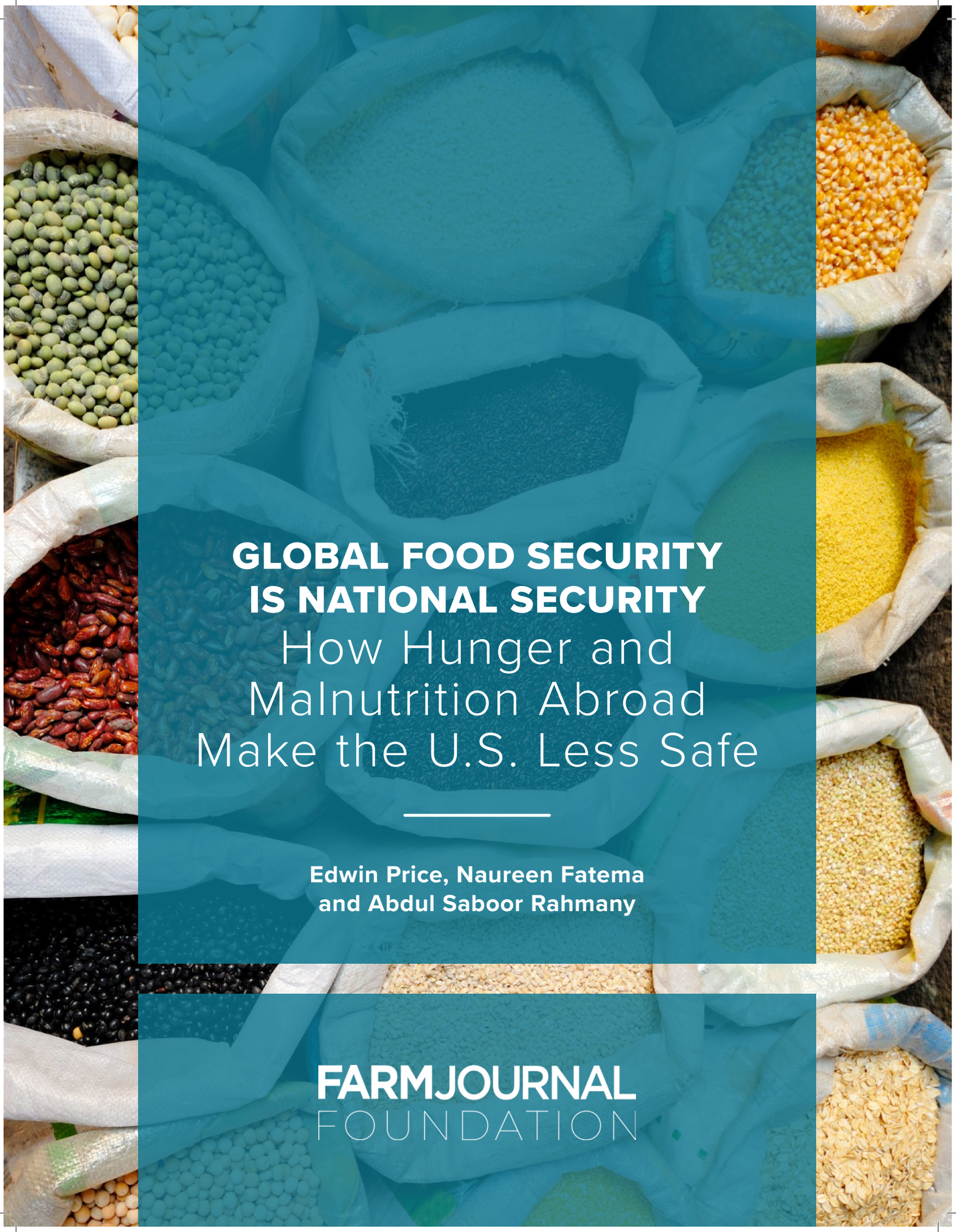

GLOBAL FOOD SECURITY IS NATIONAL SECURITY

How Hunger and Malnutrition Abroad Make the U.S. Less Safe

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ABOUT THIS REPORT

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EXECUTIVE SUMMARY

The world is now teetering on the edge of a global hunger and malnutrition crisis. The conflict between Russia and Ukraine, extreme weather events caused by climate change, the ongoing global pandemic, and a host of other factors have wreaked havoc on harvests and food supply chains around the world. The World Food Program predicts that 2023 will be "another year of extreme jeopardy" for a record 349 million people facing acute food insecurity, the severest form of hunger. This global crisis has already had serious repercussions for the U.S. – over the past year, Americans have faced rising food costs and shortages of many staple products. While these challenges have been significant, there are a number of even greater risks potentially looming on the horizon. Although it may seem far away to many Americans, hunger and poverty around the world, particularly in developing countries, pose serious threats to U.S. national security.

Around the world, many developing countries have one thing in common – for the majority of populations, agriculture is the primary way that people feed themselves and maintain a source of income. Yet in many countries, yields for major staple food and cash crops lag behind global averages, in large part due to a lack of investment in agricultural research and development (R&D) and a lack of access to existing technologies and knowledge on the part of farmers. Together, these factors lead to stagnating crop yields in developing countries, cycles of hunger, and extreme vulnerability to shocks such as those the world is seeing now. In addition, the lack of economic opportunity in developing countries, which is often driven by low agricultural productivity, is a major driver of the migration of people into the U.S. and other developed nations.

National Security Threats Linked to Global Hunger

The U.S. faces a wide range of national security threats that can be linked to increasing global hunger and poverty. These threats fall into five main categories:

- **Social and political threats**, such as real or perceived risks linked to mass migration, the potential spread of extremism and/or terrorism from radical groups that exploit impoverished communities, and risks from crime and the drug trade in countries where it is more profitable to grow illicit crops than food crops.
- **Economic threats,** such as lost export opportunities when developing countries are hit by shocks, and disrupted access to import products that cannot be produced in the U.S., such as coffee, cocoa, pharmaceuticals, and minerals such as cobalt and lithium that are used in manufacturing.
- **Nutrition and health threats,** such as the potential for new diseases to spread from countries that have poor health and sanitation infrastructure, shortages of health professionals, populations weakened by hunger, and other hardships.
- **Environmental threats,** such as the degradation of land, air, and water due to deforestation, which in developing countries is often linked to clearing natural lands to grow more crops, and related effects on climate change and biodiversity.
- **Cultural threats,** such as the expansion of anti-American sentiments and values that could develop if the U.S. were to withdraw or withhold assistance to developing countries, leaving others to fill the gap. This could include the rise of autocracy, corruption, extremism, and human rights issues.

Investing in agricultural productivity and other long-term solutions is a better way to improve developing countries' resilience against shocks, compared with direct commodity aid, which is a short-term solution to crisis situations. To address the root causes of hunger and poverty, the U.S. should make investments in various forms of long-term capital in developing countries, including human capital (e.g. investing in education and science training programs), technological capital (e.g. investing in agricultural research and development), and institutional capital (e.g. investing in local partners to build their capacity), as well as natural, physical, financial, and cultural capital. Importantly, U.S. development programs should consider the individual needs of different developing countries, and tailor capital investments accordingly.

Key Recommendations

Within this context, the U.S. government should consider the following recommendations to address global hunger and poverty and alleviate related risks to U.S. national security:

1. **Increase investments in global food and nutrition security programs, as well as research and innovation, within the Feed the Future initiative.**
   - Increase funding for the Feed the Future initiative to improve local agricultural production, incomes, and nutritious food systems. Feed the Future, the U.S. government's main global food security initiative, has received stagnant funding since 2010, while spending on emergency food aid has risen.
   - Within Feed the Future, ensure funding for agricultural research remains at least at 15 percent of global food security and agricultural development program funding. Innovation is needed to support a range of solutions for farmers, including developing more productive seeds adapted to local conditions and treatments to protect crops and livestock from pests and diseases.
   - Scale up long-term agricultural development and nutrition-sensitive programming through Feed the Future to better mitigate the drivers of migration to the U.S., including from Central America. Central America is a major source of migrants coming to the U.S., with many people fleeing because they can no longer make a living in agriculture. Support could include improving access to innovations that help farmers adapt to extreme weather, improve soil fertility, and reduce impacts from pests and diseases.

2. **Expand and strengthen knowledge-sharing and peer-support programs for developing countries in agriculture.**
   - The Farm Bill should continue to support scientist-to-scientist and educational programs such as the Farmer-to-Farmer program, the International Agricultural Education Fellowship Program, and other fellowship opportunities. These programs are highly impactful because they facilitate local capacity building and education and benefit extension systems that deliver solutions directly to farmers.
   - Create incentives for scientists in developing countries to focus on localized agricultural production issues. The scientist-to-farmer ratio needs to be dramatically increased in many countries. Incentives could include adequate pay, good laboratories, research operations support, and collaborative relationships with developed country scientists.
   - Fund graduate-level agricultural research projects for U.S. students at CGIAR. U.S. student-scholars are greatly underrepresented at CGIAR centers compared with scholars from other countries. Strengthening the relationship between U.S. land grant universities and CGIAR would create a base for future collaboration between U.S. and developing country scientists.

3. **Support robust funding of the Foundation for Food and Agriculture Research (FFAR) in the Farm Bill.**
   - U.S. agencies like the Defense Advanced Research Projects Agency (DARPA) and National Science Foundation (NSF) should also be encouraged to utilize FFAR to leverage scientific resources to solve global food challenges that may impact national security.

4. **Leverage and coordinate executive branch departments to advance global food and nutrition security priorities.**
   - Leverage the State Department to secure greater investments in agriculture, R&D, and extension by developing country governments. This is particularly relevant in Africa, where some African governments have not met their commitments to support agriculture.
   - Expand the mandate and increase the funding for the Millennium Challenge Corporation (MCC), particularly as it relates to agriculture and rural transformation. The MCC is a development model that puts the design and management of projects into the hands of developing country leaders. Allowing more middle income countries where poverty is increasing to be eligible for MCC programs would expand its impact.
   - Leverage International Development Finance Corporation (DFC) investments aligned within Feed the Future. China's global infrastructure investments are reducing U.S. influence in strategic regions, particularly in Africa. DFC should augment Feed the Future-related food security investments in countries where U.S. national security interests are most threatened.
   - Improve coordination between Feed the Future and the Department of Defense on the U.S. government's global food security strategy. Coordination could help identify target areas that might be prone to security issues and fund programs that are doing tailored, localized science to increase agricultural productivity.

5. **Provide the authorized amount of funding to the Agriculture Advanced Research and Development Authority (AgARDA) to develop technologies that address global food and agriculture challenges.**
   - Fully funding AgARDA would help infuse much needed research funding into agriculture, in line with national security goals.

6. **Support research into the effectiveness of different agricultural technologies and production systems under conflict dynamics and in socio-politically fragile environments.**
   - Some agricultural technologies are likely better than others for supporting families and communities during conflict, but to date, little research has addressed this problem.

INTRODUCTION

The goal of this paper is to identify channels through which food insecurity in developing countries affects the national security of the U.S. It provides recommendations on investments that the U.S. government can make to increase agricultural production and incomes in fragile countries and thereby lessen danger to the U.S. Special attention is given to international migration and the rise of crime, gangs, militias, and terrorism, and how they are linked to food insecurity.

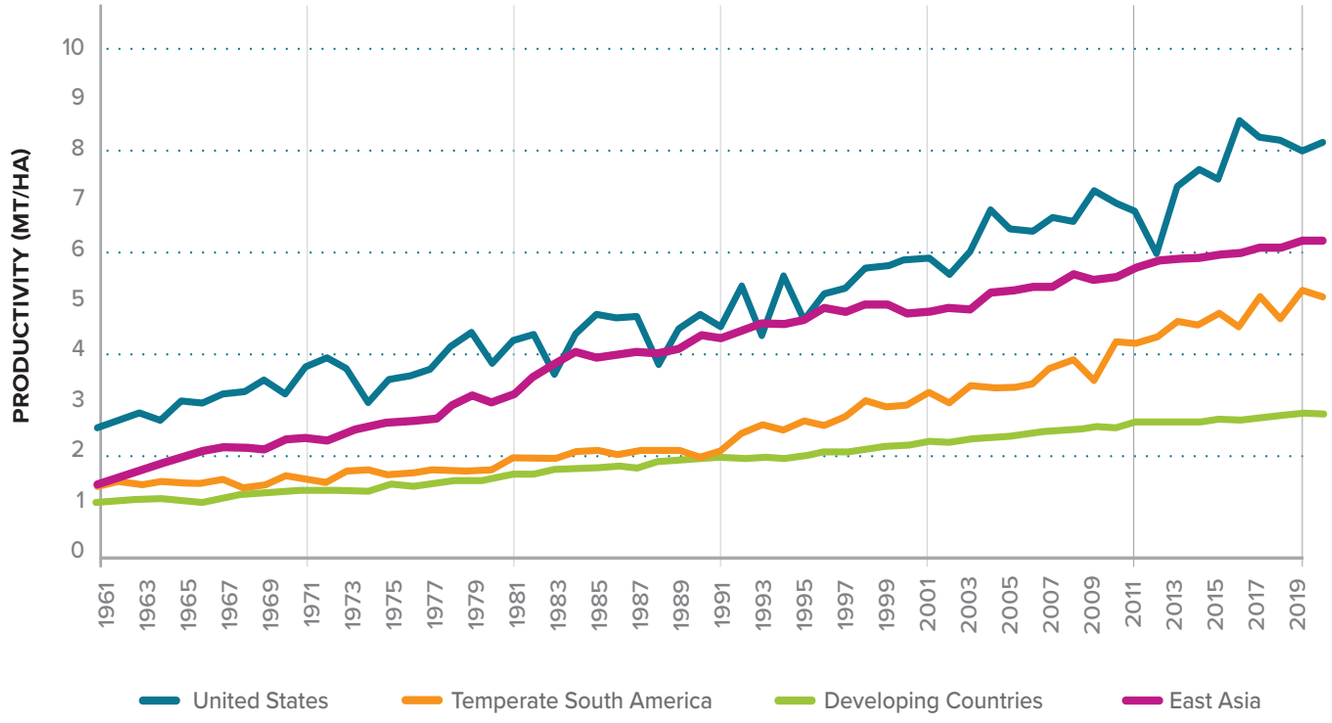
- National security is the assurance to all current and future Americans of their ability to freely and fairly make economic and political decisions, worship as they wish, acquire knowledge, benefit from natural resources, and remain safe from fear of hunger, disease, and disruption of daily lives from internal or external threats.[1]
- Food security is the condition whereby all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.[2]

Agricultural Productivity Overview

Three quarters of the world's poorest people live in rural areas and rely on agriculture for their livelihoods (World Bank, 2014). Smallholder farmers, those with less than 5 acres of land, account for 84 percent of the world's 570 million farmers. They are located mainly in developing countries where crop yields are relatively low. Small farm size coupled with low yields means that food supplies are tight, and families often go hungry. (Ritchie & Roser, 2021).

Incomes with which to purchase food and food availability are both tied to agricultural productivity. Cereal grains including rice, wheat, maize, sorghum, and millet account for more than 50 percent of calories in human diets worldwide (Awika, 2011). Cereal yields are therefore a useful indicator of a country's productivity. Figure 1 compares cereal yield in metric tons per hectare in 110 developing countries with the more developed world regions of East Asia, Temperate

Figure 1: Comparison of Productivity (mt/ha) Between USA, Temperate South America, Developing Countries, and East Asia Between 1961-2020



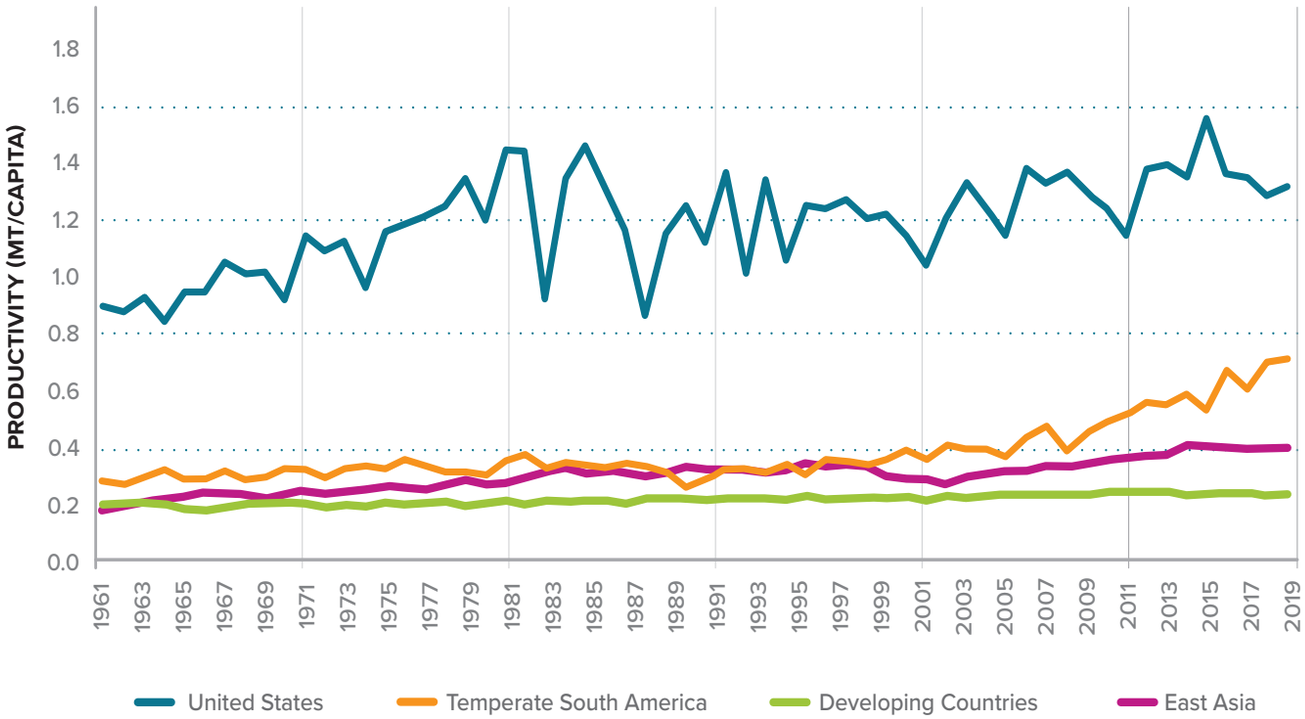
Source: Compiled from United Nations Food and Agriculture Organization (FAO) statistics, 1961-2020, https://www.fao.org/faostat/en/#country

1 Adapted from Heritage Foundation 2 Food and Agricultural Organization (FAO), of the United Nations.

South America, and the U.S. The figure shows that yields have increased in all regions since 1961, but most markedly in the U.S., where the cereal yield in 2019 amounted to 8.2 mt/ha – about three times the average of all developing countries at 2.8 mt/ha. The situation is more concerning when per capita production is compared (Figure 2). Using this measure, developing countries have essentially made no improvement since 1961, while per capita cereal production in the U.S. increased by 60 percent. In 2019, U.S. cereal production per capita was about six times that of developing countries. While imports and other carbohydrate sources (root and tuber crops such as cassava and potatoes) can partially fill the food gap in poor countries, given their relative poverty and inability to pay for imports, food insecurity is a clear threat throughout much of the developing world.

Both production per hectare and production per capita are important. Yield per hectare is indicative of technological advancement and the profitability of farming, or farm incomes. Yield per capita is indicative of food security.

Figure 2: Comparison of Per Capita Productivity (mt/Capita) Between USA, Temperate South America, Developing Countries, and East Asia Between 1961-2020

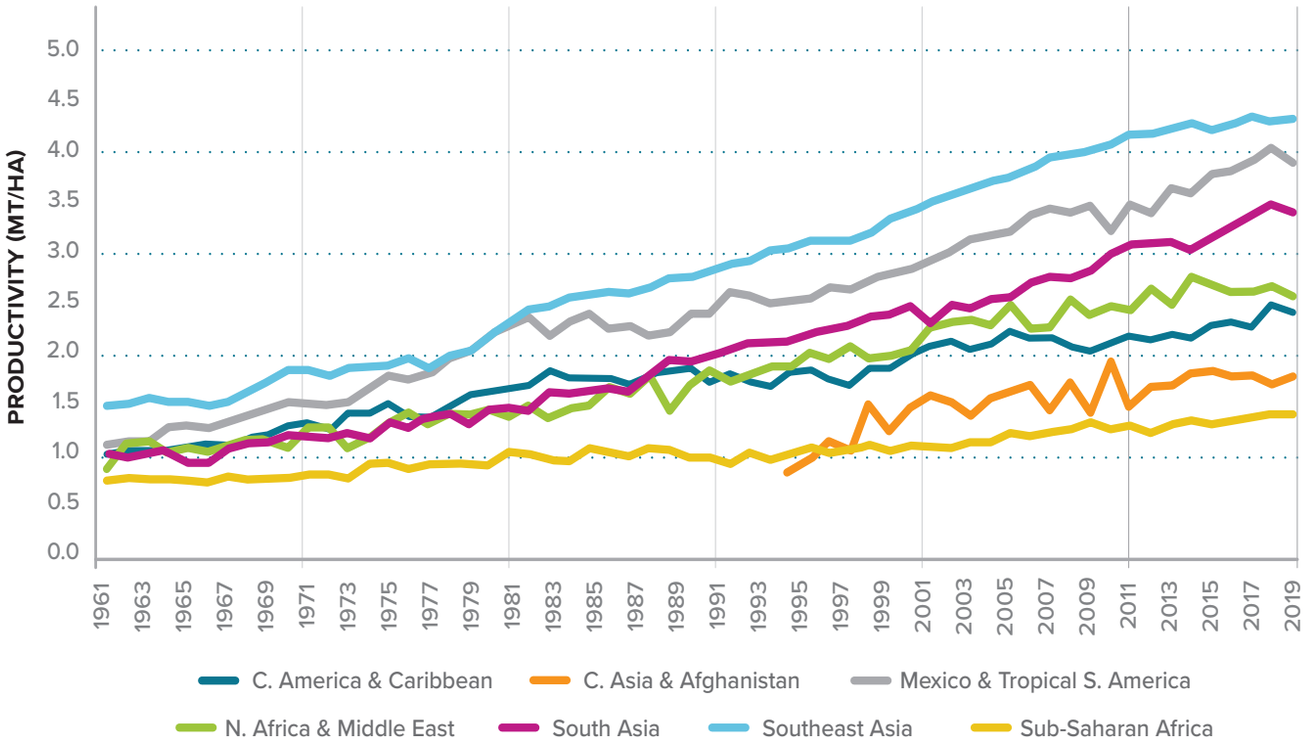


Source: Compiled from United Nations Food and Agriculture Organization statistics, 1961-2020, https://www.fao.org/faostat/en/#country

There are marked differences in cereal productivity among less developed countries. Figure 3 shows cereal yields across seven less-developed regions of the world. In 1961, the yield difference between the least productive and most productive developing regions, Sub-Saharan Africa (0.75 mt/ha) and Southeast Asia (1.5 mt/ha) respectively, was about three-fourths of a metric ton. By 2019, the yield gap between Sub-Saharan Africa (1.4 mt/ha) and Southeast Asia (4.3 mt/ha) had more than tripled to 2.8 mt/ha. However more indicative of stress in food security are the alarming trends in cereal production per capita (Figure 4 on the following page). On a per capita basis, Central America fared worst among all developing regions with per capita domestic cereal production essentially unchanged between 1961 and 2019. The regions facing the greatest food insecurity based on per capita cereal production were Central America, Mexico and Tropical South America, Africa, and the Middle East.

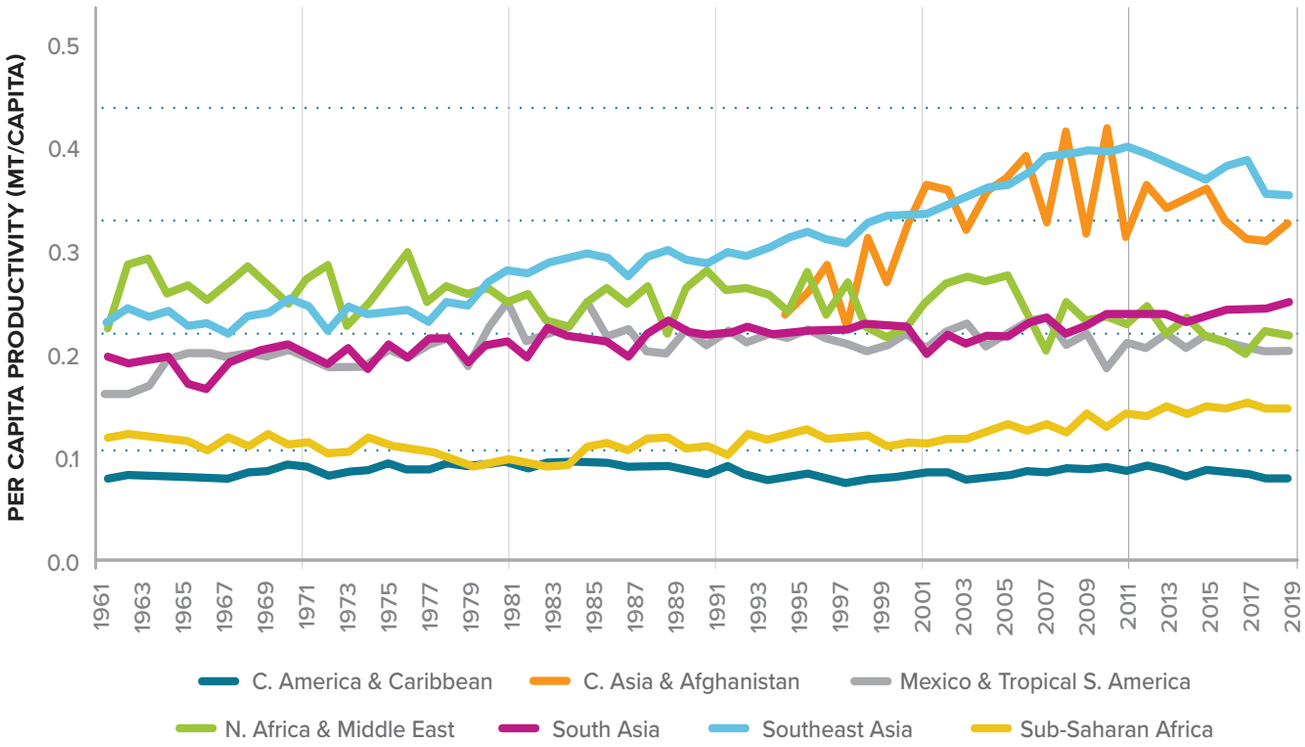
Though the performance of Southeast Asia cereal farmers was comparable to the rest of the developing world in 1961, the region has shown marked improvements in recent decades both in terms of yield per hectare and production per capita, due to investments in and adaptation of scientific innovation. Southeast Asia lies in a Tropical Zone much like the U.S. neighboring region of Central America. Southeast Asia is recognized for its uptake of modern rice technology – improved varieties, along with greater use of fertilizer, pesticides, and irrigation, all aspects of the so-called Green Revolution. Equivalent advances are needed in the Tropical Americas, the continent of Africa, and the Middle East in order to address food insecurity.

Figure 3: Comparison of Productivity (mt/ha) Among Developing Countries by World Region, 1961-2020



Source: Compiled from United Nations Food and Agriculture Organization statistics, 1961-2020, https://www.fao.org/faostat/en/#country

Figure 4: Comparison of Per Capita Productivity (mt/Capita) Developing Countries by World Region 1961-2020



Source: Compiled from United Nations Food and Agriculture Organization statistics, 1961-2020, https://www.fao.org/faostat/en/#country

Migration Overview

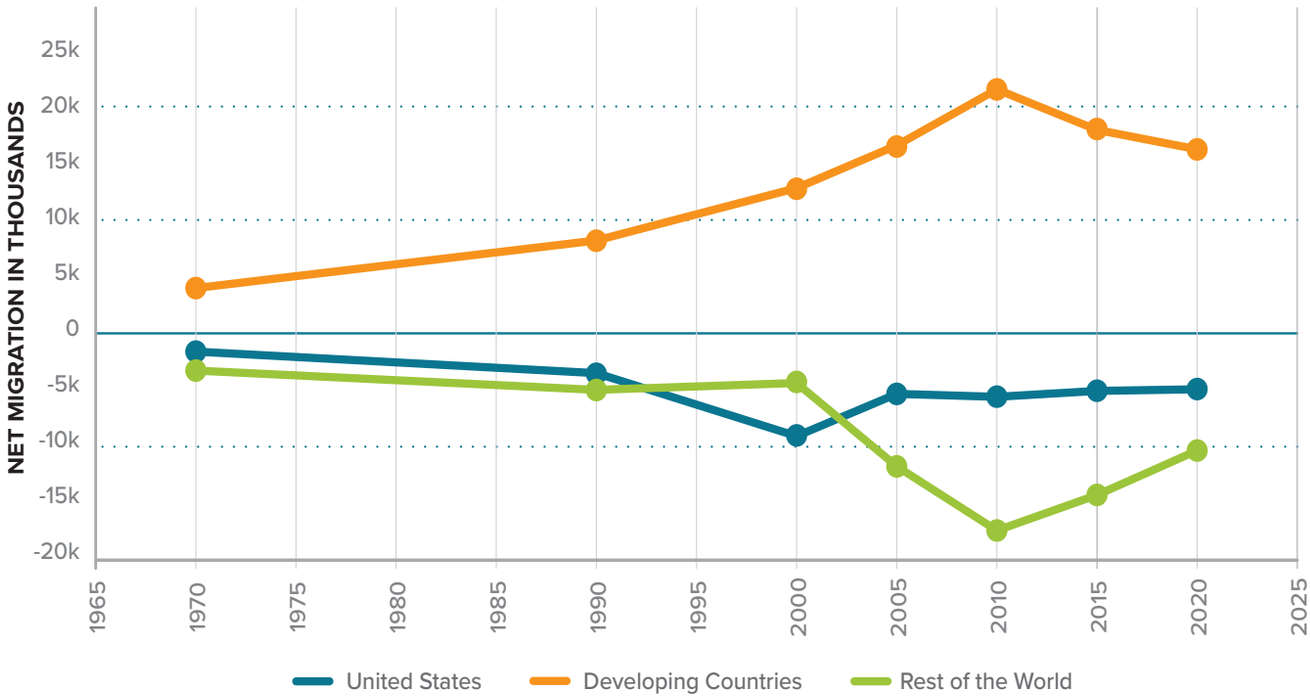
The immigrant population of the U.S. (legal and illegal) in January 2022 was estimated to be 46.6 million or 14.2 percent of the total U.S. population, nearly reaching the 14.8 percent immigrant population recorded at the previous peak in 1890 (Camarota & Zeigler, 2022). While the U.S. is the world's largest recipient of immigrants in absolute numbers, the proportion of immigrants in the overall population is modest compared to other countries such as Germany with 18 percent, Sweden with 20 percent, Canada with 22 percent, Australia with 28 percent, Switzerland with 30 percent, and the Persian Gulf countries with 70-90 percent (Budiman, 2020). With the U.S.-Mexico border being the world's largest immigrant portal, U.S. immigrants are less diverse than those arriving in Canada and Europe. 50 percent of all U.S. immigrants are Latin American, of which half are of Mexican descent (Connor & López, 2016). Another quarter of U.S. immigrants are Asian, with a growing share migrating from Africa (Pew Research Center, 2018). The global immigrant count was about 260 million in 2017 of which, apart from Syria, Sub-Saharan African emigrants accounted for the fastest growing component of world migration. Between 2010 and 2017, emigration out of Sub-Saharan Africa grew by 31 percent, while that originating from the Middle East and North Africa increased 39 percent (Connor, 2018).

Among U.S. immigrants, it is estimated that 45 percent are now naturalized citizens, 32 percent are lawful residents, and 23 percent are unauthorized immigrants (Budiman, 2020). Figure 5 shows that net migration out of 110 developing countries was about 16 million persons over the five-year period ending in 2020, with the U.S. taking in about 5 million, and the rest of the world taking in about 11 million migrants. More than a million people have been granted U.S. citizenship in the fiscal year 2022 (USCIS website, accessed Feb 2023). Migrant encounters – both apprehensions carried out under Title 8 of the U.S. code and expulsions carried out under Title 42 of the U.S. code – accounted for more than 3 million cases in the calendar year 2022 (calculated from U.S. Customs and Border Protection website, accessed February 2023). The deportees were mainly of Mexican and Central American origin, and 70 percent of them

single adults seeking jobs in the U.S. Another large group of migrants from Cuba, Venezuela, and Nicaragua were arrested but could not be deported since the U.S. does not maintain political relations with these countries. Under current policy, they will be released into the U.S. (Pérez & Hackman, 2022). The U.S. Department of Homeland Security has recently announced procedures through which nationals of Cuba, Haiti, Nicaragua, and Venezuela may legally enter the U.S. (USCIS website, accessed Feb 2023).

McKinsey analysts suggest that worldwide, 90 percent of migration is voluntary and mostly for economic reasons. About 10 percent of migrants are refugees and asylees who are escaping conflict and persecution. Half of all migration is from developing to developed countries (Woetzel et al., 2016). Migrants at the southern border of the U.S. present mainly as asylum seekers, driven by the unfavorable political, social, and economic conditions of the Northern Triangle countries of El Salvador, Guatemala, and Honduras. As of March 2019, 74 percent of apprehensions at the U.S. southern border were from the Northern Triangle, of whom 58 percent were families and unaccompanied children. Their reasons to migrate included high crime rates, pervasive gang violence, extreme poverty, corruption, and environmental degradation in their communities back home (National Immigration Forum, 2019).

Figure 5: Net Migration of World Regions, Cumulative Number of Persons Over 5-Year Intervals Between 1970-2020



Source: Compiled from Knoema report, Accessed August 17, 2022, https://knoema.com/atlas/topics/Demographics/Population/Net-migration-rate

VECTORS OF INSECURITY AND COMMUNITY DESTABILIZATION IN THE U.S. ASSOCIATED WITH LACK OF ECONOMIC DEVELOPMENT IN OTHER COUNTRIES

A seminal 2017 United Nations Food and Agriculture Organization review of research on the relationships of food insecurity to conflict in less developed countries led to four key conclusions (Holleman, 2017):

- Food insecurity can cause violence and instability, especially where inequalities are prevalent and institutions are weak.
- Spikes in food prices increase the risk of political unrest and violence, such as what occurred in 2007-2008 when food riots erupted in more than 40 countries.
- Drought and other climate events that threaten food security increase the risk of conflict.
- Competition for the land and water that support food security often culminates in conflict.

In a literature review commissioned by World Food Program USA in 2017, the authors found that 77 percent of articles that explicitly tested the relationship within countries between food security and national security found a positive correlation between the two phenomena (WFP USA, 2017).

Here we examine how global poverty, hunger, and conflict in foreign countries can impact U.S. national security and destabilize U.S. communities. This occurs through many pathways – not only from any unfavorable effects of immigration, but also through the production and export of illicit crops, human trafficking, utilization of U.S. resources to address foreign conflicts, foreign conflicts crossing our borders, increasing radicalization of youth frustrated by lack of opportunity and their recruitment into international terrorist organizations, and threats to our military personnel overseas. Still other less violent pathways can nonetheless erode the quality of life in the U.S.

Socio/Political Vectors of Instability

Illicit crops such as coca and poppy (from which cocaine and heroin are derived) are frequently grown where food productivity is low and the rule of law is absent. Social and political security of the U.S. is undermined by the violence, crime, and loss of productivity caused by narcotics trade and consumption in the U.S. About 82 percent of the domestic wholesale value of illicit drugs in the U.S. is imported illegally, and if officially counted in the U.S. balance of payments, would comprise 1.3 percent of the value of all import transactions. An estimated $14 billion worth of cocaine and heroin were imported annually to the U.S. from Latin America over the decade ending in 2017, with another estimated $5 billion entering from Asian developing countries (Atkinson, 2019). Illicit drug imports help supply a drug trafficking industry costing the U.S. $200 billion a year in lost productivity, health care, and justice system costs (Office of National Drug Control Policy, 2019). Drugs of all kinds disrupt lives in every American community, draining resources and introducing fear of family members becoming users and/or victims of drug-related violence.

Farmers in developing countries who grow illicit crops often express aversion to the enterprise. They know the harm that illicit drugs cause to families. Also growing illicit crops conflicts with local community values, violates national laws, and affords little flexibility for crop use or sale. But given the low-yielding technologies and inefficient input and product markets for food crops in some developing countries, illicit crops are often farmers' most profitable choice, even though they receive only about 1 percent of the retail value of those crops. Thus, even modest improvements in productivity of food crops could help those crops compete better with illicit crops.[3]

Grievances derived from perceived unfairness of developed nations toward less developed nations, linked to terrorism and crime. A study of 900 terrorists and 600 nonviolent extremists in the U.S. found that 60 percent have experienced grievance against the U.S. government or other governments, or in reaction to a specific political event (Smith, 2018). Directly and indirectly, poverty and hunger in developing countries create dissension and violent extremism in the U.S. Dissent arises directly among Americans from the sympathetic view that too little is done to assist poor countries, or that affluence in the West has been achieved at a cost to poor countries. A central tenet promoted by Communist nations during the Cold War was that Capitalism victimized the poor. Eisenhower's own warning to "guard against the acquisition of unwarranted influence, whether sought or unsought, by the military industrial complex" (National Archives, 2021) was a call to the barricades to American youth of the 1960s, albeit less violent than the current radicalism of the right (Jasko et al., 2022). Indirectly, radical extremism born of poverty and food insecurity in developing countries feeds radicalism born of other causes in the U.S. A key element of the U.S. strategy for combating domestic terrorism is to "illuminate transnational aspects of domestic terrorism" (National Security Council, 2021).

Beyond U.S. borders, terrorism abroad is bad for the U.S., as it leads to lost economic opportunities for trade and tourism, and increased costs for protecting U.S. interests. The global economic costs of terrorism in 2019 was estimated at $26.4 billion. This includes the direct and indirect costs of deaths ($16.2 billion), loss of GDP ($9.3 billion), property damage ($0.7 billion), injuries ($0.3 billion) – for victims, perpetrators, and local governments. It does not include indirect impacts on business investment, insurance costs, lost opportunity (e.g. tourism), and costs for security agencies countering terrorism (Institute for Economics & Peace, 2020). Reduction of poverty and hunger in developing countries could do much to weaken the root motivations for violent extremism overseas and in the U.S.

Poverty and terrorism. Omer Taspinar (Taspinar, 2009) suggests that poverty and deprivation lead to the radicalization of communities, which in turn become the breeding ground of terrorists. Extreme poverty in itself is not necessarily the cause of radicalization, but rather it is the perception of relative deprivation. "Globalization has created an acute awareness of opportunities available elsewhere." Unemployed youth compare their lives with their counterparts' situations in other countries. Radicalism is brought about by a shared feeling among youth of victimization, frustration, humiliation, and deprivation relative to other countries and expectations for themselves. Globalization makes matters worse because young men and women are torn by the conflict of their traditional societies with western modernity.

Few radicals become terrorists, but radicalized societies are where terrorism can take hold. "The scale of youth frustration is compounded by a demographic explosion, growing expectations, weak state capacity, and diminishing oppor-

3 Working with former WWII operatives in the U.S. Office of Strategic Services, author Price and colleagues replaced opium production in Kutcai communities in Northern Burma with improved maize through Project Old Soldier, 1995-2000.

tunities for upward mobility… Terrorist organizations exploit these radicalized social habitats" (Taspinar, 2009). But despite the variability in cultures, economies and histories across radicalized societies, some of their members become terrorists when they come to share a willingness to kill or harm civilians for their cause.

"From Somalia to Afghanistan, from Mali to Yemen, from Chechnya to the Pakistani Federally Administered Tribal Areas and to the Philippine island of Mindanao, ungoverned spaces often attract terrorist networks that use these territories for two major purposes: (1) as a staging ground for international attacks, and (2) to recruit uneducated and impoverished young men with no prospects" (Taspinar, 2009). Moroccan jihadists recruited from the slums bombed their capital in Casablanca in 2003 and Madrid, Spain, trains in 2004. Lebanese Hezbollah and Fatah al Islam organizations also draw the bulk of their support from the socio-economically deprived segments of society.

The violent extremist organization Boko Haram targets the "poor and alienated" northern Nigerian population. Al-Shabaab similarly targets unemployed youth, and other poor and marginalized members of Somali society, 70 percent of whom are under the age of 24 (Omenma, 2020). Both seek to establish Sharia Law in their respective countries, with some regional African operations. Al-Shabaab receives funds and recruits globally, including from the U.S., and advances a global jihad objective (Omenma, 2020) and has attacked U.S. military personnel deployed in East Africa as recently as 2022.

Counter-terrorism efforts must focus on human development to prevent radicals from becoming a threat in the form of terrorism. Fighting radicalism with human development – specifically social and economic development – should emerge as a new public narrative and long-term objective for a smarter effort at strategic counter-terrorism" (Taspinar, 2007).

Insurgencies during the last half of the century in Central and South America have largely built upon similar forces as has radicalism and terrorism in Africa and the Middle East. The notorious terrorist groups Sendero Luminosa in Peru, Sandinistas in Nicaragua, and FARC in Colombia originated among the poor and disenfranchised. These movements spawned no directly related violence in the U.S., but it is not impossible that new waves of violence in Central and South America could adopt some of the methods of global terrorism learned from Africa and the Middle East.

Losing hearts and minds. Supporting the economic development of foreign countries is one of the ways in which the U.S. government seeks to advance U.S. national security interests.[4] Most developing countries are heavily dependent on agriculture not only for food security, but also for its contributions to their national economy and family income. As many as 75 percent of the population of Afghanistan and Iraq, for example, are dependent upon agriculture for their livelihoods. Therefore, the improvement of agricultural productivity in developing countries is essential to U.S. national security. Evidence for Afghanistan prior to the Taliban takeover in 2021 suggests that indeed agricultural development was winning hearts and minds, reflected in villagers' improved feeling of well-being and more favorable views of the government. (Beath, Christia, & Enikolopov, 2012).

But the competition for hearts and minds is strong from those nations that would view the U.S. as an adversary. For example, as of August 2022, 149 countries have signed up for China's aggressive belt and road initiative – aimed to promote development and inter-region connectivity. Americans view China's influence as growing while 47 percent think U.S. influence is weakening (Connaughton, 2022). Meanwhile Russia has weaponized food security to win power and influence over those countries needing Russian and Ukrainian cereal grains (Henkhaus, 2022).

Local crime can become international conflict. It has been noted that people caught in poverty and food insecurity sometimes turn to crime to feed themselves and their families. A growing body of literature links crime, overzealous policing, and incarceration as pathways to radicalization, (e.g. Sahgal & Zeuthen, 2022). The problem is sufficiently well recognized that the United Nations provides guidance on preventing the progression to violent extremism in prisons (United Nations, 2016). Research reported in 2018 by George Washington University suggests that radicalization among detained or incarcerated individuals will be a major factor in the growing threat from terrorism over the next decade (Clifford, 2018). Vulnerable youth in Trinidad have been documented as being recruited into drug trade by a political underground that was connected to the prison transportation system, and to agents inside the jails who recruited the youth into radical Islam. A number of these youth then traveled to Syria and joined ISIS (Robles, 2017; Price, 2017).

4 The mission of the U.S. State Department Office of Foreign Assistance is to advance "U.S. national security and development objectives by coordinating policy, planning, and performance management efforts; promoting evidence-informed decision making; and providing strategic direction for the State Department and U.S. Agency for International Development foreign assistance resources." https://www.state.gov/bureaus-offices/secretary-of-state/office-of-foreign-assistance/

The accords that ended the El Salvadoran Civil War in 1992, a war spawned by poverty, did not include a plan for development of the country, creating a reservoir of youth seeing no future for themselves. The ensuing years have been marked by the growth of cross-national sharing between the U.S. and El Salvador of growing gangs and criminality (Martinez, accessed on September 15, 2022). Salvadoran youth incarcerated for gang activity in Los Angeles have been deported to El Salvador, where both in their communities and in the El Salvadoran prisons, they have retained the identity of their U.S. street gangs. The national security of the U.S. is threatened by the poverty of agriculture in Central America and the attraction of youth into gangs and crime.

Perceived impacts of migration. Americans as a whole regard immigrants as net contributors to the U.S. economy. A Pew Research survey in 2019 found that 66 percent of Americans say that immigrants strengthen our country by their hard work and talents, while 24 percent see them as a burden by taking jobs, housing, and health care. (Budiman, 2020). A 2021 Gallup poll found that 75 percent of Americans considered immigration to be good for the U.S. but felt that illegal immigration was a significant threat to national security. In 2015, the total number of illegal immigrants in the U.S. was estimated at about 11 million persons. Among illegal immigrants, the number of persons who overstayed their legal entry to the U.S. far outnumbered those who entered illegally. From 2008 to 2015, about 2 million immigrants overstayed their visas compared to 1.1 million who "entered without inspection," abbreviated EWI (Warren, 2017). The trend continued in 2016-2017, when visa overstays (320,000 persons) accounted for 62 percent of newly undocumented immigrants, compared to 38 percent (210,000 persons) classified as EWIs (Warren, 2019).

By and large, any harm that migrants pose to U.S. national security may be the result of inaccurate impressions. "Immigration has been a touchstone of the U.S. political debate for decades, as policymakers have weighed economic, security, and humanitarian concerns. Congress has been unable to reach an agreement on comprehensive immigration reform for decades, effectively moving some major policy decisions into the executive and judicial branches of government and fueling debate in the halls of state and municipal governments" (Klobucista, Cheatham & Roy, 2022). The most recent comprehensive immigration legislation passed by Congress was under President Reagan in 1986 when 3 million undocumented immigrants were granted legal amnesty. Presidents George W. Bush and Barack Obama both worked with Congress to pass immigration reform, but neither succeeded. Immigration remains a high profile, contentious issue in U.S. politics (ibid.).

But it appears that the greater harm to U.S. national security caused by immigration is not any danger caused directly by immigrants, but rather the disruptive and sometimes violent actions taken by individuals and groups who are opposed to current U.S. policies, or in response to misinformation about government actions toward immigrants, or to immigrants themselves. The August 3, 2019, attack on Walmart shoppers in a heavily immigrant section of El Paso, Texas, which killed 22 persons, is one such case. The perpetrator ranted online against the "Hispanic invasion of Texas" (Romo, 2019).

While evidence suggests that immigrants themselves tend to have a net-positive, rather than net-negative, impact on their communities, taking steps to stem the flow of migration from poor countries remains in the U.S. interest from humanitarian and economic standpoints. Immigration is not typically an enjoyable venture – it is costly, difficult, dangerous, confusing, and emotionally wrenching to leave home. If given the opportunity to pursue a free and moderately prosperous life in their home countries, most immigrants would rather stay at home (McKenzie, 2017; National Security Council, July 2021). If the U.S. could successfully assist developing countries to provide better livelihoods for their would-be emigrants, both the countries and their citizens would be better off. The likely benefits to the U.S. over the long-term of newly prosperous trading partners, unhampered by the social-political costs of poverty in developing countries, likely outweigh the benefits of receiving migrants into the U.S. economy.

Developing countries receive 60 percent of U.S. agricultural exports and represent the best opportunity for U.S. export expansion.

Economic Vectors of Instability

Gaining/losing trading partners. Developing countries receive 60 percent of U.S. agricultural exports and represent the best opportunity for U.S. export expansion. The World Bank projects that in coming decades population growth will be greater in the Global South than in developed coun-

tries, with Africa's population expanding from 17 percent to one quarter of the world's population by 2050 (Harris, 2017). However, poverty that is associated with a lack of development deprives the U.S. of potential trading opportunities. If the U.S. assists countries to develop their economies, then those countries are good candidates to become more robust trading partners of the U.S. Experience shows that helping countries improve their food productivity, and/or agricultural productivity broadly, results in greater food imports by the developing country (Herdt, 1998). Increased agricultural growth leads to higher incomes and a consequent greater demand for goods and services, thus leading to higher imports. For example, an increase of $1 in GDP causes total imports to increase by $0.32, agricultural imports to increase by $0.07, and cereal imports to increase by $0.03 (Pinstrup-Anderson, Lundberg & Garret, 1995). Among the most rapidly developing countries, each $1 increase in agricultural production is associated with a $0.54 increase in agricultural imports (Herdt, 1998). Increased productivity earns income for farmers and for the country, and they respond by consuming more. Increased consumption enabled by higher incomes from an enterprise can outstrip countries' increasing domestic supply of that product. Or, more commonly, increasing incomes bring a shift in consumption to more preferred foods, such as livestock products, and thereby increases the demand for animal feeds that the U.S. might supply. The key is that the nation that helps the developing country improve their productivity, is the nation most likely to benefit from increased exports to that developing country. The U.S. can gain markets if it is a country's partner in development, or it is likely to lose a trading partner if the U.S. allows a competing nation to befriend that country in need.

Among the most rapidly developing countries, each $1 increase in agricultural production is associated with a $0.54 increase in agricultural imports (Herdt, 1998). Increased productivity earns income for farmers and for the country, and they respond by consuming more.

The disruptions of international food, energy, and agricultural input trade brought by the Russian invasion of Ukraine in February 2022 bring challenges and opportunities. Russia and Ukraine are major suppliers of wheat, feed grains, and vegetable oil to African and Asian countries, and Russia also sells them petroleum products and fertilizer. Trade is being realigned as importing nations seek to secure their sources of these commodities, and exporting nations seek to secure their markets. The U.S. needs to be alert, smart, and nimble as developing countries sort out the partners on whom they will rely for development assistance and trade.

Complementarities in product industry and trade. There are opportunities for the U.S. to assist developing countries to improve their production and export of commodities that the U.S. does not produce, but which it needs for its industry. Typically, these are tropical crops such as coffee, tea, cacao, sugar, tropical timber, tree fruits, and pharmaceuticals. Following the Rwandan genocide in 1994, caused in part by the collapse of coffee prices (New Internationalist, 2019), the U.S. assisted Rwanda to rebuild its coffee industry by increasing production and export of high quality (fully washed Arabica) coffee. Starting from zero, this "specialty" coffee rose to 60 percent of total coffee exports in 2020 (Oirere, 2022), with one-third, valued at $22 million, going to its largest customer, the U.S. (OEC, 2020). In 2015, the coffee industry was worth $225 billion to the U.S. economy, about 1.5 percent of GDP, and was responsible for 1.7 million U.S. jobs. The coffee industry generated $29 billion in local, state, and federal taxes in 2015 (NCA, 2017). All of this comes from an industry for which the raw material is imported from tropical regions of the world, much of it in developing countries such as Colombia, Indonesia, and Ethiopia.

In contrast, productivity of the coffee industry in El Salvador, once one of the world's major suppliers, has stagnated, and the sector no longer supports a vibrant industry of small farmers. The decline of the industry in Central America, caused by the spread of coffee leaf rust disease and loss of markets to Brazil, is the primary driver of northward migration of destitute workers and families seeking a new life in the U.S. (Angel et al., 2021). An all-out effort by the U.S. to improve productivity of the Central American coffee industry could do much to stem the tide of migrants, and at the same time assure the American coffee industry of raw material for years to come. Coffee is but one of many tropical products that can profit U.S. business and industry if we can help improve productivity of those crops in the face of climate change.

Labor markets between the U.S. and developing countries are a double-edged sword. Migrants comprise 17 percent of the U.S. workforce (Peter G. Peterson Foundation, 2022). If the U.S. helps to foster development in food insecure countries, and migration of their citizens out of the country to the U.S. declines, it may force wages higher in the U.S. (PRB, 2010). The process would likely be gradual, as development itself is a gradual process, so presumably adjustment in the labor force would be gradual. Higher wages in the U.S. would of course be advantageous for U.S. workers.

On the other hand, failure of food insecure countries to develop and continued out-migration to the U.S. would benefit those U.S. industries that are dependent on low-wage workers. (Ibid.) On balance, given the trauma and humanitarian costs associated with migration, and the benefits of trade with prosperous nations, a policy of helping these nations escape poverty is the alternative the U.S. might best pursue.

Access to resources. Less developed countries are the source of many categories of natural resources that are vital to U.S. defense and industry. One of the world's poorest and most volatile countries, the Democratic Republic of the Congo, holds the world's largest cobalt reserves. In addition, Afghanistan has one of the largest deposits of lithium and rare earths – vital minerals for the electronics industry and emerging climate-smart economies. Copper, bauxite, and graphite are also vital to the renewable energy economy and are primarily mined in developing countries (The World Bank, 2022). China is aggressively pursuing partnerships in these countries and access to these raw materials (Marlow & Curran, 2021).

It is important for developing countries that are the source of these vital minerals to seek balanced growth, including domestic food security. The benefits from growth that rely on mineral exports are frequently captured by the wealthiest segments of those societies, which often leads to internal conflict. The so-called "resource trap" or "resource curse" is a phenomenon that has been observed in Nigeria and Yemen in recent decades. Formerly diversified economies with proportionately large agricultural sectors accounted for 41 percent of GDP in Nigeria and 24 percent in Yemen in 1970, with substantial exports from the sectors. By 2006, petroleum accounted for 98 percent and 90 percent of export receipts in the two countries. Agriculture had declined to 6 percent and 10 percent of GDP respectively, manufacturing had declined, and the level of poverty had increased (UNDP, 2011). Developed nations that partner with developing countries to improve and expand food and agricultural production can better assure their own access to the minerals and other resources that are vital to their own continued growth.

Balance of payments and strong U.S. dollar. A strong U.S. dollar relative to foreign currencies makes U.S. goods more expensive to foreigners, while a weak dollar makes U.S. goods cheaper to others and increases U.S. exports. While there are advantages and disadvantages of a strong dollar, on balance U.S. national security is best assured by a strong dollar and strong U.S. economy, attracting to the U.S. investments seeking y reliability and a good rate of return. A strong economy needs good trading partners and a peaceful world. Both are built on the advancement of developing countries, as they increasingly satisfy their hungry populations and are increasingly able to trade with the U.S. If the U.S. is a partner in developing countries' economic advancement, the U.S. is likely to be a partner of choice in trade, helping to keep the U.S. economy and dollar strong.

Technology development and acquisition. U.S. engagement in the advancement of agriculture in developing countries often pays off in improved technologies for U.S. farmers. This happens in at least two ways. First, seeing how technology performs in environments different than our own helps U.S. scientists better understand weaknesses and strengths of that technology. For example, scientists can see animal and crop susceptibility or resistance to diseases and insects, or to heat, cold, or drought, before those conditions are faced in the U.S. We can test technologies against conditions not typically seen in the U.S., helping to prepare for the future. Indeed, U.S. Agency for International Development (USAID) Collaborative Research Support Programs (CRSP), which operated between 1979 and 2011, and subsequent Feed the Future Innovation Laboratories succeeded in demonstrating the mutual benefits to U.S. and developing countries of international cooperation in improving technologies for peanut, sorghum, maize, millet, forage, and livestock production.

Also, nearly all U.S. food crops and animals have a foreign heritage – the U.S. has always been reliant on foreign countries for the sources of new technology, or the raw material for new technology. On average, 70 percent of the food around the world originated and was first cultivated outside the country where it is now consumed (Khoury et al., 2016). The region of origin of a crop usually has the most genetic diversity in that crop. To find resistance to new diseases or pests, or to find new flavors or colors of a food, one needs to acquire the related genes in the landrace crop varieties from the country of origin.

Partnering with countries in their development can help U.S. scientists improve food quality and productivity for Americans. One important USAID program, Feed the Future Innovation Labs, focuses precisely on the mutual benefits to foreign and U.S. farmers and consumers from collaborating in agricultural research. Partnering with countries in their development can help U.S. scientists improve food quality and productivity for Americans. Mutual benefits to developing countries and U.S. farmers is a feature of the U.S. law authorizing international collaboration agricultural research (Famine Prevention and Freedom from Hunger Improvement Act of 2000, 2000).

The Bumpers Amendment. The Bumpers Amendment, part of the U.S. Foreign Assistance Act of 1961, was introduced in the U.S. Congress by Senator Dale Bumpers of Arkansas in 1985 and became law in 1986. It was intended to prevent U.S. foreign assistance programs from helping developing countries increase their production of crops that compete with U.S. crops in world trade. This included such crops as wheat, maize, sorghum, rice, and soybeans. It also covered crops such as tropical oil palm, from which vegetable oil is produced that might compete with U.S. vegetable oil from soybean, sunflower, and other oilseeds (Thompson, 1992). For many years the law curtailed U.S. assistance to developing countries, aggravating efforts to stabilize and improve the agricultural economies, for example, in Afghanistan and Iraq 2002-2010. The law was revised in 2011 to substantially remove its worst effects, but still no major U.S. efforts have emerged to improve the production of staple food crops in developing countries.

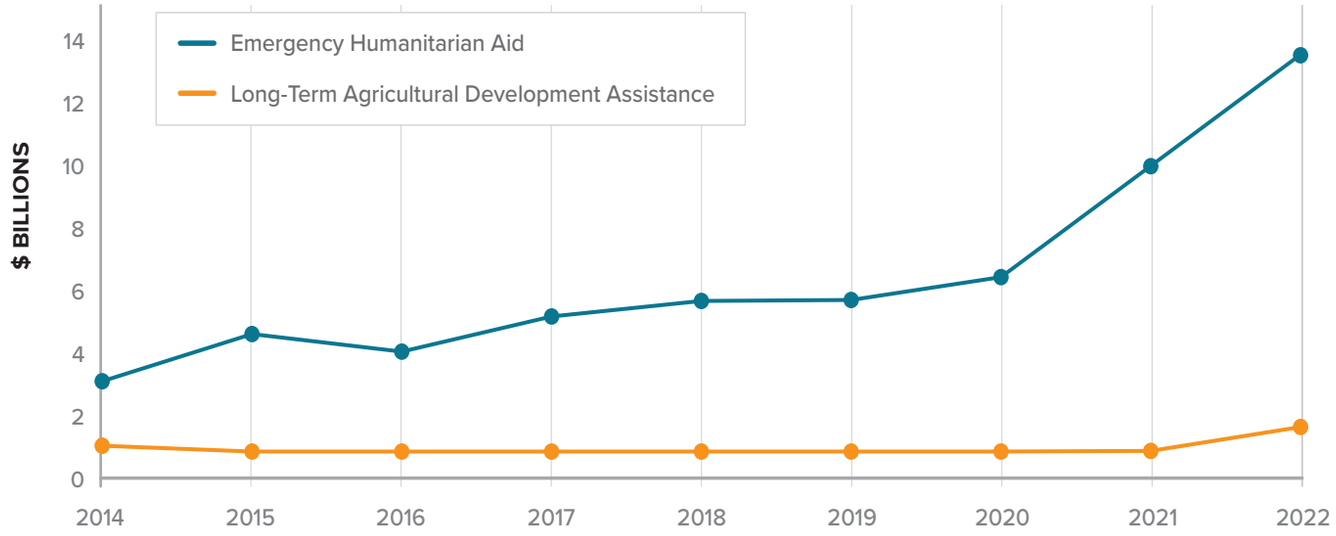
In practice, the amendment was probably more damaging than helpful to U.S. interests because it (1) opened the door to other nations to offer critical assistance to food insecure poor countries and thereby bolster their longer-term friendship and trade partnership, (2) slowed the productivity of food insecure countries, contributing to terrorism and migration issues, (3) placed the U.S. in a bad light as a nation unwilling to help poor countries in the areas of their greatest need and a nation whose policies belie its professed interest in competitiveness and free trade, and (4) proved incorrect because increased agricultural productivity in developing countries actually expands export opportunities. Now with Bumpers Amendment strictures more relaxed, new initiatives in cooperation may be able to reverse some of the damage that was done.

U.S. humanitarian assistance ballooned from under $4 billion in 2014 to $14 billion in 2022, according to USAID. In contrast, Feed the Future, the U.S. government's global hunger and food security initiative tasked with addressing the root causes of hunger and poverty by supporting local agriculture, has been flatly funded at $1 billion since its inception after the global food crisis in 2010.

Potential supply disruptions. The U.S. relies on other countries for a range of food products, such as coffee, cocoa, certain fruits, and vegetables, as well as products that are essential for our own agricultural production, such as fertilizer, fuel, and electronic components. Instability can cause supply disruptions and shake up trade relationships. Food and agricultural production crises in other countries impact food prices for U.S. citizens through international markets, even of the products we grow ourselves. For those commodities that we don't produce, we are affected directly by their availability and quality as produced elsewhere.

World food supply and U.S. food prices. As a wealthy, powerful and productive nation, the U.S. food supply is considered to be generally secure, but nevertheless, scarcities in other nations can impact U.S. food prices and even food availability. U.S. food price spikes occurred in 1973-74, 1994-96, 2007-2009, and again in 2022. A number of domestic and international factors cumulatively contributed to each price spike, but the crises were largely triggered by conditions in other countries, respectively, Eastern Bloc countries, Asian countries, Brazil/Mexico/India (The World Bank, 2022), and most recently, in Russia/Ukraine. A sound food policy for the U.S. to assure our national security would be to assist other countries to be as food secure as possible. This means especially assisting developing countries to increase agricultural production to better secure their own food supplies. In crisis situations, every additional increment of food supply and consumption counts. The alternative is increased U.S. taxpayer spending on humanitarian assistance; short-term cash and food-based handouts that do not address the underlying causes of food insecurity and poverty. U.S. humanitarian assistance ballooned from under $4 billion in 2014 to $14 billion in 2022, according to USAID. In contrast, Feed the Future, the U.S. government's global hunger and food security initiative tasked with addressing the root causes of hunger and poverty by supporting local agriculture, has been flatly funded at $1 billion since its inception after the global food crisis in 2010.

Figure 6. Emergency Food Aid vs Long-Term Agricultural Development



Source: USAID

U.S. access to food imports in needed quantities and quality. The U.S. imports 15 percent of its food supply from 200 foreign countries and territories, including 32 percent of fresh vegetables, 55 percent of fresh fruit, and 94 percent of seafood. U.S. access to specific food requirements depends not only upon whether it is available somewhere in the world, but also whether the U.S. has friendly relations with the countries where we can source these foods. The Russia-Ukraine war is bringing about a major adjustment among trading partners. Food, energy, and agricultural input supplies are all at stake presently as developing and developed nations rearrange their trading relationships and attempt to assure access to all three commodity areas.

Friendly relations and openness to trade can depend upon historical relationships that have been built (or eroded) by colonial history, past wars, comprehensive trade agreements, or, importantly, friendships built through development assistance. With the Russia-Ukraine war in 2022, once again African, Asian, Middle Eastern, and Latin American countries are reconsidering their futures and upon which suppliers they can rely. The availability to the U.S. of its own food supply depends critically on the security not only of food, but of energy and other agricultural inputs. It is incumbent upon the U.S. to secure those supplies through long-term friendly relationships built in part upon our assistance to countries during their period of development.

The safety and nutritional qualities of imported foods are also important. In 2011, the U.S. shifted from responding to contaminated food arriving at U.S. ports to preventing contamination at the source, as a result of provisions of the Food Safety Modernization Act (FDA, 2019). In the case of imported food, this means ensuring its safety before it arrives at our border, and that requires complex relationships with the exporting countries, many of which are developing countries.

Assuring the safety and nutritional quality of food imports requires partnership in foreign countries that extend backward from the point of export to local inspection, processing, and farm production. In the case of developing countries where sometimes the knowledge of advanced safety procedures may be lacking, an efficient approach is to be a strong partner to the exporting country and its farmers as needed through the process of their development. Development assistance can be a key aspect of the strategy to assure the safety and nutritional value of the imported U.S. food supply.

Nutrition and Health Vectors of Instability

Underdevelopment as a petri dish for pathogens that cross borders. Emerging infectious diseases spread rapidly from one world region to another. Poor countries are most vulnerable because they often have a high disease burden, poor infrastructure, unclean water, poor sanitation, shortages of health professionals, and the economic hardship of families and communities. HIV/AIDS, Ebola, and Zika are examples of some of the recent zoonotic diseases emerging from -developing countries to threaten the national security of the

U.S. (Tangwa, Abayomi, Ujewe, & Munung, 2019). Much of the developing world lies in tropical environments that are rich in host biodiversity and hold large pools of pathogens (Kuchipudi, 2020). Broad-based development assistance in building food security, health systems, infrastructure, education, and strong national economies in the tropics would go a long way toward protecting the national security of the U.S. from cross-border pathogens. Moreover, animal diseases like highly pathogenic avian influenza (avian flu), foot and mouth disease, and African swine fever virus threaten U.S. food supplies and agriculture. The recent bout of avian flu in 2022 and 2023, which is now endemic in the U.S., has more than doubled the price of eggs domestically. If the African swine fever virus were to enter the U.S., the pork industry valued at $50 billion would suffer significant animal losses, as there is no vaccine to combat the disease. The industry would also likely lose its ability to export, while consumers would face higher prices for pork products.

Nutrition's impact on human capital. Nutritional status has a profound impact on human capital. Stunting, defined as low height for age, causes irreversible damage to physical and mental development and has educational, income, and productivity consequences that reach far into adulthood, reinforcing poverty.

> *According to the World Bank, "The economic costs of undernutrition, in terms of lost national productivity and economic growth, are significant — our economy and society is paying $3 trillion a year in the form of productivity loss, ranging from 3 to 16 percent (or more) of GDP in low-income settings."*

The World Bank estimates economic productivity losses equivalent to $29 billion globally by 2022 as a result of the additional malnutrition burdens attributable to the COVID-19 pandemic alone. While malnutrition resulting from poverty and food insecurity directly threatens the economic stability of countries and entire regions, nutrition-specific interventions are not enough. According to the Lancet Series on Nutrition, if populations can access the 10 most effective, evidence-based nutrition interventions at 90 percent coverage, the current total of deaths in children younger than 5 years would be reduced by only 15 percent. Nutrition-sensitive interventions aimed at improving food security and incomes are needed to address the underlying causes of malnutrition and poverty. Agricultural development and research that improve agricultural productivity, food availability and dietary diversity, that strengthen nutritious food systems along with other interventions like healthcare, clean water and sanitation, and education will be essential to advancing global nutrition goals.

Pharmaceuticals from developing countries. Plants, mostly from the tropics, provide about 7,000 medicinal compounds prescribed by Western doctors. Seventy percent of the 3,000 plants identified by the National Cancer Institute as having anti-cancer properties are from tropical rainforests. Cortisone, Novocaine, and Quinine are some of the well-known tropical products we use. In 1995, an estimated 10-15 percent of the potential medicinal compounds from tropical forests had so far been discovered, and their potential value to global society was estimated at about $150 billion (Mendelsohn & Balick, 1995).

Securing for Americans, indeed for all humanity, the benefit of drugs derived from plants in developing countries, depends upon protecting their bio-diverse forests and other natural environments. Tropical forests are being destroyed at a rapid rate by communities wanting to feed themselves. Increased productivity of the lands that are already under crop production in those countries would help to protect the forests. U.S. engagement with developing countries to improve agricultural productivity, and to protect their forests, would preserve for mankind the enormous medicinal value of those forests. U.S. partnerships in this effort, including medical research, could facilitate discovery of tropical pharmaceuticals and secure access for Americans to life-saving medicines.

Environmental Vectors of Instability

Reduced air and water pollution, mitigation of global warming, and other benefits of healthful environments. Forested watersheds and wetlands provide 75 percent of the world's fresh water for use by households, industry, and agriculture (IUCN 2016). Yet agriculture is a disproportionate cause of deforestation, as food insecurity in developing countries encourages the clearing of forests, degrading the environment and contributing to global warming. Land clearing for food production pumps carbon into the atmosphere and removes the capacity of forests to continually store and recycle carbon for ages to come. Deforestation pollutes streams, kills wildlife, degrades the recreational quality of the environment, and impairs the quality of human life. Forests are often cleared to make more land to grow food, but if current farmland were made more productive, the pressure to clear forests would be reduced.

Food insecurity in developing countries is contributing to degradation of the environment and the worsening of global warming. U.S. engagement in making existing agricultural lands more productive would reduce the pressure in poor communities to clear forests. Dr. Norman Borlaug, who received the 1970 Nobel Peace Prize for his plant breeding work, but studied forestry as an undergraduate, was fond of pointing out that it would take half of the world's land now in forests to feed the world with 1950s crop technology. Better food security in developing countries through improved food crops and animal productivity would improve the quality of life for all.

Natural resources for U.S. enterprise. Developing countries are stewards of many resources that are vital to the long-term welfare of the U.S. and all mankind – such as rare minerals, biodiversity, oceans, timber, energy, and other resources. Degradation of the natural environment depletes these resources and curtails future livelihoods. Unwise and unsustainable use of resources imperils the U.S. as well as other nations. The best chance that the U.S. has for conserving natural resources is to engage with poor countries to improve their food security and livelihoods through means that are economically healthy for us all over the long term. U.S. national security is dependent upon assisting poor countries to provide for their populations through sustainable means, conserving natural resources for future generations.

Alleviating climate change and environmental threats. Climate change has a direct impact on food security and national security. One prime example of this occurred in 2008, when drought in grain-producing regions, high fuel prices, and export bans contributed to a sharp rise in the price of basic staple foods – namely wheat, corn, soy, and rice. High prices triggered food riots and protests in dozens of countries, threatening the stability of governments in Africa, Asia, the Middle East, and Latin America and the Caribbean. More recently, drought in 2022 decimated local food production and agriculture-related incomes in the Horn of Africa, where conflict is a constant challenge and terrorism threats from Islamic State (ISIS) in places like Somalia are growing. In late 2022, the United Nations reported that 20 million people in Somalia, Kenya, and Ethiopia – countries with strategic U.S. national security interests – were on the brink of famine.

Environmental damage affects all countries and has the ability to cross borders. Atmospheric dust, acid rain, polluted oceans, rising sea levels, extreme weather, and other factors associated with climate change reduce the quality of life for all the world's inhabitants. Both developing and developed countries are responsible for damage to the environment, but lower-income countries have fewer resources to combat environmental degradation. People in developing countries disproportionately work in agriculture, and while agricultural practices can have negative environmental impacts, a sustainable way forward is for developed countries to partner with and support developing countries to discover and utilize technologies that will achieve equivalent development through more conserving and environmentally friendly methods. The best way the U.S. can maintain the quality of life for Americans is to convince countries to pursue different paths to development that protect the environment along the way.

Cultural Vectors of Instability

Strengthening of the U.S. value structure. The values of American society are woven into everyday lives and occupations and are an inherent aspect of our national security. Preservation of those values within the U.S. to some degree depends upon sharing those with other nations. U.S. engagement in reducing poverty and food insecurity in developing countries reflects our values, and exercising our values strengthens them within us. Of course, we still have to work on our values, and promoting them in other cultures refines our understanding and commitment to our own values. Some of these American cultural values include:

- Democracy
- Free enterprise
- Freedoms (press, thought, religion, etc.)
- Human rights
- Gender equality
- Rule of law
- Generosity
- Diversity
- Mutual respect
- Honesty

Many developing countries share many of those same values, and our engagement with them strengthens that value system within their own cultures. U.S. values permeate our interactions with others, and through partnerships in development, can nurture the growth of those values in their culture. Also respecting their values where they are different strengthens us all. The effect of U.S. engagement in the economic development of poor countries, often through food security and agricultural development initiatives, strengthens U.S. national security through shared and strengthened value systems.

Combatting expansion of competing antithetical cultural norms and values. When the U.S. withdraws from the effort to improve food security of poor countries and leaves the job to others, it runs the chance that less benevolent competing values will be inculcated or strengthened. Such values might include:

Autocracy | Constrained human rights and freedoms

Corruption | Racial, ethnic, religious, and lifestyle intolerance

The growth of such value systems is a threat to U.S. national security. Failure to partner with poor countries in their development is a potent vector for the destabilization of the U.S. and erosion of national security.

BUILDING FORMS OF CAPITAL THROUGH U.S. DEVELOPMENT ASSISTANCE

Building capital to support future productivity is a better way of providing for current and future human welfare needs than giving commodity aid, which is more of a short-term solution for crises. We can see evidence of this if we look at humanitarian spending over the last ten years versus development, which contributes to the process of building capital in poor and food insecure countries.

Forms of capital that are critical in economic development extend beyond simply financial capital as normally considered in economic models, to include human, technological, institutional, natural, physical, financial, and cultural capital. By whatever process the U.S. might engage with developing countries to build and strengthen these forms of capital, it will be most effective if investments are guided by the beneficiaries of investments in aid-recipient countries and their markets for goods and services.

Human Capital. Building human capital means providing adequate nutrition for human physical health, inculcating knowledge, building skills and creativity, and inspiring the human spirit. Some of the activities that contribute to human capital include, (a) education sustained by long-term partnerships between U.S. and developing country scientists and teachers, (b) reducing the burden of malnutrition by ensuring access to affordable, healthy diets so that children can develop physically and cognitively to reach their full potential (c) improving public health and medical capacity, (d) fostering creativity in science and arts, (e) imbuing spirit for leadership, am-

Building capital to support future productivity is a better way of providing for current and future human welfare needs than giving commodity aid, which is more of a short-term solution for crises.

bition, self-reliance, teamwork, and change, (f) empowering youth and disadvantaged populations in decision-making at all levels, (g) and refraining from practices by international agencies that distort local markets for human capital. The last refers to the phenomenon that often occurs especially when development assistance is in crisis mode in developing countries and international agencies attract a large portion of local talent away from their local roles and occupations. It is best that international agencies seek to work through local institutions and avoid the temptation to set-up new parastatal organizations controlled by the donor to carry out development activities.

Investing in education. USAID support for foreign scholars studying in the U.S. peaked at about 15,000 scholars in 1985 (Dwyer, 1986). Much of that investment was associated with the institutional building programs under which entire agricultural colleges and universities were established or greatly expanded and strengthened. Current numbers of USAID supported scholars in the U.S. are relatively low, below 1000 total. One reason for reduced funding of scholars was the length of time required for seeing the results of investing in academic degree programs, as U.S. policymakers wanted to see impact more quickly. Now, it is time for the U.S. government to renew long-term commitments to building human capital. One way this can be accomplished is by expanding the education and training components of USAID Feed the Future programs as further detailed below. Investing in higher education institutions is essential if developing countries are going to improve and become global partners. The World Bank's "Peril and Promise" publication says that higher education is essential in the 21st century (Task Force, 2001).

Technological Capital. Technology is all the ways by which different kinds of capital are combined and transformed into new goods, resources, ideas, and services. Technology is both manmade and natural. Examples of natural technology are fermentation and photosynthesis. Of particular interest when attempting to improve food security, natural and manmade technologies are used to improve crop and animal production. Some of the considerations in creating and improving technological capital for developing countries are (a) creating models by which foreign assistance supporting innovation is guided by local markets, (b) indigenizing technical innovation, (c) engaging youth in technology development and adoption, (d) building systems of technology development and utilization that can persist and succeed through long periods of trial and error, (e) tempering the notion that technology can be transferred from developed to developing countries, and (f) appreciating the importance of local conditions in determining the suitability of new technology.

Investing in agricultural technologies in developing countries. Investments made in agricultural innovation coupled with extension can greatly advance food security. Norman Borlaug's breeding research producing high-yield, disease-resistant wheat varieties is credited with saving over a billion people worldwide from starvation, particularly in Asia where governments invested in agriculture. However, technology adoption rates remain low in many developing countries, particularly in Africa, despite widespread campaigns to promote advancements in agricultural technology as a means of increasing production and productivity. This is partly due to a lack of funding for local extension systems, infrastructure, and services in many poor, rural areas. Therefore, irrespective of research and development efforts, there remains a gap between potential and actual impacts of technology on income and food security in developing countries.

The U.S. can fill this gap through education by providing institutional support in the form of training for smallholder farmers and extension workers in developing countries. The U.S. should also incentivize governments to invest more of their own resources into research and extension. Technology-specific training can help increase knowledge and awareness about the benefits of using technology as well provide guidance and technical know-hows on the specific technology. Collaborations with local institutions (such as local and regional chambers of agriculture) can also improve the delivery of extension services and ensure that it reaches a larger number of farmers in training sessions, demonstrations, farmer field schools, or other activities. Local institutions can also serve as a social hub where farmers can learn and exchange information that can encourage uptake as well as help farmers resolve issues arising from the use of technology. Finally, information related to agriculture, such as early warning systems, climate-sensitive information, benefits of improved varieties, and the relevance of improved agricultural technologies must be disseminated through various channels that can reach farmers and producers directly.

Overall, the U.S. needs to increase its public funding for agricultural research and agricultural development programs that are designed to increase agricultural output and productivity, build local capacity, improve welfare and nutrition, and reduce global food insecurity while increasing resilience to climate threats. Besides providing direct support to farmers in developing countries, agricultural research in the U.S. can benefit economies that are dependent on agriculture.

The main U.S. government programs for improving technology for food security in developing countries have been the USAID Feed the Future Innovation Laboratories, which have largely replaced CRSP, and through U.S. government contributions to the multilateral organization CGIAR, formerly known as the Consultative Group for International Agriculture.

Institutional Capital. Institutions are the ways in which people organize to conduct their affairs with one another. Formal institutions include systems of government, banking, education, medical care, marketing, common defense, property ownership, labor organization, sports competition, religious worship, laws, rules and regulations, and other documented systems. Informal institutions include customs, traditions, behavioral patterns, and social, economic, political, and other informal networks. Some of the considerations in building and strengthening institutional capital in developing countries are: (a) encouraging local institutions that channel or supplant elite competition, (b) encouraging national and regional institutions that build upon and are guided by local institutions and market forces, emphasizing bottom-up processes, (c) building upon established, local, and/or traditional institutions and community structures (e.g. discourage formation of new Western-oriented institutions that displace or compete with established local institutions), and d) engaging women, youth, and representatives of disadvantaged communities in governance of institutions.

Building stronger local institutions. The U.S. government needs to better support capacity building efforts with local partners. Recognizing this need, USAID recently released its first ever Local Capacity Strengthening (LCS) Policy, reaffirming the agency's commitment to local capacity strengthening. It lays out seven principles to guide USAID humanitarian assistance and development programming and provides a framework to build upon the existing strengths of local actors and systems, respond to dynamic local priorities, and align with USAID strategic aims. This is a great step, however more specifics on implementation to build capacity will be important for partners.

Moreover, greater local investment in agriculture, R&D, and extension is needed by governments themselves to build capacity, particularly in Africa. In 2003, African heads of states and governments signed the Maputo Declaration on Agriculture and Food Security in Africa, which included a "commitment to the allocation of at least 10 percent of national budgetary resources to agriculture and rural development policy implementation." In 2014, the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods reaffirmed this

commitment. It also added numerous commitments on infrastructure, natural resources, land tenure, intra-African trade, poverty reduction, and nutrition, to be achieved by 2025. However, according to the latest biennial review, only one-third of countries are on track to meet commitments. The U.S. Department of State should continue to be leveraged through Feed the Future to work with host governments to devise commitments to shared priorities, encouraging and providing incentives to local governments to invest more in agriculture, extension, R&D, and technical assistance to strengthen the capacity of smallholder farmers and stakeholders along the value chain to be more profitable, productive and resilient.

In addition, the U.S. needs to engage with higher education institutions, both within the U.S. and in developing countries, as well as foster public-private partnerships, including through research oriented organizations like the Foundation for Food and Agriculture Research (FFAR), to strengthen the training of students and professionals in areas of agricultural and food science, economics, and policy and strengthen institutional research networks, including through partnerships with existing institutions such as the Feed the Future Innovation Labs. The Innovation Labs, in partnership with leading U.S. research institutions as well as developing country research institutions, continue to develop and provide novel solutions to agricultural challenges. They can play a pivotal role in strengthening local institutions in developing countries. The U.S. can also support local institutions and capacity building at national universities (without paying for graduate students to come to the U.S.), similar to what AgriCorps is doing in West Africa and what the Howard G. Buffett Foundation is doing in Rwanda. So-called "sandwich degree" programs at African universities can also be supported more cost effectively than bringing in students to the U.S. for degree programs.

Natural Capital. Natural capital includes renewable and non-renewable resources such as water, soil, air, solar radiation, minerals, timber, wildlife, genetic material, and many other natural resources. Some considerations in assisting developing countries include (a) working with and through local institutions to incentivize practices that conservatively utilize and/or enhance natural resources, and (b) fostering an understanding of natural resources and their long-term relationship to the quality of human life.

Physical Capital. Physical capital may also be referred to as manufactured capital, infrastructure, or material capital. It includes all materials, infrastructure and machinery made or modified by humans through the use of technology. It includes intermediate goods used in manufacturing, as well as final products. Examples include food, fuel, chemicals, buildings, building materials, vehicles, ships, aircraft, roads, bridges, dams, and extracted and processed minerals, gasses and fluids. Considerations in assisting the development of physical capital in food insecure and poor countries are (a) investing in infrastructure that is prioritized by local communities and designed or co-designed by local communities, and (b) encouraging the design and construction of physical infrastructure that is fully compatible with the human, technological, institutional, cultural, financial, and natural capital with which it is associated.

Financial Capital. Financial capital includes banknotes, bonds, debt instruments, shares, certificates of deposits, insurance contracts, warehouse receipts, promissory notes, and other instruments that enable one form of capital to be exchanged for another. Units of financial capital have no intrinsic value but for the other forms of capital that they represent. To be efficient and effective, development assistance programs related to financial capital might be designed so as to assure that (a) financial capital provided through foreign assistance is budgeted so as not to distort local financial markets or to conflict with producer (including farmer) and household consumer preferences, (b) financial capital provided through foreign assistance is allocated for expenditure according to local priorities and according to local producer or household preferences, and (c) investments of foreign assistance in revolving loan funds, following loan repayment, continues to be reinvested in further loans, rather than revert to the use of the lending intermediary.

Cultural Capital. Culture is the accumulated and shared thought, practice, and patterns of capital utilization in a human community. Human capital, institutions, technology, manufactured capital, are a part of culture if they are widely shared or replicated within the community and endure across generations. Some considerations for the design of development assistance include (a) valuing cultural capital equally with all other forms of capital, (b) investing foreign assistance into cultural capital as a complementary investment with each other kind of capital investment, and (c) assuring that investments in any and every other form of capital is fully compatible with and/or possibly reinforcing, local cultural capital.

U.S.-FUNDED ENTITIES SUPPORTING GLOBAL FOOD SECURITY AND FOOD SYSTEMS

Although not an exhaustive list, below are several U.S.-funded entities that support the U.S. government's engagement on global food security and are relevant to the scope of this paper and its policy-oriented recommendations.

Feed the Future (FTF): The U.S. government's whole-of-government global hunger and food security initiative, Feed the Future (FTF), was established in 2010 in response to the 2008 global food price crisis to fight hunger and food insecurity through the advancement of global agricultural development, increased food production and food security, and improved nutrition. The initiative is led by the U.S. Agency for International Development (USAID), but includes participation from 12 U.S. government departments and agencies, including the Department of State, Department of Agriculture, Millennium Challenge Corporation, and others. The Department of Defense and other security-minded agencies are not included in the initiative. FTF funding for global food security activities at USAID and the State Department has been relatively stagnant in recent years, increasing from $813 million in FY2010 to roughly $1 billion annually since FY2015.[5] Approximately 15 percent of these funds are used for agricultural research at the Innovation Labs at U.S. land grant institutions and universities, CGIAR, and other research, scientific, and private sector partnerships. Between 2011 and 2020, the initiative has unlocked $4 billion in financing for food security, generated $15.3 billion in agricultural sales to help farmers, and raised an estimated 5.2 million families out of hunger (Feed the Future). At present, FTF operates in 12 target countries across Latin America and the Caribbean (Guatemala and Honduras), Africa (Senegal, Ghana, Mali, Niger, Nigeria, Kenya, Uganda, and Ethiopia), and southeast Asia (Bangladesh and Nepal). In response to the global food, fuel, and fertilizer crisis, which has deepened with Russia's invasion of Ukraine, Feed the Future is in the process of expanding to eight new countries (Democratic Republic of the Congo, Liberia, Madagascar, Malawi, Mozambique, Rwanda, Tanzania, and Zambia). Given the success the initiative has had in initial target countries, the expansion to new countries, and the current conflict in Ukraine's continued impact on food and fertilizer prices, the U.S. should consider scaling up longer term development funding through Feed the Future to strengthen local, nutritious food systems, reduce poverty, and move target countries from aid to trade.

CGIAR: As indicated above, the U.S. government has invested in CGIAR through agricultural research funding included in the Feed the Future initiative. At COP26 in 2021, USAID pledged $215 million over five years from 2022-26, or $43 million a year, to CGIAR for innovations supporting smallholder agriculture. For over 50 years, CGIAR has been the world's largest agricultural research partnership, implementing multiple programs to increase global food and nutrition security through partnerships with local and international research institutions, development and civil society organizations, and the private sector. A 2020 study (Alston, Pardey & Rao, 2020) found that investments in CGIAR generated a benefit-cost ratio of 10 to 1 over the past five decades. In recent years, as climate change continues to threaten the fight against food security, CGIAR's Climate Change, Agriculture, and Food Security (CCAFS) program has played a major role in scaling up the practices, technologies, and institutions that enable agriculture to meet food security, adaptation, and mitigation goals. Data from the program's Climate Smart Villages shows that investing in climate smart agricultural technologies has led to increased agricultural productivity, production, income, and food security in Mali (Ouédraogo et al., 2019; Singbo et al., 2021; Smale et al., 2018), Niger (Zakari et al.,2022), Nigeria (Awotide et al., 2012; Ogunpaimo, Oyetunde-Usman, & Surajudeen, 2021), Kenya (Wekesa, Ayuya, & Lagat, 2018), Ethiopia (Mekonnen, 2017), and Zimbabwe (Mujeyi, Mudhara & Mutenjez, 2021). With a physical presence on the ground in 89 countries in the Global South, CGIAR has also been instrumental in improving seeds by adapting them to local preferences and conditions to improve agricultural productivity, nutrition, and incomes. These results provide ample evidence that U.S. investments in the research, development, and implementation of agricultural technologies can increase food security and income in developing countries, thus reducing threats to national security through channels identified earlier.

5 Global food security and agricultural development funding for USAID and State Department activities under the Feed the Future initiative is directed through the State, Foreign Operations, and Related Programs appropriations bill under the header, "global food security and agriculturtl development programs."

International Agricultural Education Fellowship Program (IAEFP): IAEFP trains and supports American agriculture professionals to work with teachers and farmers in developing countries to implement school-based agricultural education and establish youth agriculture leadership clubs. Fellows serve for one year as agriculture instructors, 4-H advisors, and agriculture extension agents. They are recruited from across the U.S. and must hold at least an undergraduate degree in an agricultural-related field. The IAEFP distinguishes itself from existing programs by length of service, focus on school-based agricultural education, and direct impact on American agricultural trade partners.

IAEFP was founded in partnership with AgriCorps and established in the Agriculture Improvement Act of 2018 (2018 Farm Bill), which authorized federal funding of up to $5 million annually between fiscal years 2019 and 2023 to fund "fellowships to citizens of the United States to assist eligible countries in developing school-based agricultural education and youth extension programs" (Section 3307). The program has remained successful and has received an annual appropriation of $1 million since its enactment but has a significant demand for additional fellowships and an increased need in developing nations considering current food security issues.

Farmer-to-Farmer Program: Established as part of the 1985 Farm Bill, the Farmer-to-Farmer program utilizes resources provided by Congress under the Food for Peace program to sponsor U.S. farmers, agricultural experts, and agribusiness employees in short-term voluntary technical assistance projects to help farmers in developing countries. Since the program was founded, more than 20,000 Americans have undertaken projects in 116 different countries.

Borlaug International Agricultural Science and Technology Fellowship Program (Borlaug Fellowship Program): The Borlaug Fellowship Program promotes food security and economic growth by providing training and collaborative research opportunities to fellows from developing and middle-income countries. Borlaug Fellows are generally scientists, researchers, or policymakers who are in the early or middle stages of their careers. Each fellow works one-on-one with a mentor at a U.S. university, research center, or government agency, usually for 8-12 weeks. The U.S. mentor will later visit the fellow's home institution to continue collaboration.

The Borlaug Fellowship Program honors Norman E. Borlaug, the American agronomist, humanitarian, and Nobel laureate known as the "Father of the Green Revolution." Since the program's inception in 2004, hundreds of fellows from across the globe have participated in research and training focused on a wide array of agriculture-related topics. By improving participants' understanding of agricultural science, the program helps foster science-based trade policies that improve international market access for U.S. agricultural products.

Millennium Challenge Corporation: Established by the U.S. Congress in 2004, the Millennium Challenge Corporation (MCC) contributes to Feed the Future by working with countries to implement market-driven solutions to poverty and food insecurity. It relies heavily on the leadership of developing countries to formulate their own development goals, methods, and measurements of success. MCC awards are closely monitored to assure that funds are managed well and achieve measurable development objectives, emphasizing its own efficiency in grant administration. MCC has demonstrated the success of its ap-

proach. Since it was established, MCC has invested more than $5 billion in agriculture and rural infrastructure and has disbursed more than $87 million in agricultural and rural loans, to help empower farmers and rural economies.

International Development Finance Corporation (DFC): The DFC was established in 2018 by an act of Congress, consolidating the Overseas Private Investment Corporation (OPIC) with the Development Credit Authority operated by USAID into a single independent agency with additional financial and investment tools at its disposal. In 2021, DFC committed $1 billion in food security and agriculture projects over five years under Feed the Future to advance agricultural production in developing countries. DFC can fund projects aimed at strengthening private sector supply chains, irrigation, food processing, food storage, shipping and logistics, and fintech related to global food systems. These investments can help strengthen food systems and advance U.S. economic development, nutrition, climate, and related migration and national security goals.

Agriculture Innovation Mission for Climate (AIM for Climate): AIM for Climate is an initiative jointly led by the U.S. and the United Arab Emirates that seeks to address global food and nutrition security issues by catalyzing increased investment in climate-smart agriculture and food systems innovation over five years (2021-2025). The initiative includes more than 40 government partners who have committed to increasing public investment in agriculture innovation and for climate-smart agriculture and food systems. AIM for Climate also leverages non-governmental sources of funding through "innovation sprints" that seek to advance specific technical solutions in the climate-smart agriculture innovation space. This includes a focus on commitments towards generating innovation in support of smallholder farmers in low and middle income countries, highlighting that the initiative is critical to help smallholder farmers adapt to climate related shocks and mitigate global food security related threats.

Foundation for Food and Agriculture Research (FFAR): FFAR was established in the 2014 Farm Bill as a public-private partnership model to help reverse declines in U.S. public agriculture research spending by harnessing U.S. private sector R&D resources to fund public food and agriculture research. Congress provided FFAR $385 million over ten years and a mandate to match every federal dollar with at least one dollar from a non-federal source. FFAR has exceeded this requirement and has more than doubled its federal funding, gaining $1.40 for every taxpayer dollar invested. While most of FFAR's research is domestic, it has successfully funded a few international grants, including research at CGIAR and training for scientists at national research institutes when matching funds were provided, working with the host governments to build capacity. It also has the capacity to respond to emergencies when needed.

USDA, DARPA, National Science Foundation, or any federal research agency can utilize FFAR as their foundation for agriculture research, and ask it to leverage financial and scientific resources from outside the U.S. government, including from agricultural groups. Providing additional funding for FFAR in the Farm Bill will be critical to ensure that the U.S. will continue to have a tool to incentive and leverage non-federal funding for public agricultural research.

Department of Defense (DoD) Defense Advanced Research Projects Agency (DARPA): DARPA is tasked with making pivotal investments in breakthrough technologies for national security. This includes investments in international agricultural research efforts, which ultimately protect domestic food security. Globally, there is an inability to effectively predict pests and diseases. To address this, DARPA's Foundational Security for Food Systems (FS2) program seeks advanced threat-detection and warning capabilities for U.S cereal crop defense. This kind of research is lacking in specialty crops, which would be helpful for global food security and U.S. agriculture. DARPA's PREventing EMerging Pathogenic Threats (PREEMPT) program seeks to preserve military readiness by protecting against the infectious disease threats within the animal reservoirs and insect vectors, where many diseases originate before they spill over into humans. The program combines biosurveillance and modeling with novel technologies for treating or containing high-risk pathogens at their source to prevent the emergence and reemergence of human-pathogenic threats.

DARPA could be better leveraged to work with the private sector, commodity groups, and other agricultural stakeholders through the Foundation for Food and Agriculture Research (FFAR) to help prevent crop and animal diseases from reaching U.S. producers, much like the PREEMPT program uses tools to contain animal-human pathogenic threats at their source. For example, in 2020, heavy rains caused the worst desert locust invasion in 70 years, destroyed crops just before the harvest period, and threatened the food supply of tens of millions of people in seven countries from Yemen through the entire Horn of Africa to Tanzania, where many U.S. troops are increasingly being deployed due to conflict, extremism, and increased terrorist activity. Data analytics and Artificial Intelligence (AI) tools

from DARPA could prove invaluable in identifying existing and potential threats like this much earlier and predict their impacts on global food security and famine while contributing to stability in fragile regions.

Agriculture Advanced Research and Development Authority (AgARDA): AgARDA is a pilot effort for a new, Advanced Research Projects-style research agency (ARPA) in the USDA authorized by the 2018 Agriculture Improvement Act (Farm Bill) to focus on the nexus of agriculture and national security. Through AgARDA, USDA can enable the research necessary for engendering transformative impacts and the development of new industries and partnerships. AgARDA will be instrumental in overcoming threats to global food production and food systems. It aims to develop and deploy technologies that address challenges in agriculture and food production, including plant disease and pests and biological threats that, if funded, can address many of the emerging threats to agriculture and national security DARPA cannot. While authorized at $50 million in the Farm Bill, it has only received $1 million in appropriations to devise a strategy for the organization. If funded by Congress, it would be a meaningful tool to bolster agricultural research in support of national and global security.

REGIONAL CONSIDERATIONS
FOR U.S. INVESTMENT IN ECONOMIC DEVELOPMENT

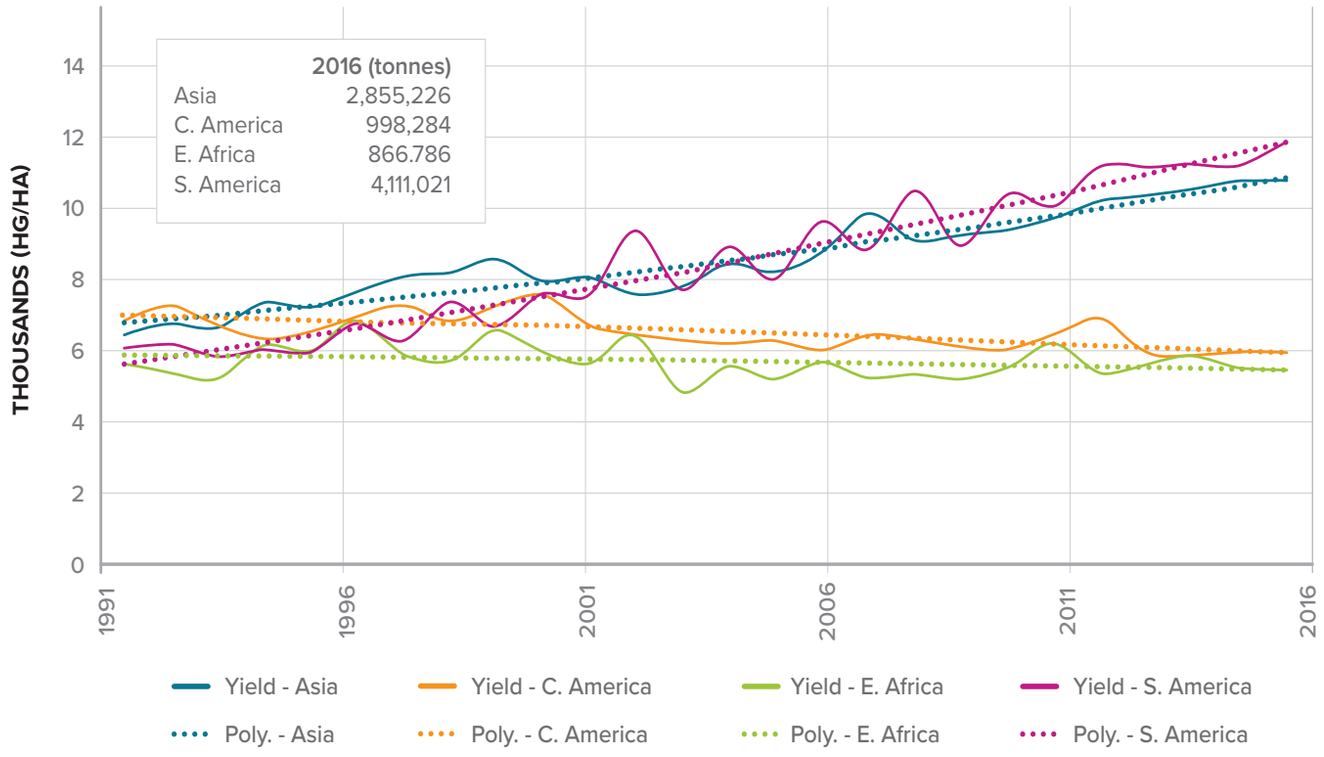
While developing countries have much in common regarding their needs and opportunities, and all could benefit from various manners of assistance, broad priorities can nevertheless be identified by world region, based upon the needs they express and relative availability of different forms of capital.

Southeast, East and South Asia are characterized by rapidly advancing modern economic sectors, with relatively strong local investments in technological, human, financial, and physical capital, but with pockets of their populations, often ethnic minorities, persisting in abject poverty in rural and subsistence agricultural environments. These pockets of poverty are a threat to the stability of these countries, and ultimately to the security of the U.S. It is essential to prioritize investment in institutional, natural, and cultural capital in these nations as a whole, aimed to address the lagging pockets of poverty and emphasize agricultural infrastructure and human capital investment especially in the lagging communities.

African countries, especially Sub-Saharan African countries, generally benefit from comparatively high levels of natural capital (e.g. relatively higher land/labor ratios), but suffer especially from deficiencies in technological and human capital. Institutions are weakened by mistrust, possibly a legacy of slavery and colonial exploitation (Jones, G., et al, 2019). Investment in physical infrastructure is needed but may be a lower priority than the vital investment in human, institutional, and technological capital, complemented by conservative uses of natural resources and investment in cultural capital. Populations in Sub-Saharan Africa experience high rates of food insecurity. As referenced above, poverty and food insecurity results in micronutrient deficiencies, hunger, and malnutrition. Malnutrition in children stunts development and leads to less productive lives.

Latin America, especially Central America is greatly affected by lagging agricultural productivity that is driving outmigration. Coffee yields in Central America peaked in about 2000 and have trended downward since (Figure 7). Average cof-

Figure 7. Central American Coffee Yields Peaked in About 2000 and Have Trended Generally Downward Since



Source: Edwin Price and Joseph King. Returns to Research on Coffee. PowerPoint presentation. Re:CO Symposium, Specialty Coffee Association. Seattle, April 19, 2018.

fee yield per hectare in El Salvador declined an average 13 kg/year from 1961 to 2016. According to the 2023 UN Regional Overview of Food Security and Nutrition in Latin America and the Caribbean, the region has faced several years of economic stagnation and contraction since 2015. This region also has the highest cost of a healthy diet compared to other world regions, and current challenges are making it even harder for people to afford healthy foods. In addition, the ongoing conflict in Ukraine is putting further pressure on food prices and fertilizer costs, impacting farmers' livelihoods and reversing nutrition gains. The UN analysis concludes that food and agricultural policies are essential to strengthen food systems and that producer-oriented policies formulated to increase the diversity of food production could be an effective way to increase the supply and reduce the cost of nutritious foods.

High priority must be placed on the development of agricultural technology that responds to the changing physical environment of Central and South America. In recent history, many persons from Latin America studied agriculture in the U.S. with the support of the U.S. government, and this supported an extended period of goodwill toward the U.S.; however, that cohort of U.S.-educated Latin Americans is dwindling. Massive new investments by the U.S. in human capital in Latin America are needed through USAID programs like Feed the Future. Investments in agricultural research and teaching institutions are also needed, and into institutions that promote the rule of law.

Central Asia and the Middle East have comparatively low food productivity per hectare, but fortunately on a per capita basis food security is still adequate, giving time to get agriculture moving. The region retains strong family structures and community loyalties that are tied to the land, such that rural to urban migration is not a serious problem, and labor supply for farming remains adequate. Improving agricultural technology suited to the more arid environments of the region is needed. Most critical however for successful development of the region is greater appreciation of the cultural capital of the region. Development innovations need to be compatible with the existing cultural capital. Development programs can usefully focus on building and strengthening cultural capital in the region in ways that demonstrate mutual respect for respective cultures between the U.S. and the region.

PRIORITY PARTNERSHIPS FOR U.S. INVESTMENT IN INTERNATIONAL DEVELOPMENT

Effective implementation of international development assistance of any kind and in any place often depends on partnerships across agencies, cultures, functions, and enterprises. Certain kinds of partnerships deserve special attention in agricultural development.

U.S. internal agency partnerships. The most important partnerships for effective and efficient U.S. investment in foreign assistance are within the U.S. The last time U.S. agencies worked cooperatively on development and security under a single administrative structure was in Vietnam (Anne MacDonald, Gordon Jones, and Edwin Price. USAID's Leadership in the Civil Operations and Revolutionary Development Support (CORDS) Program 1967-1973. Report to the USAID. 2022).

In Vietnam, cooperation among U.S. agencies was eventually forced by the U.S. President Lyndon Johnson and remarkably, despite U.S. military setbacks, the agricultural development of Vietnam was largely a success. It set the country on a path toward food security and development that is enviable today. In contrast, lack of cooperation, even hostility, among U.S. agencies weakened the development effort that was intended to win hearts and minds in Iraq and Afghanistan. It weakens U.S. effectiveness in development and security in all its partnerships in developing countries today.

Research and education partnerships. Following the formation of Truman's Point Four Program in 1950, the predecessor of the International Cooperation Agency and the USAID, the first U.S. effort in international development was the U.S. government-sponsored creation of developing country agricultural teaching and research institutions by U.S. land grant universities. The program led to long-

term partnerships between many U.S. land grant universities and the similar institutions they built in developing countries. The late Senator Mark Hatfield, Chairman of the Senate Appropriations Committee for eight years in the 1980s and 1990s, called it the most successful investment in international development ever made by the U.S. government. Although these developing country institutions were introduced from a U.S. model, they were quickly indigenized. The Americans who led the programs took their families to those countries and stayed for long periods of time, becoming well-acquainted with the cultures of their hosts. The Oklahoma State University program in Ethiopia became so embedded in the country that Emperor Haile Selassie famously regarded the program as his own. Fortunately, or unfortunately, the emperor regarded the OSU chief of party as more important than the U.S. ambassador.

These kinds of long-term partnerships are needed to support developing country scientists and teachers, making them technically more effective, supporting them as interactive members of global communities of problem-solving scientists, and giving them a sense of worth by staying on their jobs in their home country institutions.

Scientist and farmer partnerships. Figures 1 and 2 show lagging agricultural productivity in many developing countries. A major reason productivity lags is that there are no proven better technologies for millions of farms in the developing world.[6] Scientists themselves will require trial, error, and innovation for several years to tailor technical solutions for local farming conditions. To solve the problem of agricultural productivity, thousands more scientists and extension workers are needed, working as partners to local farmers. The ratio of scientist and extension worker to farmer in the U.S. is far higher than that in developing countries, and it has been that way since modern agriculture began in America. That is why productivity lags in developing countries compared to the U.S.

In summary, working partnerships are required between national security and development agencies and personnel in the U.S.; hundreds of long-term partnerships are needed between U.S. and developing country scientists and institutions; thousands of partnerships are needed between developing country scientists and farmers.

6 In his pathbreaking book "Transforming Traditional Agriculture" (1964) Theodore Schultz observed that agricultural technology is highly location specific and that poor farmers typically use their resources and available technology quite efficiently. What they need, and Vernon Ruttan (2002) supports this proposition, is research institutions to develop improved inputs suited to their environment, industry to manufacture and market the new inputs, and rural education and extension to enable them to use the new inputs.

KEY RECOMMENDATIONS

Given the context outlined in this paper, we offer the following recommendations to improve global food security and strengthen U.S. national security:

1. Increase investments in global food and nutrition security programs, as well as research and innovation, within the Feed the Future initiative.

- Increase funding for the Feed the Future (FTF) initiative to improve local agricultural production, incomes, and nutritious food systems. FTF funding for global food security activities at USAID and the State Department has been stagnant in recent years, increasing from $813 million in FY2010 to roughly $1 billion annually since FY2015.[7] By contrast, U.S. funding for emergency response, which is primarily composed of in-kind food and cash handouts, grew from $3.2 billion in 2014 to $15 billion in 2022, according to data drawn from appropriations bills, which is unsustainable. Moreover, food and cash handouts do not enable the majority of people in developing countries who rely on agriculture for their family food consumption and incomes to recover their livelihoods. It also does not address the root cause of hunger, which is the long-term lack of nutritious, affordable food at the local level. Any supplemental global food security funding in response to the impact of Russia's invasion of Ukraine should also be better balanced to support farmers, especially women, with sustainable food production so that they can better mitigate the impact of the crisis and improve their livelihoods. This includes delivering innovations to help them, increasing access to improved seeds adapted to local conditions, improving soil health and nutrient management, reducing food losses, and strengthening agriculture supply chains.
- Within Feed the Future, ensure funding for agricultural research remains at least at 15 percent of global food security and agricultural development program funding. This funding will continue to support the Feed the Future Innovation Laboratories, CGIAR, and other research, scientific, and private-sector partnerships. Innovation is critical to increasing farm productivity and incomes, which in turn reduces food insecurity, malnutrition, and poverty. Farmers need to have better access to affordable solutions such as more productive seeds adapted to local conditions, more nutritious crops, and affordable fertilizer to make the most of limited soil and water resources. R&D is also needed to help protect farmers from catastrophic pests and diseases, which can wipe out livestock herds and harvests. Solutions are also needed to improve local storage and processing options so that high on-farm, post-harvest losses that currently characterize smallholder agriculture can be reduced. Research on local indigenous crops that are good sources of nutrition in the Global South is also especially important. These crops are already adapted to local conditions and can bolster dietary diversity and provide communities with local nutritious fresh fruit, vegetables, and grains when imported staple food prices are high.
- Scale up long-term agricultural development and nutrition-sensitive programming through Feed the Future to better mitigate the drivers of migration to the U.S., including a particular focus on Central America. Feed the Future should prioritize emerging issues in Central American agriculture to improve farm livelihoods, crop yields, and the affordability of a healthy diet. This includes disseminating innovations to help farmers adapt to extreme weather, improve soil fertility, and reduce impacts from pests and diseases, in order to improve food security and ensure better poverty reduction and nutrition outcomes. In order to do this, the U.S. could consider scaling up programming or launching a special campaign that would team up U.S. scientists and change agents with Latin American counterparts and challenge them to triple the productivity of Central American agricultural enterprises. Scientists, farmers, and entrepreneurs in Latin America need support to respond to changing environments and market conditions, as well as risks across the entire production system – including challenges facing institutions, transportation, processing, storage, energy, water, soil, and crop and animal species, breeds and varieties.

2. Expand, strengthen, and lengthen knowledge-sharing and peer-support programs for developing countries in agriculture.

- The Farm Bill should continue to support scientist-to-scientist and educational programs such as the Farmer-to-Farmer program, the International Agricultural Education Fellowship Program, and other fellowship opportunities. These programs are highly impactful because they facilitate local capacity building and education and create new opportunities to build scientific capacity in developing countries. Continued support for these programs would also benefit local extension systems that can deliver impactful solutions to farmers and their communities. Importantly, these programs invest in youth in rural communities through agriculture education and experiential learning to build the future of agriculture for developing nations.
- Create incentives for scientists in developing countries to focus on localized agricultural production issues. In many developing countries, the scientist-to-farmer ratio needs to be dramatically increased, and scientists need to be incentivized to focus their research on increasing local agricultural production over longer periods of time. The U.S. should consider ways to incentivize scientists through initiatives that might ensure adequate pay, good laboratories, and ample research operations support, as well as support for participation in international professional organizations and long-term collaborative relationships with developed country scientists.

7 Global food security and agricultural development funding for USAID and State Department activities under the Feed the Future initiative is directed through the State, Foreign Operations, and Related Programs appropriations bill under the header, "global food security and agricultural development programs."

The latter would require incentives to developed-country scientists to enter into and maintain long-term collaborative relationships with developing country scientists.

- Fund graduate-level agricultural research projects for U.S. students at CGIAR. The U.S. government should consider strengthening the relationship between U.S. land grant universities and CGIAR by funding graduate research projects at CGIAR centers for U.S. Ph.D. and master's degree students in agricultural disciplines. Presently, U.S. student-scholars are greatly underrepresented at CGIAR centers compared with scholars from other developed and developing countries. This step would engage U.S. graduate students in cutting edge research on current problems in developing country agriculture, and thereby help to build a stronger base for future long-term collaboration with developing country scientists.

3. **Support robust funding of the Foundation for Food and Agriculture Research (FFAR) in the Farm Bill and encourage U.S. agencies like DARPA and NSF to utilize FFAR to leverage scientific resources to solve global food challenges impacting national security.** Examples for collaborative research pilots could include: predictive modeling using artificial intelligence (AI) to predict pests and disease occurrence and changing environmental fluctuations and its impact on production; better surveillance systems to monitor pest and disease outbreaks; new rapid breeding technologies for important local food crops to increase productivity, improve nutrition, and increase drought and heat tolerance; and funding technologies that will be needed to reduce emissions and help farmers adapt to climate change, while conserving natural resources.

4. **Effectively leverage and coordinate executive branch departments and agencies to advance global food and nutrition security priorities.**

- Further leverage the State Department to secure greater commitments and investments in agriculture, R&D, and extension by developing country governments. This is particularly relevant in Africa, where past African government commitments to allocating at least 10 percent of national budgetary resources to agriculture have not been reached by all governments. The State Department should also continue to prioritize encouraging developing country governments to join the AIM for Climate initiative and scale up climate adaptation research commitments to better adapt smallholder agriculture to changing local conditions. This approach should also aim to encourage developing country governments, particularly in Africa, to invest more of their own funding to build local capacity. This could include scaling up support for developing countries' agricultural ministries to enable them to increase investments in agricultural extension and technical assistance, and improving private sector policies to strengthen the capacity of smallholder farmers and stakeholders along the value chain to achieve sustained inclusive agriculture-led growth.
- Expand the mandate and increase the funding for the Millennium Challenge Corporation, particularly as it relates to agriculture and rural transformation. The Millennium Challenge Corporation (MCC) is a development model that posits major responsibility for the design and management of development projects with local developing country leaders. This model helps to assure that development projects respond to the needs of beneficiaries. The MCC is currently limited to 81 of the lowest income countries that meet its criteria. Increasing eligibility to include middle income countries where poverty is increasing could greatly expand the application of this highly useful model of development assistance to improve local food systems, further leveraging MCC's contributions to the Feed the Future initiative.
- Continue to leverage International Development Finance Corporation (DFC) investments aligned within Feed the Future to better achieve poverty reduction and global food and nutrition security outcomes for stability. China's infrastructure investments are reducing U.S. influence in strategic regions, particularly in Africa. DFC invests in agricultural trade infrastructure to better connect Feed the Future-supported areas to markets to drive economic growth and food security. With poverty and food insecurity driving instability, extremism, and migration, DFC should augment Feed the Future-related food security investments where U.S. national security interests are most threatened. Infrastructure investments, as well as more support for local food processing, large scale food fortification, and R&D for productivity, climate adaptation, and nutrition-enhancing innovations, could help accelerate Feed the Future's goals, reduce instability, and counter China's growing influence through their Belt and Road Initiative.
- Improve coordination between the Feed the Future initiative and the Department of Defense and other security-minded agencies on the U.S. government's global food security strategy. This coordination could help to identify target areas that might be most prone to security issues and fund programs that are doing tailored, localized science to increase crop yields and animal productivity in local areas (e.g. designing seeds for localized soil and weather conditions, improving livestock genetics). Better understanding shared impact and coordinating responses to emerging threats like climate change can be beneficial to national security as well as food security, and is particularly important in East and West Africa, where the U.S. is expanding military deployments, and in Central and Latin America to help stem migration to the U.S.

5. **Provide the authorized amount of funding to the Agriculture Advanced Research and Development Authority (AgARDA) to develop and deploy technologies that address challenges in global agriculture and food production.** Agriculture does not yet have an Advanced Research and Deployment Authority (ARPA). The creation of AgARDA was intended to uniquely focus on addressing challenges within the nexus of agriculture and national security. Farmers around the world are

struggling with new threats, high input costs, and lack of innovation making farming less and less economically viable. It is essential that farmers are equipped to deal with future climate-related challenges, including those that accelerate the spread of new pests and disease. Since the U.S. has not prioritized this authority for agriculture, fully funding AgARDA would help infuse much needed research funding into agriculture, in line with national security goals. Through AgARDA, USDA could enable the research necessary for engendering transformative impacts and the development of new industries and partnerships. AgARDA will be instrumental in overcoming threats to global food production and the stability of food systems, as it aims to develop and deploy technologies that address challenges in agriculture and food production, including plant disease and pests and biological threats.

6. **Support comprehensive research on the effectiveness of different agricultural and rural technologies and production systems with respect to conflict dynamics in socio-politically fragile environments.** Poverty, food insecurity, and conflict are closely linked in what has been termed the "conflict trap." Some agricultural technologies are likely better than others for supporting families and communities during conflict, but little research addresses this problem, partly because civilian development agencies avoid working in conflict zones. On the other hand, U.S. military units often do engage in community stabilization projects through Commander's Emergency Response Program (CERP). It would be highly useful for advanced research to be conducted across an integrated database on USAID, CERP, USDA, and possibly international agency data. The challenge may be gaining access to military data.

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