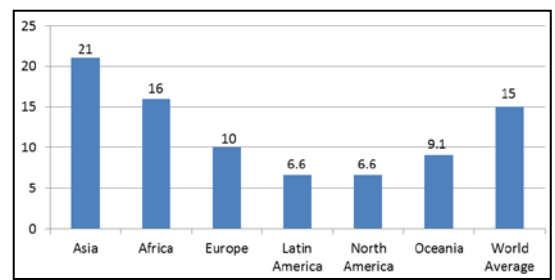
Percent of GDP by Sector			
	Agriculture	Industry	Services
India	18.1	26.3	55.6
Thailand	12.2	45.3	42.5
Vietnam	20	41.4	38.6
USA	1.2	22.1	76.7
Percent of Labor Employed by Sector			
	Agriculture	Industry	Services
India	52	14	34
Thailand	42.4	19.7	37.9
Vietnam	53.9	20.3	25.8
USA	0.7	20.3	79.1
Percent of Population Below Poverty Line			
		(Reported)	
India	25	2007	
Thailand	9.6	2006	
Vietnam	10.6	2010	
USA	15.1	2010	
Data Source: CIA World Fact Book ⁹³			

Repairing and expanding transportation infrastructure could potentially create positive multiplier of economic growth. First, it addresses an immediate concern, unemployment. Second, it creates income that will further stimulate the economy. Third, expansion of the infrastructure creates an opportunity for increased economic expansion in all sectors. Fourth, including rural agriculture regions in infrastructure development can support direct farm to market entrepreneurs. This fourth element is particularly important for countries having a significant percent of the labor force employed in the agriculture sector. Direct farm to market sales keep a higher amount of profit on the farm; and in-turn supports rural economies.⁹⁴

These improvements in transportation infrastructure must be complemented by gains in storage and distribution infrastructure such as silos, transfer facilities and cold storage units. Road or rail improvement alone will not suffice to solve the spoilage problem. For comparison, the United States currently enjoys 10 billion bushels of grain storage capacity while India has capacity for only 1.78 billion bushels.⁹⁵ Likewise, as noted in the table above, the United States has enormous capacity for twenty foot container equivalents (TEUs) in its ports. For the developing Asian nations to be competitive as exporters, they must ensure that they have sufficient container capacity and other port infrastructure. Domestically, they must ensure sufficient grain storage capacity and cold storage capacity to ensure that they are food secure even if they are not pursuing agriculture exports.⁹⁶

Fishing and Protein - Colonel Shane Hamilton and Lieutenant Colonel Steve Weaver

Human dependence on fish for protein is higher in Asia than any other world region.⁹⁷ Fresh water and ocean fishing provides over two billion Asians with at least 15% of their daily



protein intake, but without change to current fishing practices this level is unsustainable.⁹⁸ This section provides an overview of the status of Asia's fresh water and ocean fisheries, and their impact on both food security in Asia and U.S. National Security.

An example of the critical role fresh water fishing plays on food security in Asia can be found in Vietnam's Lower Mekong Basin (LMB). The LMB is home to an estimated 850 fish species of which approximately 50 are important to fishing.⁹⁹ This diversity supports the largest freshwater fishing activity in the world, producing between \$2 and \$9 billion (U.S.) in revenue annually.¹⁰⁰ Over 90% of this revenue results from the harvest of migratory fish species on the Mekong with the balance achieved through a relatively immature fish farming industry.¹⁰¹ The two primary threats to continued productivity in the LMB and to those who rely on it are damming and climate change. A recent report issued by the International Panel on Climate Change identified the Mekong River Delta as one of the three most vulnerable deltas on the earth.¹⁰² As little can be done to realistically effect the near-term impact of climate change, the most human dependent variable adversely affecting the LMB is the creation of dams.

Mainstream dam construction on the Mekong will result in reduced fish populations, as noted by Senator Jim Webb who remarked that "with mounting evidence, experts estimate that existing and planned hydropower dams may block the migration of 70 percent of the most commercially important fish."¹⁰³ Indeed, as noted by Lilao Bouapao, following construction of the Pak Mun dam on the Mun River in Thailand, "fishing communities located upstream and downstream reported a 50-100% decline in fish catch and the disappearance of many species" and that as yields decreased, an approximate 30% of the fisherman sought other employment, thereby placing increased social stress on their communities.¹⁰⁴

The ability of ocean fishing to continue meeting Asia's rising food security requirements is bleak. According to the United Nations (UN) Food and Agriculture Organization (FAO), world fisheries catch has been declining by about 0.7 million tons per year since the 1980s.¹⁰⁵ The improved technology wielded by Asia's fishing fleets, combined with expansion of fishing zones and the exploitation of previously spurned lower quality species, has masked this waning trend.¹⁰⁶ The problem cannot continue to be masked, however, as the FAO concluded in 2005 that "52% of global fish stocks were fully exploited and 25% were overexploited, depleted or recovering."¹⁰⁷ Today Asia is the largest food fish producer in the world, producing 66% of the world's catch as shown in Figure 2. Asia will be impacted by the negative ocean fishing trend more than the world's other regions.¹⁰⁸

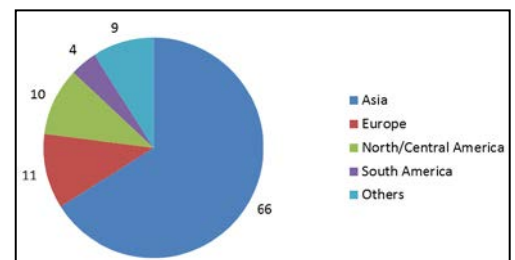


Figure 2: Fish Catch as a % of World Total

"The Asia Pacific Fishery Commission calls the fishing industry fundamental to the Asia Pacific region in terms of food security, revenue generation, and employment and describes fisheries income as playing a critical role in the national economies of developing states."¹⁰⁹ But the region's overfished waters are under extreme stress and have already passed their peak production years. Many factors influence this decrease in catch, but the single largest factor is overfishing. Put simply, today "fish are taken in greater numbers than they reproduce."¹¹⁰

If Asia is unable to develop policies and programs to arrest the declining fresh water and ocean fishing trend, food security in the region will suffer. It is likely the increased food insecurity would increase poverty at both the individual and national levels. Individuals would have to spend an ever increasing percentage of their income to secure food, if it is even available for purchase. National governments would be forced to increase their subsidies of the national food system to maintain order, thereby decreasing the amount of money available for education, stability and health care. In extreme circumstances, nations unable to afford these subsidies can devolve into the status of failed states, increasing the incidence of the factors than enable “terrorism, weapons and narcotics traffickers, illegal fishers, and human smugglers.”¹¹¹ It is also possible that states would resort to military means to secure adequate food supplies for their populations, if all else fails, to the detriment of their neighbors. Any of these situations could negatively impact national interests of the United States.

Any effort to resolve Asia’s fresh water fishing issues must occur at multiple levels and expand upon the existing agreements, like the Lower Mekong Initiative (LMI), providing U.S. mentorship into other disciplines. For instance, the U.S could conduct exchanges of its Army Corps of Engineers and U.S. Fish and Wildlife Service experts to help model dam placement and design controls for maximized energy production with minimal environmental impact (i.e., placement on tributaries vice mainstream and development of fish ladders or passages to allow for seasonal migration). The engineers could also assess the current system of sluices, dykes and sea walls, that some LMB countries (Vietnam in particular) began constructing more than a decade ago in an attempt to mitigate some of the ill-effects of flooding and drought – some of which are thought to be of poor design and counterproductive. Likewise, the Department of Energy could assist in assessing the viability of other “green” energy sources such as wind, solar or nuclear, and the U.S. Department of Agriculture could help develop drought and flood resistant farming techniques and harvesting guidelines to mitigate seasonal variances.

Beyond mentoring, the U.S. should also leverage its leadership position to influence investment banks and multilateral organizations. Investment banks, such as the Asian Development Bank, must be encouraged to take full measure of the true benefits and costs of backing the construction of LMB dams – for instance, they must weigh the benefits of additional energy and revenue against the losses in agriculture, fishing and perhaps increased potential for conflict between neighbors. The U. S., as a Developmental Partner to forums like the Mekong River Commission (MRC), must also encourage a continuous and robust dialogue among the LMB countries including Burma and China. In a December 2011 Joint Development Partner Statement to the MRC, the U.S and other major donor nations began applying just such pressure by pushing MRC member countries to continue to seek the full membership of Burma and China.¹¹²

Any possible solution to Asia’s ocean fishing woes needs to consider “the migratory nature of fish, and of the boats that hunt them, marine conservation requires global cooperation to support an effective regional organization.”¹¹³ It is also critical the total catch allowable for the region be capped at a sustainable level, otherwise nations will continue depleting fishing resources to sate the demand of the larger nations.¹¹⁴ The solution to saving the fisheries in Asia shares much in common with concepts behind the Kyoto Protocols. In effect, fishing in Asia should be thought of as one pie. Each nation in the region would be given a slice of the pie

roughly equivalent to the resources it possesses, in this case, the fish within its economic exclusive zone (EEZ). Asia's larger nations could increase their allowable fishing catch by purchasing some or all of another nation's pie slice. This would allow them to increase the scale of their legal catch while also providing the smaller nations with the monetary resources they could utilize to purchase food or retrain their fisherman, thereby breaking the current cycle.

This effort would seek to reverse the historic trend of government policies that wittingly or unwittingly encouraged continuing market failures. In the end, it is clear that a real and drastic reduction in ocean fishing overcapacity must be realized if Asian fisheries are to reap a sustainable future.¹¹⁵ The proposed "cap and trade" policy, mimicking the Kyoto Protocols on climate change, promises to enable such a future.

Conclusion and Final Recommendations

Without global food security, U.S. national security could be affected. Hunger very often leads to violence and local uprisings can lead to national and regional conflict. Agriculture becomes a critical component of U.S. national power in this vein. All along the agricultural value chain, the U.S. maintains a competitive advantage. However, improving food security requires an understanding of the breadth of relevant factors.

While the United States offers production capacity, scientific prowess to improve yields and reduce wastage, logistical expertise, and developed capital markets, evaluations of regional food availability shortfalls must respect regional historic and cultural issues that contribute or are impacted by the situation. Agricultural improvements must be tailored to meet local or regional circumstances.

Food security in the U.S. is enhanced by beneficial natural resources and robust storage and distribution infrastructures. Determining the manner of U.S. engagement in addressing food security around the globe should include leveraging U.S. production and distribution capacity along with improving extension and technology transfer efforts in other nations. Governance for land and water management and standards for food safety remain critical issues requiring domestic and international attention. Policies that support a mobile and skilled agricultural labor force are necessary as well. Continued research and innovation is required to continue increase yields in the face of intensifying weather patterns. Investment in global supply chain infrastructure and information campaigns will lead to the reduction of food spoilage and waste. The strength of U.S. agribusiness should be used to ensure all nations become and remain food secure now and into the future.

Endnotes

¹ Food and Agriculture Organization, “How to Feed the World in 2050,” 2009 report, accessed April 18, 2012 at: http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf. See also “Declaration of the World Summit on Food Security,” November 2009, available at: www.fao.org.

² *Ibid.*

³ *Ibid.*, Section 2.1.

⁴ The United Nations Food and Agriculture Organization Homepage, <http://www.fao.org/economic/ess/ess-fs/en/> (accessed 20 Feb 2012).

⁵ The Asian pivot was first described in writing by Secretary of State Hillary Clinton, “America’s Pacific Century,” *Foreign Policy*, November 2011, accessed March 15, 2012 at:

http://www.foreignpolicy.com/articles/2011/10/11/americas_pacific_century. President Obama elaborated on the policy approach during his November 2011 Asia-Pacific swing, stating that the U.S.’ top foreign policy priority is to “to advance security, prosperity and human dignity across the Asia Pacific.” Barack Obama, Remarks By President Obama to the Australian Parliament, Nov 17, 2011. Accessed April 23, 2012 at: <http://www.whitehouse.gov/the-press-office/2011/11/17/remarks-president-obama-australian-parliament>.

⁶ Our field studies provided us with an opportunity to examine challenges and opportunities first hand, especially as concerns waste and spoilage in India, trade policy and business practices in Thailand and extension and outreach programs in Vietnam. Our domestic field studies provided insightful contrasts between U.S. practices and those employed in Asia, as well as an ability to appreciate the complexity of market analysis, such as the export of \$300 million worth of California almonds annually into an eager Indian market.

⁷ Industry segments by value creation, as defined by the IBIS World Agribusiness report, include: Food and supplies wholesaling (30%); Agribusiness services (25%); oil, grain, and packaged food manufacturing (17%); crop farming (9%); meat, beef, and poultry processing (8%); animal including dairy (6%); tractor and ag machinery (4%); and pesticides/herbicides (1%). See Nicoleta Panteva, “Agribusiness in the U.S.,” IBIS World Industry Report NN004, dated March 2012, accessed April 23, 2012 at: <http://clients.ibisworld.com/industryUS/default.aspx?indid=2004>.

⁸ “Value of U.S. trade and trade balance, by calendar year,” accessed April 20, 2012 at:

<http://www.ers.usda.gov/Data/FATUS/#calendar>. One industry estimate is that every \$1 billion in agricultural exports supports 9,000 jobs, for transportation workers, food processors, packers, longshoremen, and sales reps; see Devry Boughner, “Written Testimony for House Hearing on Trans-Pacific Partnership,” Dec. 14, 2011, accessed March 20, 2012 at: http://waysandmeans.house.gov/UploadedFiles/Boughner_testimony92111b.pdf.

⁹ *Ibid.*

¹⁰ United States Department of Agriculture, National Institute of Food and Agriculture. “Extension.” <http://www.csrees.usda.gov/qlinks/extension.html>, accessed May 16, 2012 and United States Department of Agriculture, Economic Research Service. “State Fact Sheets,” <http://www.ers.usda.gov/StateFacts/us.htm>, accessed May 16, 2012.

¹¹ United Nations Food and Agricultural Association. “Country Pature/Forage Resource Profiles,” <http://www.fao.org/ag/AGP/AGPC/doc/Counprof/Brazil/Brazil.htm>, accessed May 16, 2012 and United States Department of Agriculture, Food and Agricultural Service. “Indian Agricultural Economy and Policy Paper.” <http://www.fas.usda.gov/country/india/indian%20agricultural%20economy%20and%20policy%20paper.pdf>

¹² Michael Porter, *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: The Free Press, 1980.

¹³ Stacey Rosen and Shahla Shapouri. *Amber Waves*. Sep 2008.

<http://www.ers.usda.gov/AmberWaves/September08/Features/ObesityCountries.htm> (accessed Mar 23, 2012).

¹⁴ On Strategic Gameboard analysis, see Kevin Coyne, Roberto Buaron, Richard N. Foster, and Amar Bhide, “Gaining Advantage Over Competitors,” *McKinsey Quarterly*, June 2000. Asia accounted for \$59 billion in 2011 U.S. ag exports, 43% of the global total. See United States Department of Agriculture, “Outlook for U.S. Agricultural Trade,” AES-73, February 23, 2012, accessed March 15, 2012 at:

<http://usda01.library.cornell.edu/usda/current/AES/AES-02-23-2012.pdf>. Agribusiness giant Cargill has positioned its global strategy with an Asia focus, and in support of the TransPacific Partnership initiative: “At Cargill, we know that trade works. Approximately 40-50% of our global revenue is directly generated by international trade. Through trade agreements, Cargill can reduce costs incurred through the supply chain, thereby enabling the

company to deploy capital saved toward investments in activities such as employee training and benefits, new businesses, marketing and research and development.” See Boughner.

¹⁵ United States Security and Exchange Commission, "Monsanto Company Form 10-K", accessed April 20, 2012 at: http://www.monsanto.com/investors/Documents/Annual%20Report/Monsanto_2011_10-K.pdf, p.21.

¹⁶ See Bunge Limited, *2011 Annual Report*, (White Plains, NY, April 2, 2012): 8. See also Archer Daniels Midland Corporation, *2011 Letter to Shareholders and Annual 10-K*, (Decatur, Ill., February, 2012): 3.

¹⁷ Joel K. Bourne Jr. « The Global Food Crisis, The End of Plenty” National Geographic Magazine, June 2009.

¹⁸ See Boughner Note 7 and Panteva Note 8.

¹⁹ "A Nibble of a Happy Meal." *Financial Express* (The Indian Express Online Media Ltd), Jan 2012.

²⁰ ISI Emerging Markets. *Processed Food - Industry Overview*. <http://www.securities.com/> (accessed Mar 25, 2012).

²¹ The top six export markets in 2011 for U.S. agriculture products in order were: China; Canada; Mexico; Japan; the 27 country European Union collectively; and South Korea. See USDA FAS data, accessed April 23, 2012, at: <http://www.ers.usda.gov/Data/FATUS/#monthly>.

²² “Trustworthy products will command a substantial price differential.” U.S. Grains Council, “Food 2040: The Future of Food and Agriculture in East Asia,” November 2011: 10. Accessed April 20, 2012 at: www.grains.org.

²³ *Ibid.* One of their “insights” is simply “Whatever China Wants.”

²⁴ “National Security-A collective term encompassing both national defense and foreign relations of the United States.” Department of Defense Dictionary of Military and Associated Terms, Joint Publication 1-02, March 2012.

²⁵ For instance, whereas the United States, United Kingdom, Germany and France respectively spent approximately 6, 10, 11 and 13 percent of their per capita incomes on food in the year 2010, the Asian countries of China, Thailand, India, Vietnam and Pakistan spent 22, 25, 28, 38 and 42 percent of their incomes. See USDA/ Economic Research Service, “Food CPI and Expenditures: Food Expenditure Tables,” accessed April 23, 2012 at:

http://www.ers.usda.gov/Briefing/CPIFoodAndExpenditures/Data/Expenditures_tables/. This fixing of substantial portions of income to basic nutritional requirements inherently limits spending on other necessities such as shelter and clothing and reduces discretionary purchases of medical care and/or education thus creating a public less capable of absorbing shocks from instability and uncertainty – a potentiality regional leadership, and indeed the U.S., must be prepared to mitigate.

²⁶ Feed the Future Guide online: www.feedthefuture.gov/FTF_Guide.pdf. Accessed April 15, 2012.

²⁷ See *Ibid.*, and <http://www.state.gov/r/pa/prs/ps/2011/03/157626.htm>. On the related role of research and improved yield challenges, see: Simon Nicholson, “Feeding 10 billion, a dialogue between Feed the Future and the International Research Community,” available at: <http://www.aplu.org/document.doc?id=3664>.

²⁸ John K. Cooley, “The War Over Water,” in *Conflict After the Cold War, Arguments on Causes of War and Peace*, Second Edition, Richard K. Betts, ed. (New York: Longman: 2002).

²⁹ A separate problem affecting the Mekong Delta, increased salinity, will be discussed in the essay section.

³⁰ Elizabeth Economy, “China’s Growing Water Crisis,” *World Politics Review*, August 9, 2011.

³¹ *Ibid.*

³² FAO, *How to Feed the World in 2050*, Note 1

³³ Margherita Stancati, “India Fires a Message to China,” *Wall Street Journal*, April 20, 2012. Stancati describes the recent rocket launch that allegedly puts China within range of Indian missiles as well as chronicling ongoing border disputes and other issues.

³⁴ FAO, *How to Feed the World in 2050*, Note 1

³⁵ Rafael Romo, “Rep: U.S. Faces Agriculture ‘Crisis’ Without Farm-Worker Visa Reform” April 13,

³⁶ We noted that the farmers’ outlook and general opinions were almost the same regarding migrant workers, even though their farm operations were quite different.

³⁷ Thus the agribusiness sector will not be affected as much as other industries by the anticipated cut in defense budget.

³⁸ See World Health Organization Statement, Food Security, available on-line at: <http://www.who.int/trade/glossary/story028/en/>.

³⁹ C. Nellemann, M. MacDevette, T. Manders, B. Eickhout, B. Svihus, A.G. Prins, B.P. Kaltenborn, (Eds). *The Environmental Food Crisis: The Environment's Role in Averting Future Food Crisis, A UNEP Rapid Response Assessment* (Norway: United Nations Environment Programme, 2009): 16-17.

⁴⁰ “An estimated one third of crops and produce in parts of the developing world are lost after they leave the field—to spoilage, rodents, pests and other factors—resulting in significant food waste and lower incomes for farmers. Cutting losses even by one third automatically increases the amount of food available in the system and raises incomes for farm families.” *Cultivating Global Food Security: A Strategy for U.S. Leadership on*

Productivity, Agricultural Research, and Trade, A Report of the CSIS Task Force on Global Food Security (Washington: Center for Strategic and International Studies, 2010): 8.

⁴¹ Jenny Gustavsson, Christel Cederberg, Ulf Sonesson, Robert van Otterdijk, and Alexandre Meybeck, *Global Food Losses and Food Waste: Extent, Causes and Prevention* (Rome: Food and Agriculture Organization of the United Nations, 2011): 15.

⁴² “Per capita food wasted by consumers in Europe and North America is 95-115kg/year, while this figure in sub-Saharan Africa and South/Southeast Asia is only 6-11 kg/yr... Food waste at consumer levels in industrialized countries (222 million ton) is almost as high as the total net food production in sub-Saharan Africa (230 million ton).” *Ibid.*

⁴³ “Some Western nations have sponsored programs designed to raise consumer awareness of food waste and to diminish the levels of food waste. This needs to be implemented in the United States as well. Food waste is an easier problem to solve than food spoilage in the sense that it simply requires a change in consumer behavior.” Andrew Grice, “Britain Declares War on Food Waste,” *The Independent*, July 7, 2008.

⁴⁴ Zia Haq, “India’s Mountains of Shame,” *Hindustan Times*, March 30, 2010; “Pakistan and India, A Rivalry that Threatens the World,” *The Economist*, May 19, 2011.

⁴⁵ Haq. *Ibid.*

⁴⁶ *Ibid.*

⁴⁷ *Ibid.*

⁴⁸ “India Needs Western Supermarkets,” *The Guardian*, November 29, 2011.

⁴⁹ *Ibid.*

⁵⁰ Trefis Team, “Wal-Mart’s Africa and India Plans Boost Its International Outlook,” *Forbes*, March 25, 2012.

⁵¹ Supermarkets, Note 27

⁵² Archer Daniels Midland Corporation, *2011 Letter to Shareholders and Annual 10-K*, (Decatur, Ill., February, 2012): 3. Bunge Limited, *2011 Annual Report*, (White Plains, NY, April 2, 2012): 8.

⁵³ World Health Organization, “Food Safety: 20 Questions on Genetically Modified Foods,” accessed April 23, 2012 at: www.who.int/foodsafety/publications/biotech/20questions/en/.

⁵⁴ India’s adoption of Norman Borlaug’s high yield wheat allowed India to become self-sufficient, even when facing a drought in the late 1960s. Joel K. Bourne Jr., “The Global Food Crisis, The End of Plenty,” *National Geographic Magazine*, June 2009.

⁵⁵ WHO “Food Safety.” Note 54

⁵⁶ “The Adoption of Genetically Modified Crops, Growth Areas,” *The Economist*.

http://www.economist.com/blogs/dailychart/2011/02/adoption_genetically_modified_crops, 15 March 2012.

⁵⁷ Sarah Liberman and Tim Gray, “GMOs and the Developing World: A Precautionary Interpretation of Biotechnology,” *Political Studies Association*, (2008:10): 395.

⁵⁸ Bourne.

⁵⁹ National Academy of Sciences. *Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy* (2011):3, accessed March 16, 2012 at: <http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/Renewable-Fuel-Standard-Final.pdf>. National Academy of Sciences, “Liquid Transportation Fuels from Coal and Biomass Technological Status, Costs, and Environmental Impacts ” (2009): 2. Accessed March 16, 2012 at: http://cmi.princeton.edu/news/pdfs/alt_fuels_brief_final.pdf.

⁶⁰ *Ibid.*

⁶¹ USDA, National Institute of Food and Agriculture, <http://www.csrees.usda.gov/qlinks/extension.html>.

⁶² Jennifer Shike, “Modernizing Extension and Advisory Services,” The University of Illinois at Urbana-Champaign, <http://www.meas.extension.org/press-release>, March 7, 2012.

⁶³ MEAS Website, <http://www.meas-extension.org>. The grant from USAID is only 9 million dollars, a modest and manageable sum even in the current constrained budget environment.

⁶⁴ <http://www.iaria.res.in>; see also Bourne. “Then came the green revolution. In the mid-1960s, as India was struggling to feed its people during yet another crippling drought, an American plant breeder named Norman Borlaug was working with Indian researchers to bring his high-yielding wheat varieties to Punjab. The new seeds were a godsend....[B]y 1970, farmers had nearly tripled their production.” The museum at the institute features the joint accomplishments of Mr. Borlaug and his Indian colleagues.

⁶⁵ Executive Summary: Seed Grants, University of California Davis, July 1, 2010, available on-line http://uoip.ucdavis.edu/documents/seed_grant_executive_summary_2010.pdf

⁶⁶ U.S. India Agricultural Knowledge Initiative, available on-line at http://www.fas.usda.gov/icd/india_knowl_init/india_knowl_init.asp

⁶⁷ Details of the revised program could include amnesty either alone or combined with a fee for earlier unlawful immigration. The details of such a program is beyond the scope of this study, but the sentiment from agribusiness leaders during our study indicated that migrant labor is considered to be the most viable and feasible labor source for horticulture products such as fresh vegetables.

⁶⁸ U.S. Agriculture Crisis, Note 36

⁶⁹ FAO Homepage accessed February 20, 2012 at: <http://www.fao.org/economic/ess/ess-fs/en/>.

⁷⁰ There are a variety of private sector driven voluntary regulatory bodies on supply chain food safety, including (for the U.S.) the Counter-terrorism/Partnership against Terrorism (CT-PAT);, which independently audits systems of harvest/collection, import, and distribution systems; (for Canada) PIP – Partnership in Protection; and (for Europe) AEO – Authorized Economic Operator. Brand integrity protection drives both primary producers of plant and animal products and retailers such as Walmart and McDonald’s to focus relentlessly on food safety, our study has found.

⁷¹ Vietnam is pursuing GLOBAL G.A.P. certification for agriculture and aquaculture products in order to pursue exports into European markets. See “SAMEFICO’s Pangasius Hatcheries Granted GlobalGAP Certificate,” *Vietnam Seafood News*, available on-line at <http://vietnamseafoodnews.com/?p=3655>.

⁷² USTR Fact sheet on outlines of the Trans-Pacific Partnership, November 12, 2011, at: <http://www.ustr.gov/about-us/press-office/fact-sheets/2011/november/outlines-trans-pacific-partnership-agreement>. For additional data on U.S. agricultural exports, see: United States Department of Agriculture, “Outlook for U.S. Agricultural Trade.”

⁷³ Secretary of State Clinton writes in her *Foreign Policy* article: “When I talk to my Asian counterparts, one theme consistently stands out: they want American to be an engaged and creative partner in the regions flourishing trade and financial interactions.” Clinton. The TPP goes beyond traditional free trade arrangements to cover services and government procurement, finance and investment, customs and regulatory coherence; it aims for stronger provisions to protect innovation in the digital economy and green technologies, intellectual property, the environment, and workers’ rights. The TPP initiative holds great promise for U.S. agribusiness, offering expanded exports of U.S. agricultural products through bilateral market access agreements and lower tariffs, as well as reduced non-tariff barriers such as sanitary and phytosanitary measures and technical barriers to trade. The interest by Japan, Canada, and Mexico to join the TPP framework offers expanded mid-term promise, with the ultimate goal of establishing a wider Asia Pacific Free Trade Area that would include China and India.

⁷⁴ Japan’s closed agricultural market is both the biggest prize and the biggest challenge for negotiators. The tradeoff is time – negotiating a final TPP agreement in 2012 as is the stated intent will not be possible including Japan. Important industry voices believe on balance that it would be worth a delay to include Japan – if Japan opens up its agriculture market substantially. See, for instance Clayton Yeutter, “Why TPP could be the biggest game in town,” *AgriPulse*, January 23, 2011, at: <http://agri-pulse.com/Opinion-Clayton-Yeutter-1-23-2011.asp>. The Co-Chair of the U.S. Business Coalition for TPP testified at a December 14, 2011 Congressional Hearing on TPP that: “For U.S. agriculture, the inclusion of Japan is critical in defining this agreement as commercially meaningful.” See Boughner.

⁷⁵ Alexander Chandra and Lucky Lontoh, “Regional Food Security and Trade Policy in Southeast Asia,” *International Institute for Sustainable Development, Series on Trade and Food Security – Policy Report 3* (2010): 10-13.

⁷⁶ Asian Development Bank, *The Economics of Climate Change in Southeast Asia: A Regional Review* (April 2009): 4-5.

⁷⁷ Tom Slayton, “Rice Crisis Forensics: How Asian governments carelessly set the world rice market on fire,” Working paper No. 163 (Washington, DC: Center for Global Development, 2009): 3-5.

⁷⁸ John Podesta and Peter Oden, “The Security Implications of Climate Change.” *The Washington Quarterly*, (Winter 2007-08): 115.

⁷⁹ European Commission Director-General for Agriculture and Rural Development. *Climate Change: The Challenges for Agriculture*. Fact Sheet, Brussels: EU Commission for Agriculture and Rural Development, 2008, p.4.

⁸⁰ U.S. Global Change Research Program. *Global Climate Change Impacts in the United States*. A State of Knowledge Report, (New York: Cambridge University Press, 2009): 9.

⁸¹ International Food Policy Research Institute (IFPRI). *Agriculture and Climate Change: An Agenda for Negotiations in Copenhagen*. (Washington: 2009):1.

⁸² United Nations Environment Program, *The Environmental Food Crisis*. A UNEP Rapid Response Assessment, (Arendal : UNEP/GRID-Arendal, 2009): 7.

⁸³ U.S. Global Change Research Program 11.

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- ⁸⁴ IFPRI 9.
- ⁸⁵ European Commission Director-General for Agriculture and Rural Development 14, 17.
- ⁸⁶ United Nations Environment Program 40.
- ⁸⁷ Oxfam. *Viet Nam Climate Change, Adaptation and Poor People* (Ha Noi: Oxfam, 2008): 16.
- ⁸⁸ *Ibid*, 19.
- ⁸⁹ Kyoto Protocol, http://unfccc.int/kyoto_protocol/items/2830.php
- ⁹⁰ *Ibid*..
- ⁹¹ United Nations Environment Program 38.
- ⁹² World Bank. *Countries and Economies*. 2012.
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- ⁹⁴ Albert Myles, and Ken Hood, Publication 2582, (Mississippi State 2010)
Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture.
- ⁹⁵ Oryza News, May 8, 2012, <http://oryza.com/Rice-News/15065.html>, accessed May 15, 2012
- ⁹⁶ Vietnam News, "Cold Storage, the Urgent Need for Mekong Delta's Development," January 10, 2009, available at http://www.vinaseafood.com.vn/news_details.php?cid=1&nid=128. By contrast, Thailand appears to have adequate cold storage which greatly enhances their ability to be a leading food exporter. See E.V. Murray "The Kitchen of the World, Origins and Growth of the Thai Food Industry and Lessons for India." CAB Calling, April-June 2007, archived on-line at <http://www.cab.org.in> , accessed May 13, 2012. The author is an Indian banker who analyzed the success of Thailand's food export market.
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- ⁹⁸ Charles J. Godfray, et al, "Food Security: The Challenge of Feeding 9 Billion People," *Science* (327, 2010): 812, 817.
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- ¹⁰⁷ Karin Strokich, "The Region in Review: International Issues and Events, 2005-2006," *Contemporary Pacific* 19 (2007), 558.
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- ¹¹⁰ Strokich, 558.
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- ¹¹² "Joint Partner Statement -18th MRC Council Meeting," Mekong River Commission for Sustainable Development, accessed March 11, 2012 at: www.mrcmekong.org/news-and-events.
- ¹¹³ Strokich 552.
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