From Scarcity to Security:

MANAGING WATER FOR A NUTRITIOUS FOOD FUTURE

US POLICY COMPANION

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Rice fields in Thailand. Credit: istock/af_istocker

Summary

- Water is a vital resource that is becoming increasingly stressed and threatens to undermine the progress that has been made on global food and nutrition security and resiliency. With the potential for severe economic, political, and humanitarian consequences across the developing and the developed worlds, water management is a critical global issue that demands immediate action.
- Agriculture depends on a reliable source of water, which will be severely tested by expected changing demand, water predictability, and availability. The fresh water necessary to produce crops and livestock accounts for the largest percentage of water usage among all sectors (71 percent), followed by industrial use (20 percent), and then domestic uses, including drinking water and sanitation (9 percent).[1]
- Competition for water resources is increasing between people and the natural environment; competition is also increasing between cities and rural areas, risking the prosperity of both. Adding to this pressure, rising incomes are increasing demand for diverse, nutritious diets—including fruits, vegetables, legumes, nuts, healthy oils, and animal-source foods—which require more predictable supplies of water to produce at a time when these supplies are becoming less predictable.

- By 2050 the global population is expected to increase to 9.8 billion, with 86 percent living in less-developed countries and 70 percent in rapidly growing urban areas.[2] Farmers will need to improve their food production capacity to meet the needs of the growing populace, while expanding urban areas will also demand more water from a steadily decreasing supply. Approximately 2.4 billion people—more than one-third of the global population—currently live in water-scarce regions, and projections indicate that by 2050 over one-half of the world's population could be at risk due to water stress.[3]
- Expanding access to irrigation can increase both productivity and climate resilience: while only 20 percent of all cultivated land is irrigated, this land accounts for about 40 percent of agricultural production.[4] Research has suggested that it will not be possible for Africa to grow enough food for the demands of their growing populations on rainfed systems alone. Therefore, intensification of agriculture, in part through irrigation, must be achieved. However, this must be approached prudently to avoid overuse, which will exacerbate already stressed resources.[5]
- The world is running out of clean, fresh water to feed—and nourish—a growing global population, ensure sustainable human development, and maintain the health of our planet.

Farmers face increasing competition for water

Competition for water among its many users—including food and agriculture production, the environment, energy, industry, and individual consumers—is going to intensify. Growing water scarcity, increasing degradation of ecosystems, and poor water quality are major challenges to the future of food and nutrition security. The reliability and quality of both agricultural and nonagricultural water supplies will decline without significant improvements in water governance, management strategies, policy, and investment.

Increased competition over highly stressed, shared water sources is a vector for migration and even violent conflict, posing further economic and security risks.

As nonagricultural demand for water grows, many regions will increasingly transfer water from irrigation use to other uses. This will create the potential for conflict as well as the loss of farm production and income. Smallholder farmers, who largely rely on rainfall for their water supply, are at the greatest risk of total crop failure in the face of increased rainfall variability.

Although the domestic and industrial sectors use far less water than the agricultural sector, the growth in water consumption in these sectors has been rapid. Globally, withdrawals for municipal and industrial uses grew nearly 150 percent between 1960 and 2010, compared to an 85 percent increase for agricultural withdrawal.[6]

The intensifying sectoral competition and water scarcity problems, along with declining reliability and quality of water supplies, will continue to cause problems for global food and nutrition security. Failure to treat water as a strategic, valuable, and limited resource will accelerate water insecurity, even for historically water-secure populations.

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Nearly all human economic and domestic activity requires clean, fresh water. Water insecurity is a direct threat to the global economy. Increased competition over highly stressed, shared water sources is a vector for migration and even violent conflict, posing further economic and security risks.

Figure 2 – Projected gap between demand and production of key crops (2017 to 2027)

Source: OECD Stat - FAO Agricultural Outlook

Demand for water is growing across the globe

Increasing global populations, rising incomes, and urbanization are causing strong growth in food and water demand and, as a result, intensified competition. Global demand for water is generally projected to increase by 30 to 50 percent by 2050.[7] Accounting for constraints in future water supplies, it is projected that agricultural water consumption will grow 21 percent by 2050, with a 29 percent increase in total consumptive use of water across all sectors between 2005 and 2050.[8]

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- The International Food Policy Research Institute (IFPRI) projects that global production of cereals will increase by 37 percent between 2010 and 2050, meat by 66 percent, and fruits and vegetables by 85 percent.[9] As the world's population is projected to grow to nearly 10 billion by 2050, agricultural production will need to increase almost 50 percent in order to meet this demand.[10]
- More than one-third of the global population—approximately 2.4 billion people—already live in water-scarce regions or in river basins with annual water withdrawals greater than 40 percent of total renewable water. Total water withdrawals are projected to increase by 45 percent from 2000 to 2050.[11]
- Out of the world's total gross domestic product (GDP), 22 percent or US$9.4 trillion is produced in these water-short areas, including 39 percent of cereal production.
- Just over half (52 percent) of the global population—or 4.8 billion people—and 45 percent of total GDP (US$63 trillion) are projected to be at risk due to water stress by 2050. This includes 49 percent of global grain production.[12]
- A quarter of cities, with a total of US$4.2 trillion in economic activity, are classified as water-stressed. In these cities, 150 million people live with perennial water shortages.[13] In the coming years, population growth and continuing urbanization will bring a 50 to 70 percent rise in the demand for water in cities.[14]

Building farmer resilience to water stress is absolutely critical to achieving food security. For example, since 2011, the US Agency for International Development (USAID), in collaboration with the Government of Kenya's Ending Drought Emergencies initiative, has established a cross-ministerial National Drought Management Authority that has resulted in a 12 percent reduction in the depth of poverty and a 28 percent increase in women's dietary diversity across key regions. Additionally, 66 percent of households report that they will be able to cope with future droughts, up from 53 percent in 2012.[15]

Threats to food and water security are multiple

Beyond direct competition, greater variability in precipitation and increases in temperature disrupt agricultural production, which will further threaten water, food, and nutrition security. These impacts will likely be felt most intensely in regions with the fewest resources for adaption.

Food insecurity

Food price shocks can act as a catalyst for both nonviolent and armed conflict. Particularly in urban areas of lower- and middle-income countries (LMICs), high food prices and reduced access can trigger protests and rioting. For example, food price-related protests

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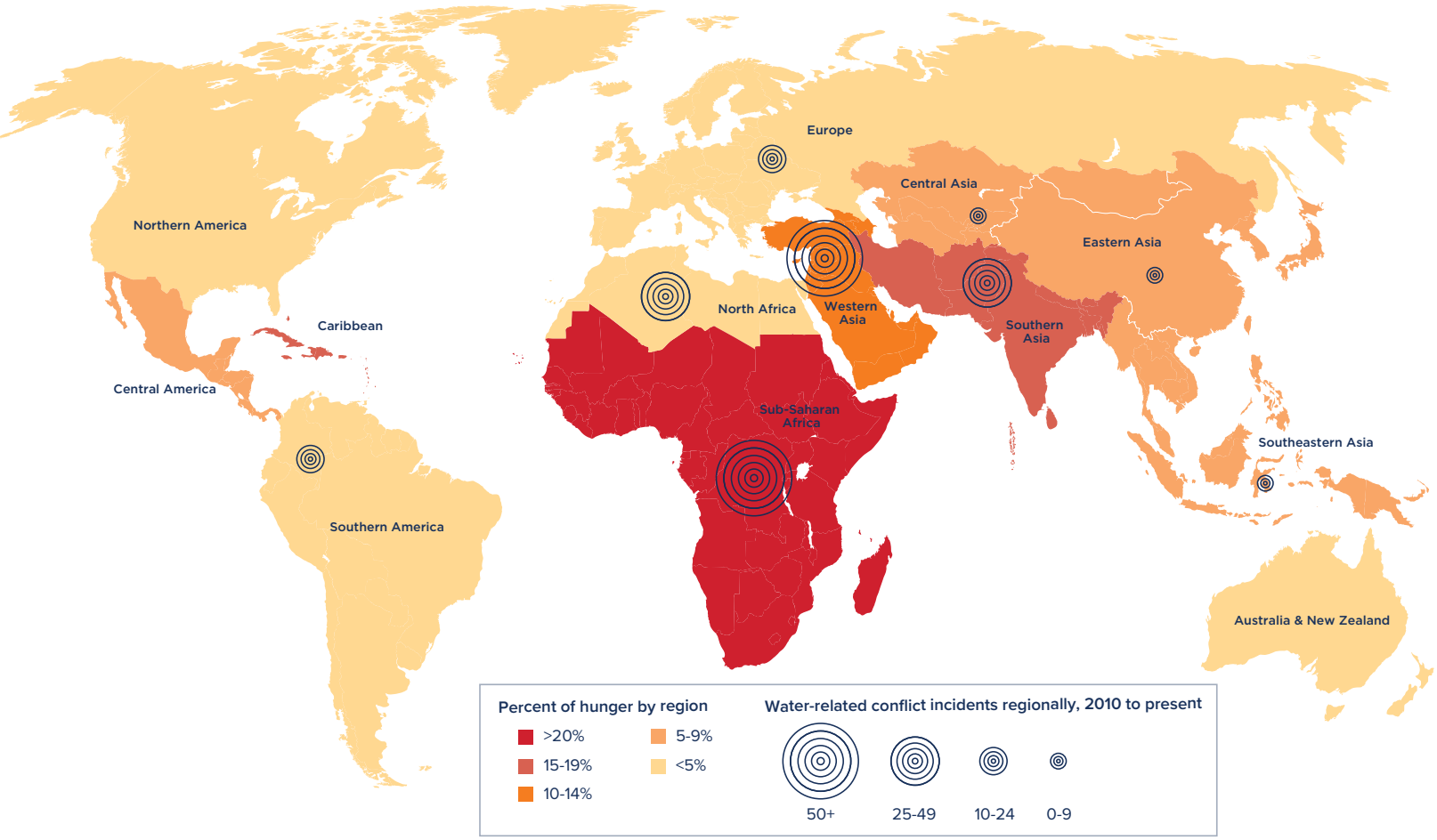
toppled governments in Haiti and Madagascar during 2007 and 2008. In 2010 and 2011, food prices and grievances related to food policy were one of the major drivers of the Arab Spring.[16]

Credit: Marilyn Shapley/Mercycorps/Niger

Hunger and water-related conflict



Source: FAOSTAT 2018; Pacific Institute 2018

Water scarcity

There is a dangerous linkage between poverty, food insecurity, other forms of vulnerability, and an unreliable water supply. In addition to water scarcity, some regions are also facing the food, water, and fuel demands of a growing population. This creates an increased likelihood of conflict over precious resources. Subnational water conflict is more likely to occur when regions with weak governance and institutions experience sudden shocks to available water supplies.

Water insecurity can exacerbate existing instability and conflict. For instance, in October and November of 2004, four people were killed and over 30 injured in the Sri Ganganagar district of India near the Pakistan border during protests over the allotment of water from

the Indira Gandhi Canal. Conflict over this water still continues. Between 2004 and 2006 a drought affected an estimated 11 million people across East Africa, killing large numbers of livestock and forcing the governments of Kenya and Ethiopia to intercede in scores of skirmishes over water in their countries through military and police involvement.

In northeastern Syria, droughts between 2006 and 2011 caused 75 percent total crop failure and 85 percent livestock loss.[17] The resulting rural-to-urban migration of more than a million unemployed Syrians added to the domestic instability that underpinned that country's ongoing civil war.

Weather variability and civil unrest

Agricultural production in LMICs is more vulnerable to adverse weather shocks due to the region's lower coping capacity. In recent years, almost one-fourth of weather-related damage has been in the agricultural sector in LMICs.[18] Existing and growing uncertainties regarding precipitation are adversely affecting investments in agricultural productivity.[19] These will increase dependence on food imports in regions with large populations such as parts of Africa, the Middle East, and Central America that are already net food importers. The likelihood of increased imports highlights the importance of a fair and open agricultural trade regime capable of providing the needed imports.

Moreover, militant activity in East Africa rises after periods of both especially high and low rainfall. This correlation indicates a relationship between weather variability and increased substate conflict.[20] If, as predicted, climate change makes rainfall more erratic,

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this could lead to more conflict than would be expected from increased water scarcity alone. Neighboring communities show greater rates of conflict if they perceive unequal access to water. Changing weather patterns may also undermine progress made on transboundary water cooperation.

Groundwater depletion

Groundwater plays a major role in irrigation and food production globally. More than one-third of the world's irrigation-equipped area relies on groundwater, and about 38 percent of net irrigated area benefits from groundwater access.[21] In addition, groundwater accounts for 43 percent of total consumptive irrigation water use.[22] Eleven of the top 15 countries using groundwater are in Asia. India alone uses double that of any other country—of which 89 percent is used for irrigation. The next highest users are China, the United States, and Pakistan. Irrigation accounts for 54 percent and 71 percent of total groundwater use in China and the United States, respectively.[23]

Groundwater depletion, which occurs when water removal exceeds the recharge rate of the aquifer, is a major threat to water supplies. Intensive groundwater pumping for irrigation has caused groundwater depletion in many arid and semiarid agricultural regions, leading to declining groundwater tables. Overpumping of freshwater wells has increased

saline water intrusion into freshwater aquifers, which can contaminate agricultural and drinking water.

Many of the depleted aquifers overlap with the world's most important breadbaskets.[24] Sustained groundwater overdraft puts future irrigated food production at risk. In all these cases, good governance can make the difference between conflict and stability. Serious

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shocks to the water supply may be unavoidable, but resilience is possible through policy and watershed-level planning. Investments in water security and good water governance are investments in peace and security.

Climate change endangers water and food security

Hunger is expected to rise about 10 to 20 percent by 2050 due to climate change relative to a no–climate change scenario. Owing to agriculture's strong dependence on climate and water resources, management of water is a key concern for food production. Extreme weather events can lead to cascading food system shocks and are responsible for lower

A man walks near a dry field, West Java, Indonesia. REUTERS/Willy Kurniawan

long-term production potential. Globally, droughts and extreme heat alone reduced national cereal production by 9 to 10 percent between 1964 and 2007.[25]

Specifically, climate change impacts on water resources also include:

- changes in the timing of water availability due to changes in rainfall, snowpack, and diminishing glaciers;
- changes in the timing and intensity of water demands due to increased temperatures, evaporation, changes in surface water availability, and groundwater storage;

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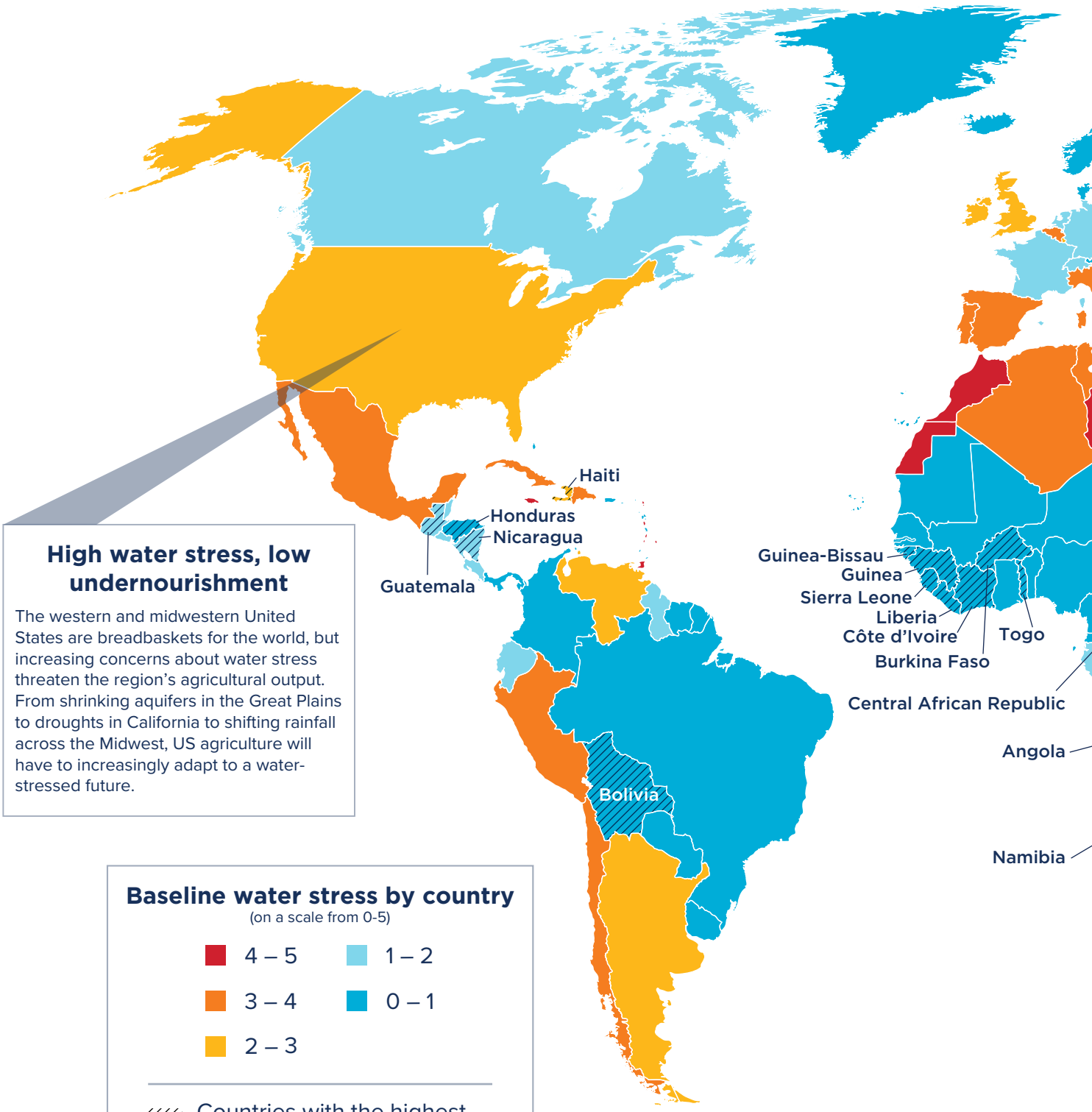
- an increased number and intensity of extreme climatic events (droughts and floods);
- changes in water quality; and
- sea-level rise, which will lead to inundation and saltwater intrusion in existing irrigated areas.

While altered patterns of precipitation are certain, the ultimate outcomes of climate change and its effect on water availability and variability are not. Despite improvements in water resources in some areas, climate change will make it more challenging to manage the world's water because it affects the entire water cycle.[26]

Prevalence of hunger and water stress



High water stress, low undernourishment

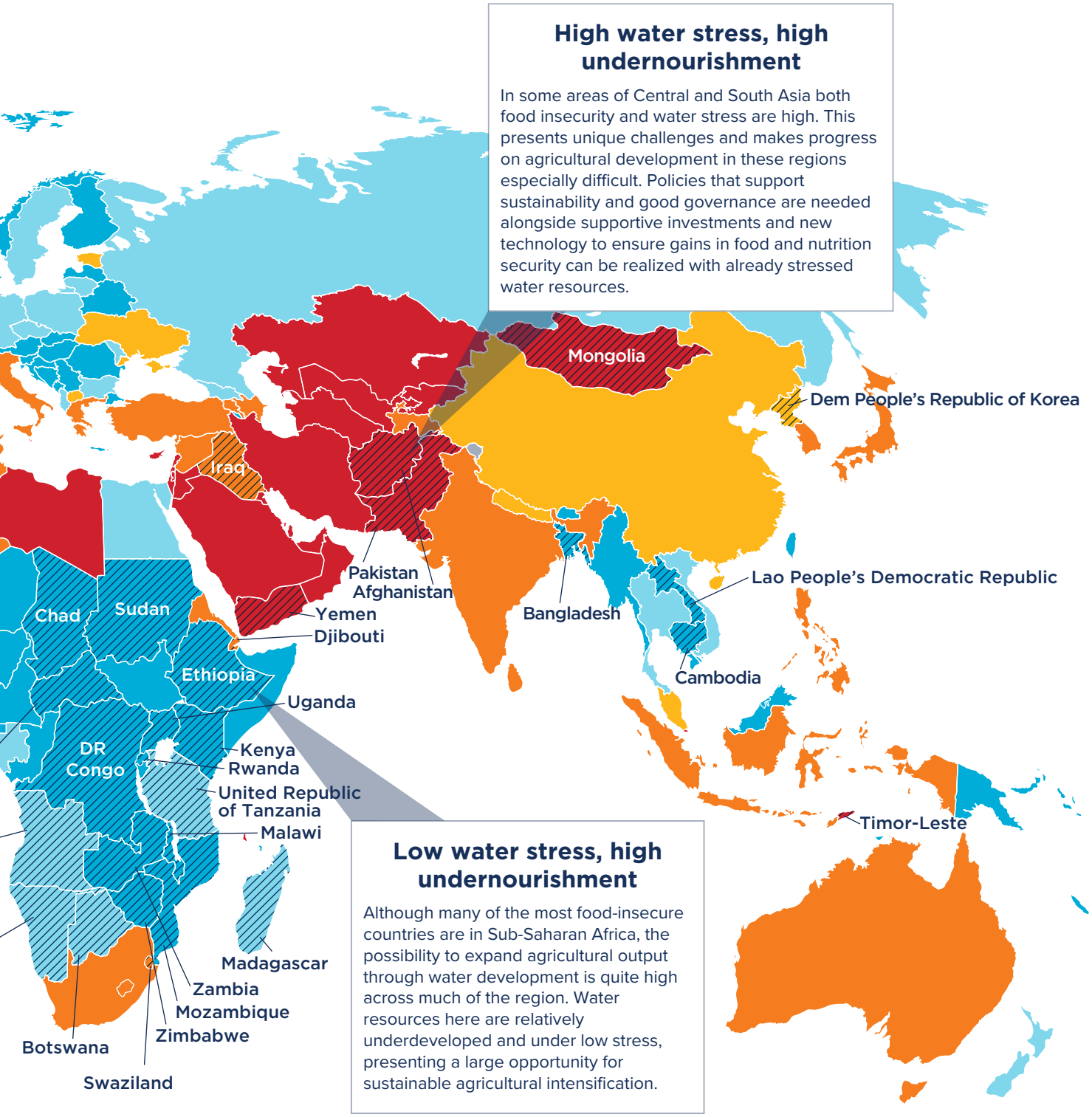
The western and midwestern United States are breadbaskets for the world, but increasing concerns about water stress threaten the region's agricultural output. From shrinking aquifers in the Great Plains to droughts in California to shifting rainfall across the Midwest, US agriculture will have to increasingly adapt to a water-stressed future.

Baseline water stress by country

(on a scale from 0-5)

- 4 – 5
- 3 – 4
- 2 – 3
- 1 – 2
- 0 – 1

Countries with the highest rates of undernutrition (>15%)



High water stress, high undernourishment

In some areas of Central and South Asia both food insecurity and water stress are high. This presents unique challenges and makes progress on agricultural development in these regions especially difficult. Policies that support sustainability and good governance are needed alongside supportive investments and new technology to ensure gains in food and nutrition security can be realized with already stressed water resources.

Low water stress, high undernourishment

Although many of the most food-insecure countries are in Sub-Saharan Africa, the possibility to expand agricultural output through water development is quite high across much of the region. Water resources here are relatively underdeveloped and under low stress, presenting a large opportunity for sustainable agricultural intensification.

Reliable access to water fosters safe, healthy populations

The stakes are high for effectively developing and managing water because of its fundamental importance to food and nutrition security. Water, when reliably available to farmers throughout the year, increases the volume and diversity of food that can be produced. It allows for the greater production of micronutrient-rich foods such as fruits, vegetables, animal-source foods, and dry season crops. Irrigation contributes to increased food production, farm income, and improved resilience against weather variability.

Women and girls

Complementary to agriculture development, the water access, sanitation, and hygiene (WASH) sector is also critically important for achieving food and nutrition security. The burden of disease from unsafe water, coupled with time spent collecting water, is a significant drag on the economies of LMICs. Women and girls are disproportionately affected, since they often bear primary responsibility for providing drinking water and sanitation to their families and for taking care of the sick. The effect of their time and labor burdens are often borne out in girls' access to education and women's livelihood opportunities.[27]

Infectious disease

In many LMICs, water facilities are multiuse, providing for both irrigation and for WASH needs. This influences the overall water environment in and around the household, potentially reducing exposure to fecal contamination and the risk of infectious diseases. Access to safe water is associated with reduced incidence of enteric infection and reduced

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incidence of disease in pregnant women, lowering maternal and neonatal mortality rates. Access to safe water can also reduce stunting among children under the age of five and improve nutrition in the first 1,000 days of life.[28]

Given that water quality issues cut across agriculture and WASH, integrating policies between these sectors opens vital new pathways for health and nutrition. This includes improvements in the proximity and cleanliness of water sources and in technologies for water extraction to support women's empowerment through time savings and improved health conditions. Moreover, access to sanitation for women and girls is particularly crucial for preserving basic dignity and improving access to education and economic opportunities.[29]

Alignment of water and food security programs is needed to ensure future prosperity

At home, the United States has been at the forefront of addressing agricultural water management by empowering entrepreneurial farmers through technological advancements, research, and innovative implementation models. Globally, legislation like the Senator Paul Simon Water for the World Act and the Senator Paul Simon Water for the Poor Act are two examples of how US leadership is essential to catalyze innovations necessary to achieve global water, food, and nutrition security. While current efforts on both water and food assistance are to be commended, a multilayered and multidimensional approach is needed to reach the nation's stated foreign policy, national security, and humanitarian goals. Water

Solutions to water scarcity and water access cannot be considered outside of the context of food production and the increasing food and nutritional needs of growing populations.

challenges will only get worse if left unaddressed, and the incredible development gains of the past 50 years could be lost. Solutions to water scarcity and water access cannot be considered outside of the context of food production and the increasing food and nutritional needs of growing populations. As a global leader in both food security and water access efforts, the United States has the expertise, knowledge, and capability to ramp up solutions. It will take bold action and a commitment from all actors to work together toward the common goal of a water- and food-secure future.

Credit: Marilyn Shapley/Mercycorps/Niger

US leadership for global water and food security

Several pieces of bipartisan legislation and policymaking have underpinned the US approach to global development policy on water. First among these is the Senator Paul Simon Water for the Poor Act of 2005 (WfP), which designated water access, sanitation, and hygiene (WASH) as important foreign policy priorities for US national security interests. The legislation created conditions for the US administration to help millions of people gain better access to water resources by increasing the US government's capacity to implement WASH programs, target resources to communities in need, and develop a comprehensive strategy for addressing a critical challenge for the most vulnerable. It is estimated that 31 million gained access to water and 12 million gained improved sanitation under WfP from 2005 to 2014.

Building upon the success of the 2005 act, the 2014 Senator Paul Simon Water for the World Act specified criteria for high-priority countries for assistance; required reports to Congress no later than every five years; and authorized the establishment of water coordinators at USAID and the Department of State with overlapping, coordinating, but independent roles. This legislation ensures that all US government agencies focusing on WASH issues are working closely together to maximize impact.

The USAID water coordinator implements water programs, focuses on economies of scale and efficiency, identifies country "capacity, capability, and commitment" to determine countries likely to make significant sustainable improvements, and is required to develop and utilize appropriate metrics and evaluation. Water management is included as a component of the role, which is more applicable to agriculture than other aspects of WASH.

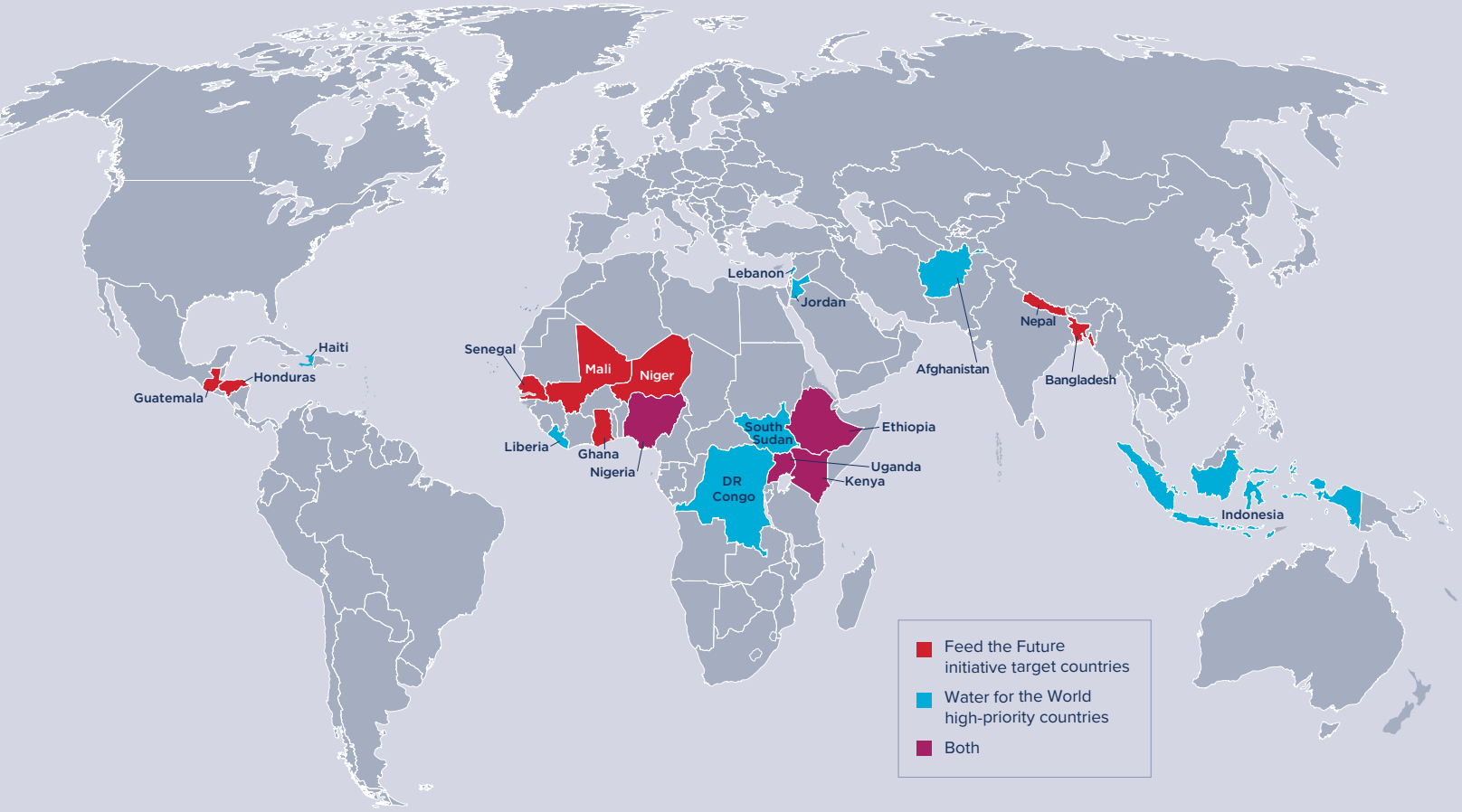
The Department of State water coordinator manages resources related to "intra- and transboundary conflicts over water resources consistent with national interests" and represents the United States in key international fora.

Water for the World Act high-priority countries

- Afghanistan
- Democratic Republic of Congo
- Ethiopia
- Haiti
- Indonesia
- Jordan
- Kenya
- Lebanon
- Liberia
- Nigeria
- South Sudan
- Uganda

Source: Report to Congress, Senator Paul Simon Water for the Poor Act; Senator Paul Simon Water for the World Act

Feed the Future and Water for the World priority countries



Source: USAID 2018

Recommendation 1: Strengthen the environment for cooperation and communication between water development and food and nutrition security

- Congress should create a formal integrated and multilayered process for communication and collaboration between implementers of the Global Water Strategy and the Global Food Security Strategy to improve whole-of-government efforts to expand sustainable agricultural development and water resource management simultaneously.
- Congress should permanently authorize the Global Food Security Act, which brings it into alignment with the Water for the World Act.
- Congress should request a comprehensive report from the administration on the impact of food and water insecurity on regional stability.
- The administration should bolster the new Bureau for Resiliency and Food Security by increasing interdisciplinary efforts and requiring increased accountability and engagement.

Congress should create a formal process for communication and collaboration between implementers of the Global Water Strategy and the Global Food Security Strategy to improve whole-of-government efforts to expand sustainable agricultural development and water resource management simultaneously.

Recommendation 2: Ease the challenges that hinder greater private-sector investment to expand sustainable water development for food and nutrition security

- The administration should assess the use of artificial intelligence and expansion of the National Agriculture Imagery Program (NAIP) at USDA for addressing major development issues such as water resource scarcity.
- USAID should establish an interagency policy working group to formalize and coordinate a holistic approach that will make development finance tools available to local private-sector investors, from small businesses and farmers to multinational corporations.
- Congress should ensure the new US International Development Finance Corporation includes opportunities for short- and long-term investment in agriculture and water.
- The administration should support the development of an enabling environment for business through a standardization of regulations and support for rule of law.
- The administration should pilot collaborations with the private sector and civil society to design programs or innovations that build demand for nutritious diets.
- The National Oceanic and Atmospheric Administration (NOAA) should continue to maintain current investments in digital mapping of water resources, and incentives should be introduced to increase sharing of critical data by commercial entities on this common platform.

Recommendation 3: Leverage US expertise and influence to improve water resource governance and sustainability

- The administration should employ all foreign policy tools available, with emphasis on technical assistance for water sustainability, to maintain US global leadership in strategically important regions.
- The administration should include education on water resource management at the state and national level as part of fellowships and academic exchanges.
- The administration should support active engagement with traditional multinational development institutions engaged in water management and development.

Recommendation 4: Strengthen support for agricultural R&D and interdisciplinary research at the nexus of water, food, and nutrition

- The administration should coordinate and Congress should fund a significant challenge fund for water scarcity issues that encourages private-sector innovation.
- The administration should support the creation of a USAID innovation lab at a land-grant university or expand existing innovation lab efforts to advance uptake and improvement of wastewater management and reuse for agriculture.
- The administration should advance innovative, new agricultural approaches to combat the impacts of a changing climate through targeted research.
- The administration should affirm and support greater research and development opportunities that are interdisciplinary and target the nexus of food, water, and nutrition.

Credit: Marilyn Shapley/Mercycorps/Niger

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For complete chart references, see the full report *From Scarcity to Security: Managing Water for a Nutritious Food Future*.

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