WATER GLOBAL PRACTICE

WATER AND NUTRITION

A Framework for Action

Claire Chase, Aroha Bahuguna, Yue Chen, Sabrina Haque, and Mik Schulte

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Executive Summary

This framework for action was developed to support the inclusion of nutritional considerations in the design of water operations and to help formulate nutrition-enhancing water policy. Chronic undernutrition early in life can cause cognitive and physical impairments that prevent children from achieving their full potential and have lasting consequences on the human capital that is essential for economies of the future to be competitive.

Water is at the core of healthy growth and development. It is a driver of better nutrition but, when poorly managed, can lead to negative impacts. The role of water for early child nutrition has centered on ensuring a hygienic living environment through clean water, adequate sanitation, and good hygiene. However, the importance of water for nutrition is much broader. A reliable water supply is needed to grow food to feed families, secure livelihoods, and provide income for other nutrition inputs. Yet water has become more variable as climate change accelerates, leading to more frequent and more damaging droughts and floods. Mismanagement of water resources results in shortages, pollution, and in some cases conflict, each of which impact a child's ability to thrive. These relationships call for a more nuanced recognition of the role that water plays in early child nutrition, as well as the need for guidance on ways to mitigate the risks and boost the benefits of water investments for nutrition.

We present an integrated water and nutrition framework to aid in understanding the various ways that water impacts early child nutrition, drawing on the three dimensions of water security: *water quantity,* adequate supply of water resources; *water quality,* water that is free of contamination; and *water accessibility,* reliable availability to all people, economies, and ecosystems. Each of these in turn affects the underlying drivers of poor nutrition outcomes in children: Water determines disease environments and therefore the ability to physically *utilize* nutrients for healthy growth; water impacts the supply of food and nutrients that people have access to in their homes; and water influences livelihoods, which indirectly affects nutrition through income, time use, and education of caregivers. Challenges associated with water-related conflict and water resources in the context of fragility cuts across each of the drivers of undernutrition.

Although the need to harness water sector investments to improve nutrition is urgent, the level of need varies by country, within countries, and by socioeconomic status. At the same time, financial resources are limited. To support countries achieving water security and improved nutrition, evidence on where to target these scarce resources can aid in decision-making. We present several diagnostic tools to help shape the design of interventions, identify areas most in need of investment, and help prioritize among multiple interventions when addressing a multisectoral

outcome like stunting. We demonstrate how diagnostics of water-related factors at a regional level can help identify "hotspots" in the region where low levels of access to water and sanitation intersect with high levels of stunting or which countries experience both water stress and high levels of stunting. This hotspot analysis helps to identify countries where further investigation could look at trends across time, variation at subnational levels, and potential underlying drivers of outcomes.

The guidance notes that accompany this framework describe the evidence of how water sector investments across irrigation, water management, and water supply and sanitation impact early child nutrition and summarize recommendations on how to design interventions for greater impact. Often, it is necessary to enhance current approaches to service delivery and water management because these have mainly been designed with more upstream outcomes in mind, such as improvements in access and use for water and sanitation services and improvements in availability of food and income for irrigation investments. It is also necessary to identify ways to coordinate with other sectors to help ensure that children receive all the necessary nutrition inputs that lead to better outcomes, not only water-related inputs.

Results at the project level require a supportive policy environment. Therefore, we conclude with three recommendations to help move the water and nutrition policy agenda forward. First is the need to harvest evidence on nutrition-sensitive water investments, particularly in water for agriculture, and feed this evidence back into policy actions. Second is the need to draw attention to the water-related threats to nutrition that are intensified by climate change, especially in regions already facing a high burden of child stunting. Finally, there is a need for more experience and guidance to support equitable and nutrition-sensitive use of water resources both within and across countries. With the right policies in place, countries will be better positioned to harness the power of water for improving nutrition and strengthening human capital.

Abbreviations

AGRA	Alliance for a Green Revolution in Africa
A-WEAI	abbreviated Women's Empowerment in Agriculture Index
BCC	Behavior Change Communication
BMI	body mass index
CARD	Council for Agriculture and Rural Development
COP 22	22nd Conference of the Parties
DALY	disability-adjusted life year
DHS	Demographic and Health Surveys
DRC	Democratic Republic of Congo
EED	environmental enteric dysfunction
FAO	Food and Agriculture Organization of the United Nations
FCV	fragility, conflict, and violence
GAIN	Global Alliance for Improved Nutrition
GDP	gross domestic product
GFF	Global Financing Facility
GNI	gross national income
HAZ	height-for-age Z-score
HCES	Household Consumption and Expenditure Surveys
HCI	Human Capital Index
HCP	Human Capital Project
IBRD	International Bank for Reconstruction and Development of the World Bank Group
IDA	International Development Association of the World Bank Group
IDW	improved drinking water
IHME	Institute for Health Metrics and Evaluation
INFA	Initiative for Food and Nutrition Security in Africa
INIR	National Irrigation Institute

IS	improved sanitation
IYCF	infant and young child feeding
IYCMAD	infant and young child minimum acceptable diet
JMP	WHO/UNICEF Joint Monitoring Programme
Lao PDR	Lao People's Democratic Republic
LDMA	Land Market Development Activity
LMICs	low- and middle-income countries
LSMS	Living Standards Measurement Study
MAD	minimum acceptable diet
MDD	minimum dietary diversity
MICS	Multiple Indicator Cluster Surveys
MMF	minimum meal frequency
MoH	Ministry of Health
MRD	Ministry of Rural Development
NSFSN	National Strategy for Food Security and Nutrition
OD	open defecation
ORS	oral rehydration solution
PROIRRI	Sustainable Irrigation Development Project
SBCC	Social and Behavior Change Communication
SDG	Sustainable Development Goal
SUN	Scaling Up Nutrition
SWA	Sanitation and Water for All
TWG-FSN&SP	Technical Working Group on Food Security, Nutrition, and Social Protection
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
UNGA	United Nations General Assembly
UNICEF	United Nations Children's Fund
UNSCN	United Nations System Standing Committee on Nutrition
USAID	United States Agency for International Development

WA	water availability
WASAG	Global Framework for Water Scarcity in Agriculture
WASH	water supply, sanitation, and hygiene
WAZ	weight-for-age Z-score
WBG	World Bank Group
WEAI	Women's Empowerment in Agriculture Index
WHO	World Health Organization
WS	water stress
WSS	water supply and sanitation
WUA	water user association

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CHAPTER 1

Introduction

Water sustains all forms of life and nurtures the well-being of populations—protecting them from hunger and disease and shaping livelihoods and productivity. It is at the crux of human development. Although there are multiple ways in which water affects well-being, this framework centers on water's complex relationship with nutrition.

Improving nutrition is a smart investment that yields economic returns. In Africa and Asia, where levels of stunting are highest, reducing stunting is estimated to increase economic productivity by 4 percent to 11 percent, as measured by gross domestic product (GDP) per capita (Horton and Steckel 2013). Such economic analyses still fail to capture the rippling physical, mental, and societal benefits that improvements in nutrition contribute to a country's stock of human capital and that accrue to the next generation. Good nutrition in the early years is a child's springboard to success later in life and an instrument to cut the cords of intergenerational poverty transmission.

Undernutrition is present in various forms, affecting both children and adults. More than a quarter of children younger than age 5 are stunted[1] worldwide (150 million), and wasting[2] affects 50 million young children. An estimated 9.7 percent of women of reproductive age are underweight,[3] and anemia affects 613 million women of reproductive age, 35 million of them pregnant (Global Nutrition Report 2018). At its worst, extreme forms of undernutrition lead to organ damage and eventual death; and in its more silent form, chronic undernutrition or stunting can cause cognitive and physical impairments later in life, preventing children from achieving their potential. The effects of undernutrition have lasting consequences on the human capital that is essential for economies of the future to be competitive.

In its various roles, water is an upstream driver of better nutrition and, when poorly managed, can lead to negative impacts. Consuming unclean water, whether contaminated with fecal pathogens or other pollutants, causes diarrhea and other ailments. In 2016, diarrheal diseases were the second leading cause of death in low-income countries, killing nearly 60 out of every 100,000 people (WHO 2018a). During periods of drought, farmers without a reliable source of water to grow food cannot feed their families or make income from selling crops. More frequent and heavier flood events

1. Stunting is defined as a height-for-age Z-score (HAZ) below minus two standard deviations from median HAZ of the World Health Organization (WHO) Child Growth Standards.
2. Wasting is defined as a weight-for-age Z-score (WAZ) below minus two standard deviations from median WAZ of the WHO Child Growth Standards.
3. Underweight in adults is defined as a body mass index (BMI) below 18.5.

attributable to a changing climate create breeding grounds for disease-carrying vectors, causing illness, anemia, and energy deprivation. In the political space, mismanagement of water can lead to shortages and even destabilize entire regions, disrupting economies, essential services, and children's ability to thrive. Recognizing both the dramatic and subtle relationships between water and nutrition underscores the need to formulate policy and investments that help mitigate risks and boost the benefits of water investments.

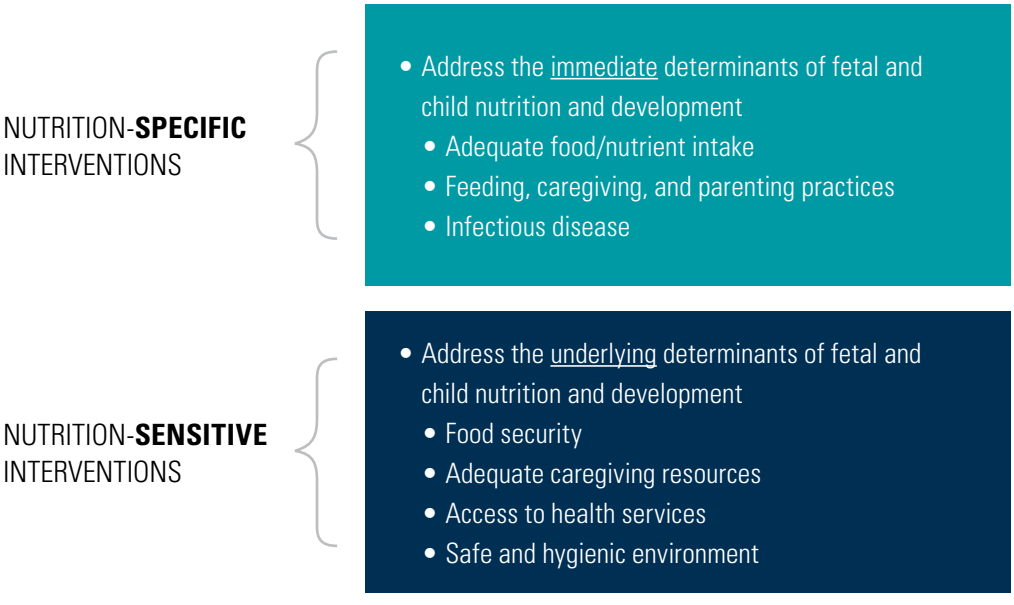
CHAPTER 2

Overview of the Framework

This document outlines a water and nutrition framework to support the rationale for and the design of operational engagements across the water sector to address early child nutrition. Nutrition interventions are characterized as either nutrition-*specific* and/or nutrition-*sensitive* (figure 2.1). Nutrition-specific interventions address the *immediate* determinants of fetal and child nutrition and development (adequate food and nutrient intake, feeding, caregiving, and parenting practices, and infectious disease). Nutrition-sensitive interventions address the *underlying* determinants (food security, safety nets, early child development and education, access to health services, and a safe and hygienic environment) (Ruel and Alderman 2013). Thus, this framework describes the role of nutrition-sensitive investments across the water sector, including water supply, sanitation, and hygiene (WASH), water resources management, and irrigation.

FIGURE 2.1

Types of Nutrition Interventions



Source: Adapted from Scaling Up Nutrition[4] and Shekar et al. 2017.

4. For more information about the movement, see the Scaling Up Nutrition (SUN) website at https://scalingupnutrition.org.

The framework paper proceeds as follows: Chapter 3 begins with a background on the range of water and nutrition challenges facing the world today, followed by how water insecurity in its various forms influences early child nutrition through three underlying forces that lead to stunting in chapter 4. Chapter 5 looks at the role of diagnostics in identifying exposure and risk profiles and how these can inform the prioritization, design, and targeting of interventions. Chapter 6 reviews the governance and policy environment that supports a role for water in nutrition and vice versa and provides examples of global-, institutional-, and national-level policies and governing bodies that have enabled synergies between water and nutrition. Chapter 7 outlines the contents of two companion guidance notes on how to design and evaluate water investments and interventions where improving nutrition in vulnerable populations is a specific objective. Chapter 8 profiles four water and nutrition engagements supported by the World Bank and its partners to demonstrate how these recommendations have been put into action. Finally, chapter 9 concludes with recommendations for advancing water and nutrition policy.

CHAPTER 3

Background on Water and Nutrition Challenges

Childhood stunting is a persistent global development challenge with severe, irreversible effects beyond short stature. It is an indicator of compromised health that interferes with the body's ability to fight off disease and perform basic biological functions (Dewey and Begum 2011). Stunting is also a marker of significant interruptions during critical stages of cognitive development. The brain is deprived of energy that goes toward building basic neural infrastructure needed for acquiring good motor, learning, and socioemotional skill sets to succeed in life (Kar, Rao, and Chandramouli 2008). Stunting is considered the greatest risk factor for increased mortality and morbidity and is responsible for 2.2 million deaths per year and more than a third of the disease burden for children younger than 5 (Black et al. 2008). Stunted children are likely to perform worse in school, have higher rates of school dropout, and go on to earn lower wages compared with their healthy counterparts (Alderman, Hoddinott, and Kinsey 2006; Dewey and Begum 2011; Hoddinott et al. 2008).

Micronutrient deficiencies are another form of undernutrition caused by a lack of intake, absorption, or use of essential vitamins and minerals. Iron deficiency anemia is the most common nutritional deficiency in the world and is highly prevalent in low- and middle-income countries (LMICs). Iron can be absorbed through diet, but undernutrition can inhibit its absorption. Blood loss and inflammation as a result of infections related to water supply, sanitation, and hygiene (WASH), including malaria, acute respiratory infections, diarrhea, and hookworm infection (Stoltzfus et al. 1996), are a major cause of anemia (Weiss and Goodnough 2005). If left untreated, this can lead to chronic conditions that include poor fetal development, delayed cognitive development, higher risk of infection, fatigue, weakness, dizziness, and drowsiness.

Addressing undernutrition is a complex challenge requiring more than nutrition interventions alone. It is estimated that a core set of proven nutrition interventions implemented at 90 percent coverage in high-burden countries would still only decrease global stunting rates by 20 percent (Shekar et al. 2017). Similarly, interventions that focus on dietary intake alone, such as iron supplementation, have resolved fewer than half of the burdens of childhood anemia globally (Stoltzfus, Mullany, and Black 2002).

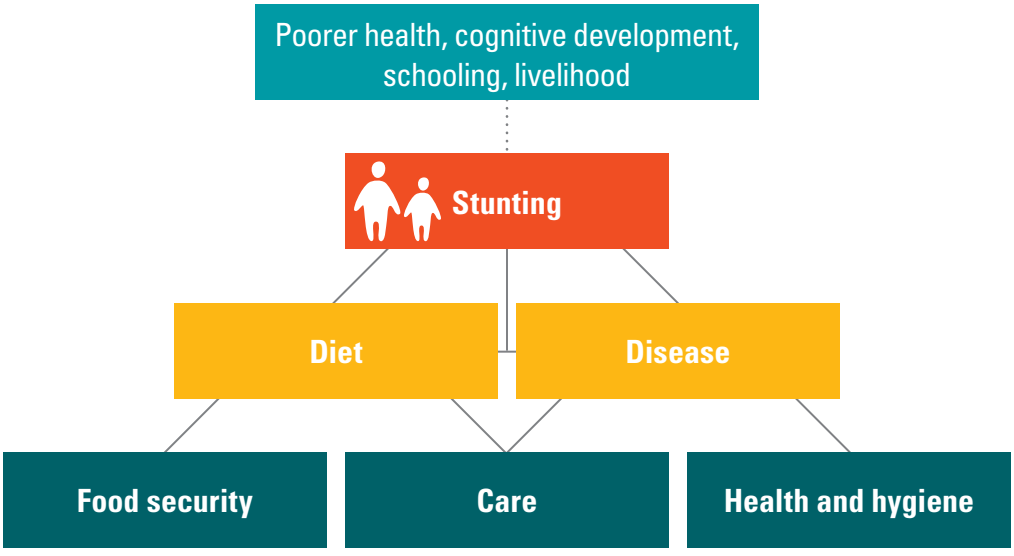
Although inadequate dietary intake and disease are the direct causes of stunting and undernutrition, poor diet and disease are caused by multiple underlying factors (figure 3.1). These include food insecurity, poor childcare practices, low maternal education, lack of access to health services, unsafe water and sanitation, and poor hygiene practices. Political, cultural, social, and economic factors likewise play a role.

The global demand for water is projected to increase between 30 and 50 percent by 2050 (Damania et al. 2017). At the same time, water is becoming increasingly scarce as a result of climate change, urbanization, population growth, and poor management of water resources. Water insecurity could drastically affect the way water is used in the future to sustain livelihoods, provide basic services for human well-being, and support economic activities and development. For example, parts of Asia and Africa are projected to lose as much as 6 percent of gross domestic product (GDP) by 2050 as a result of losses in agriculture, health, incomes, and property (World Bank 2016).

We outline three dimensions of water security through which the risks and impacts will be felt most strongly in the future: *water quantity,* adequate supply of water resources; *water quality,* water resources free of contamination; and *water accessibility,* reliable availability to all people, economies, and ecosystems (figure 3.2).

FIGURE 3.1

Adapted UNICEF Conceptual Model, 1990



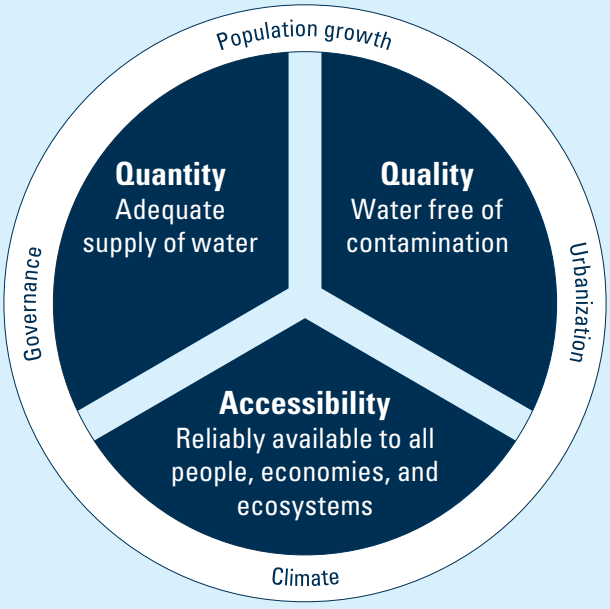
Water Quantity—An Adequate Supply of Water

The supply of water is finite. Although it is a renewable resource, current practices of overuse and unsustainable withdrawal in some areas, coupled with increasingly unpredictable rainfall patterns and changes in water flows because of climate change, make resource recharge more uncertain. India and China, for instance, are now estimated to extract groundwater 56 and 25 percent faster than it can be replenished, respectively (Rasul and Sharma 2016). Today, agriculture accounts for 70 percent of freshwater withdrawal, making it the largest consumer of water (Khokhar 2017). But farmers now must contend with decreasing freshwater availability and higher demand for water from other sectors. One of these is energy, which is projected to consume 85 percent more water by 2035 (World Bank 2016). Moreover, the demand for water for domestic consumption and

FIGURE 3.2

Dimensions of Water Security

Water security is the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.



Source: UN-Water 2013.

industry is increasing, especially in less developed regions as incomes rise and populations continue to grow. Current estimates suggest that high fertility and population growth in some parts of the world will have a greater impact on water availability than climate change.

Water Quality—Water Free of Contamination

The declining quality of water resources is a significant contributor to water stress. Contamination is both naturally occurring and caused by human activity, and it includes industrial waste, fertilizers, pesticides, sewage, heavy metals, and salt, among others. Data suggest that the quality of freshwater resources has degraded globally, particularly in regions of Africa, Asia, and Latin America. For example, the United Nations Environment Programme (UNEP) estimates that between 1990 and 2010, fecal coliform bacteria and organic pollution has worsened in more than half of all river stretches in Africa, Asia, and Latin America, and salinity intrusion has worsened in nearly a third (2016). Rising temperatures and more aggressive water cycles from a changing climate will exacerbate the environmental fate of contaminants.

Water Accessibility—Reliable Availability to All People, Economies, and Ecosystems

The accessibility of water resources by populations, economies, and ecosystems is a third dimension of water security. Governance over water resources and the efficacy of institutions that hold responsibility for management of water resources are key determinants of water accessibility and strong predictors of the stability and resilience of water resources in response to political and environmental shocks. Water- and fecal-borne disease outbreaks, transboundary water disputes, ecosystem degradation, drought, flood, and famine are all symptoms of the mismanagement of water (Sadoff, Borgomeo, and de Waal 2017).

The Sustainable Development Goals (SDGs) to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture (SDG2) will not be achieved without careful attention to safe and sustainable availability of water supply and sanitation for all (SDG6). Safe drinking water and improved sanitation and hygiene are key contributors to end various forms of undernutrition. The productivity and sustainability of agricultural systems rely on the quantity and quality of water supply though water and related agroecosystems embedded in sustainable landscapes are keystones of sustainable agriculture. Indeed, a comprehensive assessment on the link between water and nutrition illustrates that progress cannot be achieved in isolation and that there is a need for the water and nutrition sectors to formulate joint policy and programmatic approaches—considering interdependencies and synergies where they exist—to achieve more rapid progress and better outcomes.

CHAPTER 4

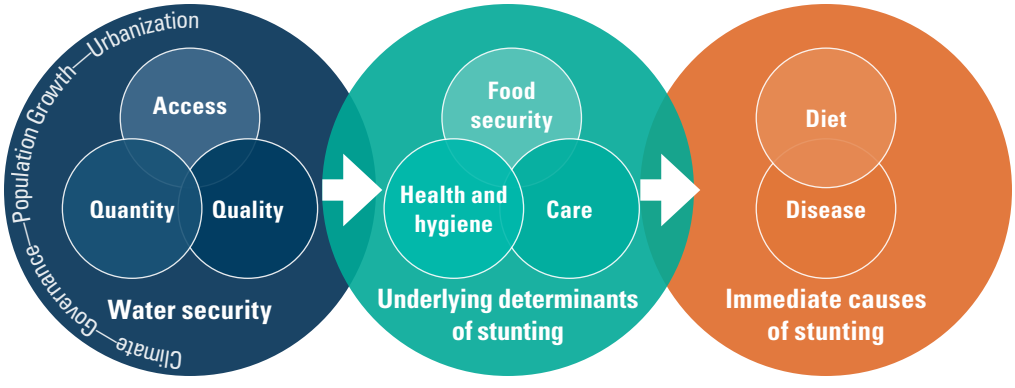
A Framework for Linking Water Security and Nutrition

Grounded in the quantity, quality, and accessibility dimensions of water security, the framework centers on three pathways through which water influences nutrition outcomes, supported by the United Nations Children's Fund (UNICEF) conceptual model of the determinants of childhood undernutrition (figure 4.1). Although other nutrition and food security frameworks have been adopted, the UNICEF model is one of the few that articulates the various intermediate and underlying causes of undernutrition and recognizes the need for a multisectoral response to improve nutrition outcomes.

The framework outlines the intricate role that water plays in each of three underlying determinants of undernutrition: (a) health and hygiene, where water determines disease environments and thus the ability to physically *utilize* nutrients for healthy growth; (b) food security, where water impacts the supply of food and nutrients that people have access to in their homes; and (c) care, where the influence of water on livelihoods indirectly affects nutrition through income, time, and education of caregivers. Finally, we address the challenges of water-related conflict and water resources in the context of fragility, which cuts across each of these underlying determinants. It is important to note, as this framework illustrates, water security alone will be insufficient to largely impact stunting. Evidence shows these impacts are best achieved when children have access to a full range of nutrition-related inputs, such as a supportive care environment, food security, access to health care, and a hygienic living environment. Countries that attain

FIGURE 4.1

Water to Undernutrition Pathway



adequate levels of each of the underlying determinants of nutrition have significantly lower levels of undernutrition compared with countries that have reached adequate levels in just one determinant (World Bank 2018a).

Water, Health, and Hygiene

Key Messages

- **Water security is essential for the practice of good hygiene behaviors and maintenance of sanitary environments to block pathways of fecal exposure.** The convenience of water collection, the quantity of water available for consumption, and the microbial and chemical quality of water supply are each linked to health and hygiene. Extreme water-related events such as droughts and flooding exacerbate water insecurity and its subsequent health and hygiene effects.
- **Exposure to water- and fecal-borne pathogens causes a variety of health ailments that are associated with undernutrition.** Diarrheal disease, soil-transmitted helminth infections, and environmental enteric dysfunction (EED) cause the body to dispel nutrients or limit intake and absorption of nutrients.
- **Water security influences health and nutrition beyond infectious disease.** Heavy metals such as arsenic and lead found in water supply can impact cognitive and physical development. Water collection burdens are also associated with injury, high caloric expenditure, violence, and mental stress.

Water insecurity threatens the ability of families and communities to practice good hygiene. The World Health Organization (WHO) estimates that an average of 20 liters per capita of water per day are needed to take care of basic hygiene needs and basic food hygiene. Yet average daily per capita domestic water consumption ranges between 4 and 15 liters in some of the least-developed countries (Sorenson, Morssink, and Campos 2011). Critical hygiene behaviors like handwashing, which is one of the most cost-effective interventions for reducing the global burden of disease (Cairncross and Valdmanis 2006), are dependent on the availability of water. Many modern sanitation technologies rely on water for the treatment and disposal of human waste. Although there are on-site sanitation technologies that are waterless (for example, pit latrines), depending on installation, materials, maintenance, and hydrogeological factors, these can degrade the microbial quality of groundwater through leaching, inadequate treatment, and unsafe disposal (Graham and Polizzotto 2013). Water security is also central to strong health systems and achieving quality of health care services under universal health coverage targets. Highly contagious infections like tuberculosis, pneumonia, Ebola, and cholera need to be controlled using stringent hygiene and waste management practices.

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Water insecurity is also characterized by extreme water-related weather events such as droughts or floods that hinder the practice of good hygiene and exacerbate the spread of infectious disease. Droughts cause households to ration water supply, with water for drinking and hygiene being the least prioritized (Sorenson, Morssink, and Campos 2011). Households are also more likely to store water during times of drought, which creates breeding grounds for mosquitoes or increases contamination of drinking water (Clasen and Bastable 2003). Dry spells may cause water supply systems to become dysfunctional, leading households to revert to unimproved water sources (Tucker et al. 2014).

Flood events have similar consequences. In most countries, the incidence of diarrheal disease spikes during the rainy season (Hashizume et al. 2008). Standing water caused by floods can mix with sewage and other effluents, increasing the population of disease-causing vectors.

Diarrheal disease is perhaps the most well-documented consequence of poor sanitation, drinking water quality, and hygiene practices. Recent analysis estimates that 58 percent of diarrheal disease is a result of poor water supply, sanitation, and hygiene (WASH), causing an estimated 842,000 deaths in 2012 (Prüss-Üstün et al. 2014). However, the overall disease burden from poor WASH is much broader. For example, protozoa and helminths that live in feces are transmitted to humans through infected water and soil, and standing water serves as a breeding ground for malaria and dengue-carrying mosquitoes.

These WASH-related exposures lead to infections, which in turn lead to anemia, undernutrition, stunted growth, and impaired physical and cognitive development. Individuals suffering from diarrheal disease lose fluids, nutrients, and their overall energy and appetite during episodes, placing them at high risk of undernourishment (Guerrant et al. 2013). Intestinal worms and mosquito-borne illness can also drain nutrients, leading to anemia. Pregnant women with helminth infections are at higher risk for preterm delivery and low birthweight of newborns, which increases the infants' chances of being undernourished throughout their childhood (Dreyfuss et al. 2000).

Some enteric infections caused by poor WASH may be asymptomatic. Repeated exposure to pathogens found in feces may be one of the primary causes of EED, which is characterized by inflammation and physical deformation of the small intestine. This limits the ability to absorb and retain essential nutrients, despite not having any outward symptoms such as diarrhea (Humphrey 2009; Prendergast and Kelly 2012). EED is difficult to diagnose because of its complex pathogenesis and limitations in testing methods but is found to be most prevalent in areas with poor WASH conditions (Guerrant et al. 2013).

An important caveat is that infectious disease and undernutrition have a cyclical relationship, making it difficult to disentangle cause and effect. Those who are undernourished have compromised immunity, making them more susceptible to infections and greater loss of nutrients (Caulfield et al. 2004). The mediating role of immunity in the WASH and nutrition relationship is particularly amplified for children in the first 1,000 days of life, a critical and vulnerable stage of growth and development, when children ages 2 and younger are most in need of good nutrition. It is during this stage that children living in low- and middle-income countries (LMICs) have the highest incidence of diarrhea. Chronic diarrhea in children living in LMICs during their first two years of life is estimated to have an 8-centimeter shortfall in height and 10 IQ-point decrement by the time they are ages 7 to 9 (Guerrant et al. 2013). This could be a result of interactions between nutritional deficits and gut infections that cause physical changes to the gut, a naïve immune system, or greater exposure to risks as a result of eating, exploratory, and play behaviors (George et al. 2015; Kotloff et al. 2013; Natchu and Bhatnagar 2013).

Although most of the literature linking water security and nutrition is mediated through infectious disease, emerging research on groundwater quality shows that heavy metals and minerals in water are associated with metabolic disorders, diabetes, and overall nutritional status. For example, though naturally occurring, arsenic in drinking water has been shown to have direct consequences on cognitive development and early childhood development outcomes (Haque, Joseph, and Moqueet 2017), and it is also linked to impaired growth in utero and low birthweight (Huyck et al. 2007). Industrial and agricultural pollution also introduces contaminants into water resources from pesticides, fertilizers, drug residues, and hazardous waste, which impacts ecosystems and human health (Mateo-Sagasta et al. 2017).

Groundwater may also be an important source of macrominerals (Naser et al. 2017). Mineral intake during pregnancy can affect the health and nutritional status of a mother, leading to adverse birth outcomes such as low birthweight and infant death (Shammi et al. 2019). A possible but empirically unexplored link between water collection and nutrition is the amount of physical energy exerted by water carriers and possible stress endured during trips. Injuries, harassment, and micronutrient deficiencies from high caloric expenditure are overlooked even though all are negative outcomes of well-being from household water insecurity (table 4.1). A survey carried out in urban Ghana found that women spent more hours fetching water during times of drought and reported a higher incidence of general sicknesses. A systematic review of studies of water-fetching finds that the task of collecting water places physical and mental stress on female water carriers, including increased risk of injury, micronutrient deficiency, and gender-based violence (Geere et al. 2018).

Water and Food Security

Key Messages

- **Water security is associated with each dimension of food security: availability, access, stabilization, and utilization of food.** Water can affect the way the human body physically utilizes food through reduced health. It is also a direct input for stable agricultural productivity and food distribution.
- **Water security and food production have a bidirectional relationship.** Food systems are threatened by declining availability and quality of water resources, whereas agricultural activity can diminish the quantity and quality of water resources.

Food security is a complex challenge that spans issues of health, environmental sustainability, and poverty (Prichard 2016). The concept of food security has evolved over time in recognition of the fact that food security is not simply about producing enough food to supply minimum daily calorie requirements. More recent definitions place people at the center and include availability, access, stabilization, and utilization of food, whereby access considers the economic and social ability to obtain food; availability reflects the supply of safe and nutritious food; stabilization refers to the constancy of the other dimensions; and utilization includes the ability for individuals to consume and use nutrients. According to the Food and Agriculture Organization (FAO) of the United Nations,

TABLE 4.1

Water Security Links to Health and Hygiene

Water security dimensions	Links to health and hygiene
Quantity	• Adequate amount of water for drinking/cooking and practicing good sanitation and personal hygiene (for example, trachoma caused by inadequate quantities of water for hygiene)
Quality	• Drinking water free of fecal pathogens and chemical contaminants (for example, diarrhea and enteric infections caused by exposure to fecal pathogens) • Recreational waters free of pollution (for example, schistosomiasis)
Accessibility	• Water is reliably available, well-maintained, and resilient to climate-related shocks (for example, flooding causes spikes in mosquito-borne illnesses and diarrhea)

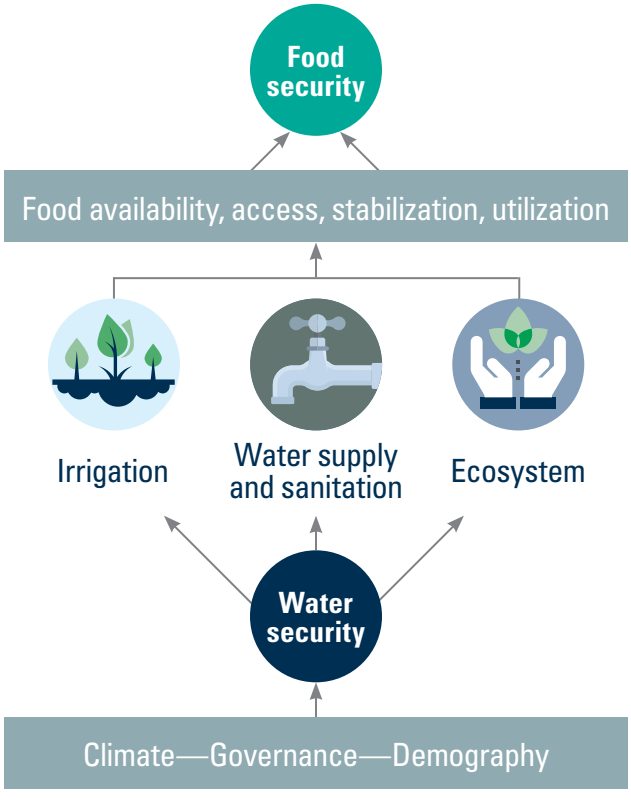
food security is achieved "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (2002).

Water relates to each of these dimensions of food security, either directly or indirectly (figure 4.2) (Cumming 2016). For example, the health and hygiene pathway described previously highlights how water insecurity impacts utilization of food—by interrupting the body's capacity to physically retain and absorb nutrients when suffering from diarrhea and other enteric infections. Water also affects availability and access to food as a direct input into agricultural productivity and food distribution, whereas the stability of food is affected by water management practices and infrastructure such as irrigation and storage.

The role of water for cultivation of cereal crops is a prime example of the significant impact that water insecurity can have on feeding the world's population. The Green Revolution is largely credited as enabling countries to overcome food deficits and famine, mainly through the increased

FIGURE 4.2

Water and Food Security



production of three cereal crops: maize/corn, wheat, and rice. Although the global population doubled over the period of the Green Revolution (between 1950 and the late 1960s), the production of these cereal crops tripled with only a 30 percent increase in land area cultivated (Pingali 2012). Today, cereal crops provide at least 50 percent of all calories to the world (Awika 2011). Particularly in Asian countries, innovations in irrigation played a critical role in the success of the Green Revolution by allowing farmers to be less reliant on rainfall for growing cereal crops.

Increased production of cereals was a cheap way to meet basic global food availability requirements, but there are challenges to sustaining progress in part because of declining water security. Irrigation withdrawals will need to increase by 11 percent by 2050 to meet the global food demand, which is projected to increase by 70 percent (FAO 2008). Yet global water availability for agriculture is projected to decrease by 18 percent over the same period, given the increasing demands from other sectors, the effects of climate change, and water needs for maintaining sustainable environmental flows (Strzepek and Boehlert 2010). A model by Lloyd et al. (2011) estimates that the effect of climate change on crop yields alone will increase the prevalence of stunting by 23 percent in Sub-Saharan Africa and 62 percent in South Asia by 2050.

Water security will also dictate the quality of the available food supply. Although the expansion of irrigation during the Green Revolution enabled a significant increase in the quantity of food produced, the crops that were cultivated were not necessarily nutrient-dense. On the contrary, the diversity of crops and the production of nutrient-dense crops like vegetables and legumes declined, which in turn may have decreased dietary diversity for poor rural households. More recent efforts targeting private and smallholder farmers with irrigation and agricultural inputs is seen as a way to encourage crop diversity, but the effectiveness of this approach on dietary diversity and nutrition is still unknown (Sibhatu, Krishna, and Qaim 2015).

Human activities disrupt ecosystems and threaten the ability to draw on these for food and nutritional needs. Biological, industrial, and other naturally occurring contaminants that are exacerbated by human activity impact downstream ecosystems and biodiversity and the safety of food produced, while at the same time compromising agricultural productivity and food diversity. Salinity intrusion is estimated to affect as much as 20 percent of all irrigated land, leading to farmers adapting by growing only salt-tolerant crops (Qadir et al. 2014). The presence of enteric pathogens in produce has been extensively linked to irrigation and floodwater. With increased consumption, large-scale production, and more efficient distribution of fresh produce, a greater number of food-borne illness outbreaks have been reported in recent years (Olaimat and Holley 2012). Although contamination can occur at any point along the food distribution chain, preharvest environmental conditions are increasingly recognized as having greater importance.

Water security links to food security are summarized in table 4.2.

Water and Care

Key Messages

- **Nurturing care of a fetus during pregnancy and throughout early childhood supports healthy development.** Caregivers need to provide access to good health care, adequate nutrition, responsive caregiving, safety and security, and opportunities for early learning and stimulation.
- **Water insecurity limits the ability of caregivers to create nurturing environments for early child growth and learning.** Water insecurity affects caregiving practices through impacts on time use, educational attainment, mental and physical health, and livelihoods.
- **Water insecurity and care are intrinsically linked with gender inequities.** Water insecurity disproportionally affects women and girls.

Nurturing care refers to an environment that enables children to have healthy growth and development to reach their full potential into adulthood (WHO 2018b). Early childhood development specialists identify five components of nurturing care:

1. **Good health:** Monitoring children's physical and emotional condition, practicing good hygiene, and seeking appropriate care and treatment
2. **Adequate nutrition:** Good health and nutrition during pregnancy, breastfeeding, and complementary feeding practices and diet

TABLE 4.2

Water Security Links to Food Security

Water security dimensions	Links to food security
Quantity	• Adequate supply of water for growing crops (for example, access to irrigation for cereal crops)
Quality	• Water free of contaminants that threaten the safety of crops (for example, fecal-contaminated irrigation supply that spreads *Escherichia coli* in produce)
Accessibility	• Irrigation water is reliably available, well-maintained, and resilient to climate-related shocks (for example, food shortages during times of drought)

3. **Responsive caregiving:** Building trust and social relationships
4. **Safety and security:** Protecting children from environmental hazards and conflict
5. **Opportunities for early learning:** Stimulation that supports skills development

Each of these depends on the economic resources, physical and mental health status, time, autonomy, and education of caregivers.

Water insecurity influences caregiving practices through impacts on time, educational attainment, mental and physical health, and livelihoods (figure 4.3). Lack of access to WASH facilities in home, schools, and workplaces are barriers to accessing education and employment opportunities. Service disruptions translate into more time spent collecting water. Reduced agricultural yields caused by drought lead to fewer resources available for health and nutrition inputs. These water-related challenges are magnified in fragile and conflict environments.

Water collection falls disproportionately on women and girls, especially in LMICs. In some water-scarce countries, water collection can be a round trip of more than an hour. This has huge opportunity costs for women and families. Having a more convenient and safe water source would free up time

FIGURE 4.3

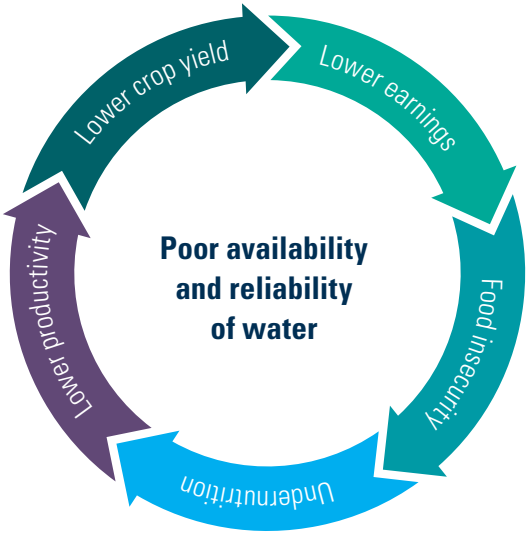
Water Insecurity and Care

that would have been spent on fetching and treating drinking water for schooling, productive activities, and caregiving—all essential inputs for better nutrition. Girls in coastal areas of Bangladesh, for example, were 12 points less likely to be enrolled in school and six points more likely to be tasked with water-fetching responsibilities in water-insecure areas affected by salinity intrusion (World Bank 2018b). Lack of access to WASH facilities in schools may also be a barrier to education, especially for females. A randomized controlled trial in Kenya found that the provision of a water treatment, hygiene, and sanitation program in primary schools showed a 58 percent reduction in the odds of school absence for girls compared with their control counterparts (Freeman et al. 2011).

Poor-quality services also result in a higher occurrence of water- and sanitation-related illness, with associated effects on schooling and cognitive achievement. For example, a study in Bangladesh shows that infants growing up in communities with low levels of sanitation were 11 points more likely to delay enrollment in primary school (World Bank 2018b). Water and sanitation insecurity in the home has also been associated with reported school absences (Dreibilbis et al. 2013), whereas improved sanitary conditions in early life are associated with better cognitive achievement (Spears and Hammer 2016). Furthermore, women who were born during periods of below-average rainfall grew up to be less educated (Damania et al. 2017). Frequent disease episodes caused by poor water and sanitation further robs women of the time to engage in productive activities, as they are often tasked with caring for ill family members.

FIGURE 4.4

Water, Undernutrition, and Agricultural Productivity



Lack of water for growing crops or feeding livestock reduces the amount of income that can be used toward household nutrition inputs, such as purchase of nutrient-dense food, health, and WASH services. Floods inflict damage on agricultural land, impacting productivity and land asset values. Farmers that lack reliable access to water supply through irrigation may be excluded from growing "high-economic value" crops.

Water insecurity may set in motion a vicious cycle, whereby poor availability and reliability of water results in lower crop yields and earnings, which leads to food insecurity and undernutrition and lower household productivity (figure 4.4). Several studies have demonstrated a link between poor health and nutritional status of agricultural households, productivity, crop yield, and income (Deolaikar 1988; Haddad et al. 1991; Strauss 1986).

Improvements in agricultural productivity do not always translate into improved nutrition but including women in agricultural decisions may encourage behaviors that lead to better household nutrition (Bertri et al. 2004). Female farmers may choose to grow crops with higher nutritional value to feed their families. Women may also be more likely to spend extra income on education, health, and food inputs for the household (Malapit et al. 2015; Straboni et al. 2014).

Water security links to adequate care are summarized in table 4.3.

TABLE 4.3

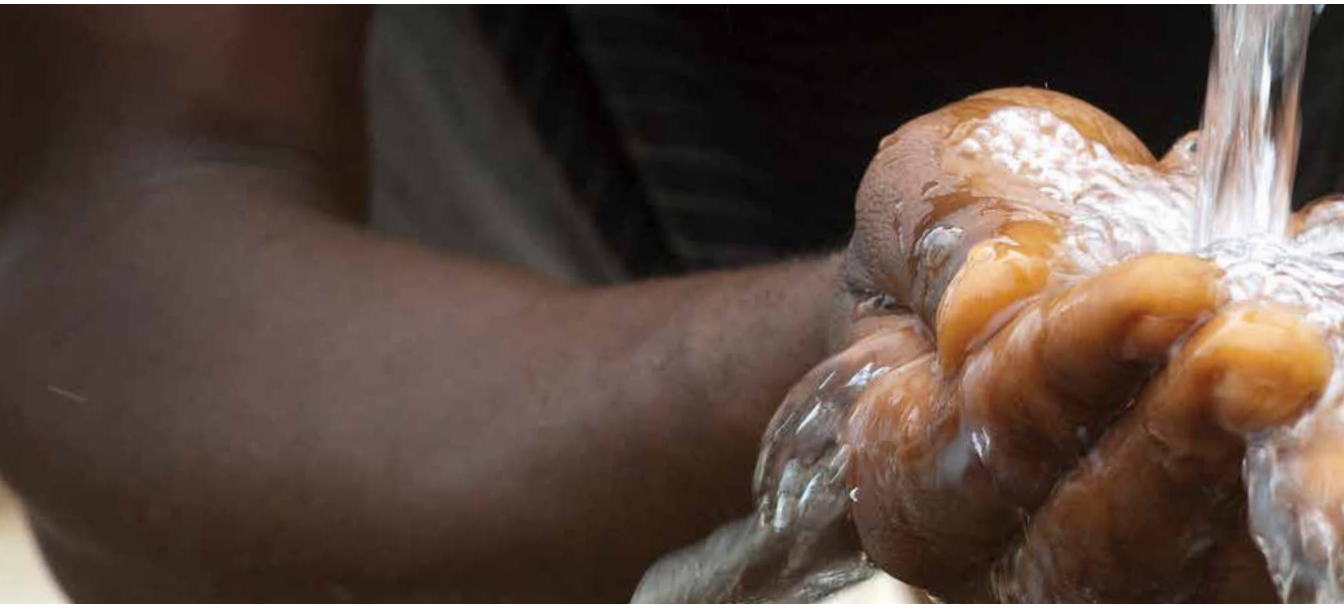
Water Security Links to Adequate Care

Water security dimensions	Links to adequate care
Quantity	• Adequate supply of water for caregiving practices (for example, available water used for consumption, hygiene, and food preparation)
Quality	• Water free of contaminants that make household members sick or inhibit cognitive development (for example, arsenic exposure through drinking water causing cognitive damage)
Accessibility	• Convenient and reliable access to water supply (for example, opportunity costs of water collection)

Water and Fragility: Interactions with Nutrition

There are various links between water and nutrition in situations of fragility, conflict, and violence (FCV). For example, Sadoff et al. (2017) describe the ways in which fragility and water interact to include (a) failure to provide services, (b) failure to protect from water-related disasters, and (c) failure to preserve surface, ground, and transboundary water resources (see box 4.1). In many fragile settings, two or more of these failures are present. In humanitarian settings, where population movement is in constant flux, it is more difficult to plan for long-term infrastructure, resulting in services that are informal, unreliable, and often costlier.

Water insecurity in fragile contexts is associated with worse nutrition outcomes (Sadoff et al. 2017), with the risks to nutrition manifested through each of the failures described above. For example, WASH is critical for survival in the first phase of many emergencies and for resilience in succeeding phases. People affected by humanitarian crises, such as natural disasters, or who are displaced by conflict are generally at a much higher risk of illness and death from disease. Inadequate access to WASH infrastructure, as well as poor and crowded living conditions, exacerbate this risk, increasing susceptibility to diarrheal and infectious diseases transmitted by the fecal-oral route as well as by vectors associated with poor sanitation, waste management, and drainage. Recent analysis finds that children younger than 5 are 20 times more likely to die from diarrheal disease than from direct violence in fragile and conflict areas (UNICEF 2019).



BOX 4.1

Water Insecurity and Nutrition in Yemen

Efforts to preserve the Republic of Yemen's water resources have been piecemeal and hindered by strong economic interests, political sensitivities, and weak state authority (Hales 2010). As in other fragile contexts where elites have used their power to capture mineral resources and rents, large landowners and political elites in the Republic of Yemen have captured scarce water resources and suitable agricultural land to invest in cash crops, most notably qat (Ward 2014). Qat is a mild stimulant consumed by an estimated one in three Yemenis that has no nutritional value and whose cultivation consumes more than half of the country's water resources (Lichtenhaeler 2010). In a country where about 50 percent of children younger than 5 are stunted and 40 percent are underweight (World Bank 2015), limiting qat cultivation and reforming agricultural water use are a priority for food security and poverty reduction and for preserving adequate, sustainable water resources (World Bank 2007). Yet attempts to curtail further expansion of qat cultivation and regulate water use in agriculture have been met with resistance because of strong vested interests (Lichtenhaeler 2010). This failure to preserve water resources is a critical element in perpetuating water insecurity, contributing to malnutrition and gender inequality and triggering conflict in the Republic of Yemen.

Source: Sadoff et al. 2017.

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CHAPTER 5

Diagnostics

There is an urgent need to improve water-related services for enhancing nutrition outcomes for children. However, the level of need varies across countries, subnational levels, and socioeconomic status. At the same time, resources are limited. To support countries achieving water security and improved nutrition, evidence on where to target these scarce resources can be a valuable tool for decision making.

Diagnostic Tools to Prioritize, Target, and Design Investments

This section outlines several approaches that have been used to inform decisions about how to prioritize among multiple interventions when addressing a multisectoral outcome like stunting, where to target investments, and how to design interventions to address the needs of the beneficiary population.

How to Prioritize Interventions

The United Nations Children's Fund (UNICEF) Synergies Analysis developed by the Poverty Global Practice analyzes household survey data to describe inadequacies across four key dimensions of child undernutrition: food security; childcare practices; health; and water supply, sanitation, and hygiene (WASH) for the population of children younger than 5 in a given country. Regression analysis is used to identify "binding constraints" to reducing malnutrition, as well as potential interactions or synergies among the four dimensions. The analysis also reveals levels of inadequacy across these dimensions that is useful for targeting purposes. The level of the analysis depends on the underlying survey data. In most cases, the analysis uses Demographic and Health Surveys (DHS), which are representative at the national, regional, and sometimes subnational levels. Disaggregation is also possible by socioeconomic status and rural residence.

The Link Nutrition Causal Analysis, developed by Action Against Hunger, takes the UNICEF causal framework for undernutrition a step further to understand locally relevant multisectoral causes of undernutrition, including water-related factors. It combines both qualitative and quantitative research methods and synthesizes these results to make program design recommendations. The method requires access to either secondary data or primary data collection on undernutrition status and known risk factors. Qualitative methods are incorporated to address questions regarding how or why undernutrition or good nutrition occurs and to consider the interactions between causes, common feedback loops, and the evolution of these causes over time, seasonally, and after recent shocks. Finally, the information is triangulated and reviewed using a participatory

process to generate consensus on the local causes of undernutrition and program design. Completed studies are currently available for 35 locations in 25 countries.[5]

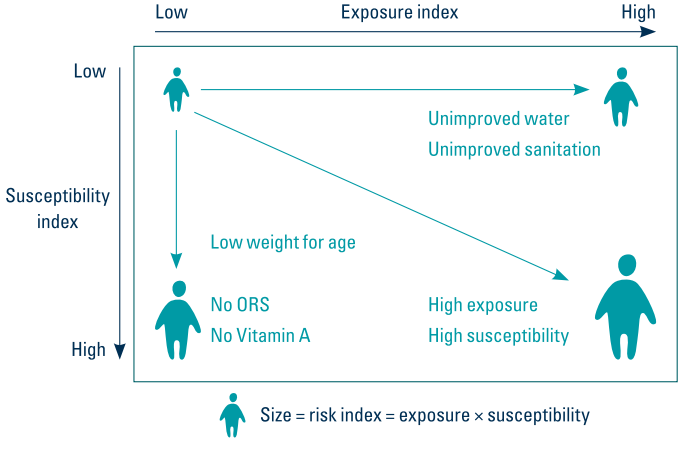
A simplified approach to identifying priority areas for stunting reduction involves identifying thresholds for underlying drivers, below which stunting prevalence is estimated to be higher than average. This was done in the 2016 Global Nutrition Report (IFPRI 2016). The thresholds are estimated for the underlying drivers by fitting a line to a cross-plot of stunting and each of the underlying drivers using data from all available countries. In the analysis presented in the Global Nutrition Report, for example, countries with less than 76 percent coverage of improved sanitation and 69 percent coverage of improved water corresponded to a predicted stunting prevalence of greater than 15 percent. These thresholds can identify which of the underlying drivers have the widest gap in a country and how this varies by socioeconomic status, region, or residence (rural or urban).

Where to Target Investments

For water sector investments to maximize impacts on health and nutrition outcomes, they should be targeted to populations most at risk for disease. The WASH Risk Model was developed to estimate where and for whom the impact of WASH may be the greatest. The approach uses data from the DHS to model overall risk of diarrheal disease and death based on exposure to poor

FIGURE 5.1

Conceptual Framework of Susceptibility, Exposure, and Overall Risk Indexes



Source: Rheingans et al. 2016.
Note: ORS = oral rehydration solution.

5. Completed studies and detailed guidelines on conducting a Link Nutrition Causal Analysis are available at http://www.linknca.org.

WASH and a child's ability to cope with illness, such as nutritional status, vitamin A supplementation, and access to oral rehydration solution (figure 5.1).

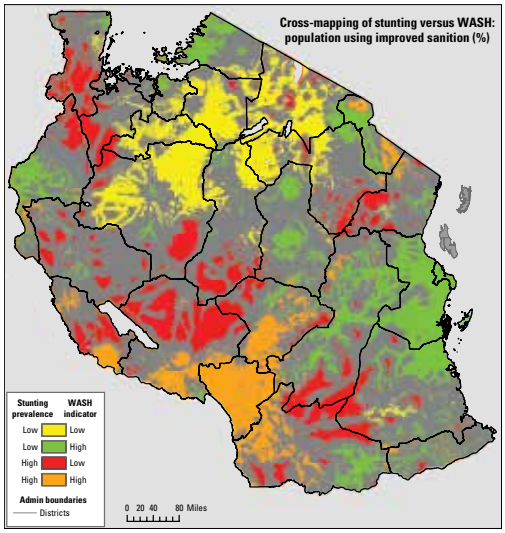
The model can be generated at subnational level, depending on representativeness of DHS data, by socioeconomic status and separately for girls and boys to inform where project investments could have the greatest impact.

Simple diagnostics showing patterns of risks (for example, poor sanitation) and outcomes (for example, childhood stunting), though not describing causal relationships, can be used to guide the targeting of policy and investments aimed at reducing childhood burden of disease. The WASH Poverty Diagnostic in Tanzania produced geospatial maps (map 5.1) to illustrate the cross-section of sanitation (panel a), water supply (panel b), and stunting. Areas marked in red highlight where access to improved sanitation is low and stunting and/or poverty levels are high. These maps were produced using DHS data along with a national survey on water and sanitation access. The maps have been instrumental in dialogue with the Tanzanian government to identify target areas for WASH investments under the Rural Water Supply and Sanitation Program-for-Results operation.

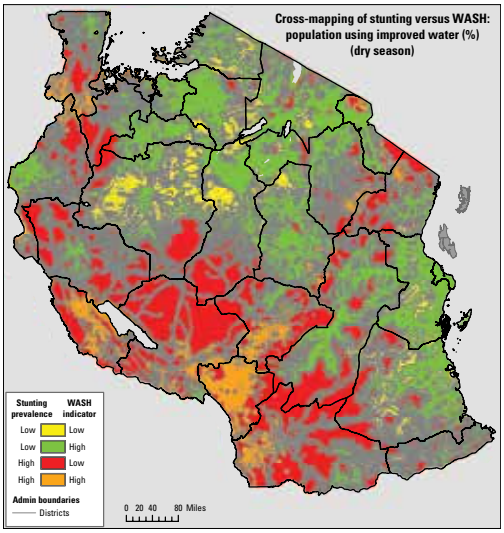
MAP 5.1

Cross-Mapping of Water Supply and Sanitation with Child Stunting

a. Sanitation and stunting



b. Water supply and stunting



Source: World Bank 2017.
Note: WASH = water supply, sanitation, and hygiene.

How to Design Interventions

More granular data are often necessary to enhance the design of nutrition-sensitive projects. This may include information on levels of stunting and prevalence of micronutrient deficiencies; rainfall patterns and occurrence of rainfall shocks; groundwater availability; existing and potential water storage capacity; seasonal production and income patterns; access to productive resources such as land, water, market infrastructure, and availability of diverse foods; access to drinking water and sanitation; and the presence of other sectors or programs in the area.

These data are often available through routine, large-scale household surveys such as DHS,[6] Multiple Indicator Cluster Surveys (MICS),[7] and Household Consumption and Expenditure Surveys (HCES).[8] These surveys are representative at the national, regional, and sometimes subnational levels, with more detailed data accessible through the Statistics Office in some countries. Routine monitoring and information systems can be a good source of project-level data in some countries. If resources permit, baseline surveys can be conducted in the project area as part of preparation.

Several indicators for nutrition-sensitive project design and the source of data for these indicators are shown in table 5.1.[9]

Water, Health, and Stunting in Sub-Saharan Africa

The diagnostics in this section provide a visual snapshot of water-related factors associated with childhood stunting and related health outcomes across Sub-Saharan Africa. Additionally, because one of the key drivers of future water scarcity is population growth, particularly in this area, we present analyses showing patterns of fertility and water availability, which help identify hotspots in the region that warrant further investigation to understand trends across time, variation in these relationships at subnational levels, and potential underlying drivers.

The scope of the analyses presented here is limited to Sub-Saharan Africa because of a high burden of childhood stunting, rising water insecurity, and poor performance on WASH access there. For example, in 2015, the coverage of improved sanitation was 28 percent on average, compared with 68 percent globally. Rates of open defecation were 23 percent compared with 12 percent globally, and improved drinking water coverage was 58 percent compared with 89 percent globally.[10]

6. For more information, see https://dhsprogram.com/.
7. For more information, see http://mics.unicef.org/.
8. The World Bank Microdata Catalog has the most comprehensive set of data from HCES at http://microdata.worldbank.org. For more information, see http://surveys.worldbank.org/lsms.
9. The International Dietary Data Expansion Project provides information on food security-related indicators at https://inddex.nutrition.tufts.edu/data4diets/indicators.
10. Data are from the Household Data Database, WHO/UNICEF Joint Monitoring Programme [Accessed on October 29, 2018], https://washdata.org/data/household.

TABLE 5.1

Data Sources for Baseline Project Diagnostics

Indicator	Definition	Source of data
Stunting prevalence	Percentage of children younger than 5 falling below minus two standard deviations (moderate and severe) from the median height-for-age of the reference population.	UNICEF aggregates data from household surveys such as DHS and MICS by country for analyses on stunting prevalence. Disaggregated data by wealth quintile, mother's education, and subnational estimates are also available.
Coverage of basic and safely managed drinking water and sanitation	Drinking water services refers to the accessibility, availability, and quality of the main source used by households for drinking, cooking, personal hygiene, and other domestic uses. Sanitation services refer to the management of excreta from the facilities used by individuals through emptying and transporting excreta for treatment and eventual discharge or reuse. Improved sanitation facilities are those designed to hygienically separate excreta from human contact. The JMP subdivides the population using improved sources into three groups according to the level of service provided: limited, basic, and safely managed.	The JMP monitors WASH at the household level globally and allows for disaggregated analyses by rural and urban areas, subnational regions, and wealth quintiles. Data are analyzed from various household surveys including the DHS, MICS, HCES, and so on.
Coverage of basic and limited hygiene	Households that have a handwashing facility with soap and water available on the premises will meet the criteria for a basic hygiene facility. Households that have a facility but lack water or soap will be classified as having a limited facility and distinguished from households that have no facility at all.	The JMP monitors WASH at the household level globally and allows for disaggregated analyses by rural and urban areas, subnational regions, and wealth quintiles. Data are analyzed from various household surveys including the DHS, MICS, HCES, and so on.

table continues next page

TABLE 5.1 (CONTINUED)

Data Sources for Baseline Project Diagnostics

Indicator	Definition	Source of data
Rainfall patterns and occurrence of rainfall shocks	Gridded precipitation data at between 5 and 250 kilometers resolution and hourly/monthly frequency based on ground station or satellite data.	HCES and especially LSMS-Integrated Surveys on Agriculture (currently administered only in Sub-Saharan Africa[a]). Data are at the household level and can be disaggregated for various levels of analyses.
Total renewable groundwater availability	The sum of the internal renewable groundwater resources and the total external renewable groundwater resources.	Aquastat data allows for national comparisons.
Access to productive capital (agricultural land, large and small livestock, fish pond, farm equipment, and so on)	Household- or farm-level (crop and livestock) indicators on access to land, seeds, fertilizer, water for irrigation, and so on.	HCES and LSMS-Integrated Surveys on Agriculture include information on access to land, water, and other farm inputs often disaggregated by gender.
WEAI	The WEAI captures women's empowerment across several different domains including decision making on agricultural production, access to and control over productive resources, control over income, community leadership, and time allocation. A shorter, streamlined version of the WEAI—A-WEAI—was developed to simplify the index and shorten interview time while still maintaining cross-cultural applicability.	Baseline survey
Household adequacy of fruit and vegetable consumption	A household-level indicator based on individual daily intake of 400 grams of fruits and vegetables (or the equivalent of five servings). Provides a measure of diet quality and can be used to understand diet patterns.	HCES data Analyses can be disaggregated to analyze patterns between regions, income groups, and subpopulations.

table continues next page

TABLE 5.1 (CONTINUED)

Data Sources for Baseline Project Diagnostics

Indicator	Definition	Source of data
Micronutrient intake (vitamin A and iron-rich foods)	This indicator measures consumption of vitamin A and iron-rich foods in the past 24 hours for children ages 6 to 23 months.	DHS data Analyses can be disaggregated to analyze patterns between regions, income groups, and subpopulations.
Market-level food diversity score	The number of distinct foods or food groups available in a local market at a given point in time.	Baseline market survey
Minimum dietary diversity for women	This indicator measures the proportion of women ages 15 to 49 who consumed food from five food groups during the previous day.	HCES in some countries include these data, which can be disaggregated to analyze patterns between regions, income groups, and subpopulations.
IYCMAD	One of eight core indicators assessing IYCF practices developed by the WHO, it is a composite indicator based on minimum dietary diversity and minimum meal frequency.	DHS, HCES, and MICS data Analyses can be disaggregated to analyze patterns between regions, income groups, and subpopulations.

Note: A-WEAI = abbreviated Women's Empowerment in Agriculture Index; DHS = Demographic and Health Surveys; HCES = Household Consumption and Expenditure Surveys; IYCF = infant and young child feeding; IYCMAD = infant and young child minimum acceptable diet; JMP = WHO/UNICEF Joint Monitoring Programme; LSMS = Living Standards Measurement Study; MICS = Multiple Indicator Cluster Surveys; UNICEF = United Nations Children's Fund; WASH = water supply, sanitation, and hygiene; WEAI = Women's Empowerment in Agriculture Index.

a. Data available for Burkina Faso, Ethiopia, Malawi, Mali, Niger, Nigeria, Tanzania, and Uganda.

Sub-Saharan Africa also has one of the highest levels of chronic undernutrition and adverse health outcomes globally—WASH-related deaths accounted for 15 percent of all deaths and 16 percent of global burden of disease in 2004, and an estimated 32 percent of children younger than 5 was stunted in 2018. Children born in Sub-Saharan Africa are 12 times more likely to die before age 5 compared with children in high-income countries (Watkins 2016). A large proportion of these deaths are a result of preventable causes including diarrhea and pneumonia, both of which are associated with WASH access (Liu et al. 2015).

Moreover, the region has the highest annual population growth rate (United Nations 2015) and is expected to have the largest number of people younger than 24 years by 2050 (Sow 2018). The population in the region is expected to continue to increase with a current fertility rate of 4.9 compared with the global average of 2.5. The consequent population growth implies growing demands for water in a region where the average water availability is 13,091 cubic meters per inhabitant per year

compared with a global average of 19,248 cubic meters per inhabitant per year. Although the average water stress level in Sub-Saharan Africa is only 3.4 percent today, compared with 12.8 percent globally, population growth, combined with overburdened water systems, weak governance structures, mismanagement of resources either because of corruption or low capacity, and low investment in infrastructure, among others, suggests that water scarcity could be an issue in the future.

The data used in this section come from multiple sources. Table 5.2 presents these indicators with the definition and data source.

TABLE 5.2

Hotspot Analysis Indicators, Definitions, and Data Source

Categories	Indicator	Definition	Data source
WASH	Improved sanitation	Improved sanitation is one "that effectively separates excreta from human contact and ensures that excreta do not re-enter the immediate household environment." Access to a flush toilet, a ventilated improved pit latrine, a pit latrine with slab, or a composting toilet would be considered an improved sanitation facility if it is not shared with other households.	JMP for Water Supply, Sanitation, and Hygiene
WASH	Open defecation	Open defecation refers to the practice of defecating in fields, forests, bushes, bodies of water, or other open spaces.	JMP for Water Supply, Sanitation, and Hygiene
WASH	Improved drinking water	An improved water source is one that is piped into the dwelling, yard, or plot; comes from a public tap or standpipe; comes from a tube well or a borewell; comes from a protected well or spring; or is rainwater.	JMP for Water Supply, Sanitation, and Hygiene
WASH	Piped improved drinking water	A piped improved drinking water source is one that is "piped into dwelling, yard or plot, and protected from outside contamination, especially from fecal matter."	JMP for Water Supply, Sanitation, and Hygiene
WASH	Basic handwashing facility	A basic handwashing facility is one where households have a handwashing facility with soap and water available on the premises.	JMP for Water Supply, Sanitation, and Hygiene

table continues next page

TABLE 5.2 (CONTINUED)

Hotspot Analysis Indicators, Definitions, and Data Source

Categories	Indicator	Definition	Data source
Water	Water availability	The total renewable freshwater resources per capita is defined as the total annual actual renewable water resources in cubic meters per inhabitant per year.	FAO
Water	Water stress	Freshwater withdrawal (both primary and secondary) as a proportion of net available freshwater resources.	FAO
WASH	Child feces disposal	Children's stools are considered to be disposed of safely if the child used a toilet or latrine or if the fecal matter was put/rinsed into a toilet or latrine. Until 2015, the indicator was for children younger than 5; after 2015, it is reported for children younger than 2.	USAID DHS Program
Health	Stunting prevalence	UNICEF defines stunting as the number of children younger than 5 falling below minus two standard deviations (moderate and severe) from the median height-for-age of the reference population/children younger than 5 in the surveyed population.	UNICEF-WHO-The World Bank Global Database on Child Growth and Malnutrition
Health	Diarrheal death rate per 100,000	Number of deaths attributable to diarrheal disease (acute watery, acute bloody, and persistent).	IHME
Health	Diarrheal DALY rate per 100,000	DALYs are a composite metric of mortality and morbidity (ill health or disability) and measure the overall disease burden—in this case, for diarrhea.	IHME
Fertility	Fertility rate	The UNFPA defines total fertility rate as the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year.	UNFPA

Note: DALY = disability-adjusted life year; DHS = Demographic and Health Surveys; FAO = Food and Agriculture Organization of the United Nations; IHME = Institute for Health Metrics and Evaluation; JMP = WHO/UNICEF Joint Monitoring Programme; UNFPA = United Nations Population Fund; UNICEF = United Nations Children's Fund; USAID = United States Agency for International Development; WASH = water supply, sanitation, and hygiene; WHO = World Health Organization.

Map 5.2 shows the distribution of sanitation coverage (panel a) and open defecation (panel b) with levels of stunting. Benin, Chad, Democratic Republic of Congo (DRC), Eritrea, Ethiopia, Liberia, Madagascar, Niger, Sierra Leone, and South Sudan stand out as countries with both low levels of sanitation and high levels of stunting. Angola, Lesotho, and Mozambique have high levels of open defecation and stunting. On the other hand, Ghana is among the countries with the lowest levels of improved sanitation where levels of stunting are less than 20 percent. This suggests that other factors could be more important for driving improvements in childhood nutrition outcomes.

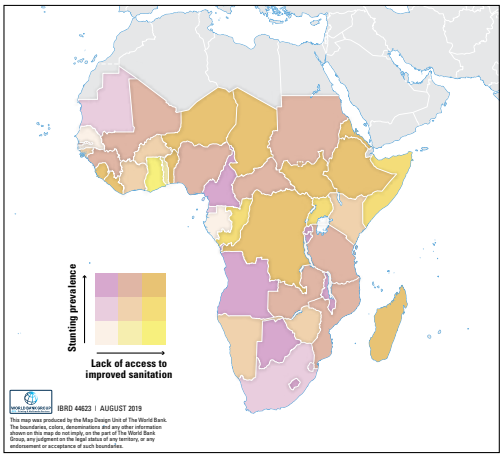
Although childhood stunting rate in Sub-Saharan Africa is 32 percent, on average, stunting rates in Burundi, Eritrea, and Madagascar are 50 percent or more.

Map 5.3 shows the distribution of stunting alongside improved drinking water coverage (panel a) and piped coverage (panel b). Countries with the lowest levels of coverage of improved drinking

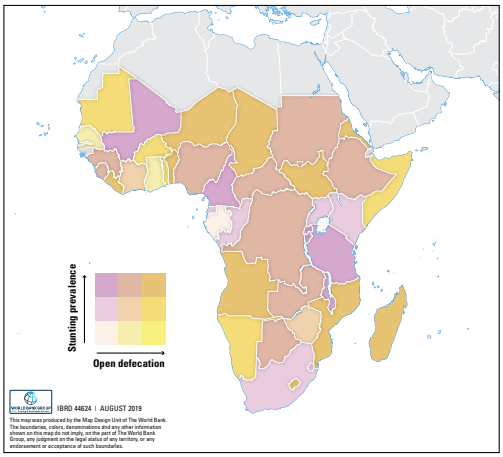
MAP 5.2

Relationship between the Percentage of Improved Sanitation Coverage and Open Defecation and Stunting Prevalence in Sub-Saharan Africa

a. Improved sanitation coverage



b. Open defecation

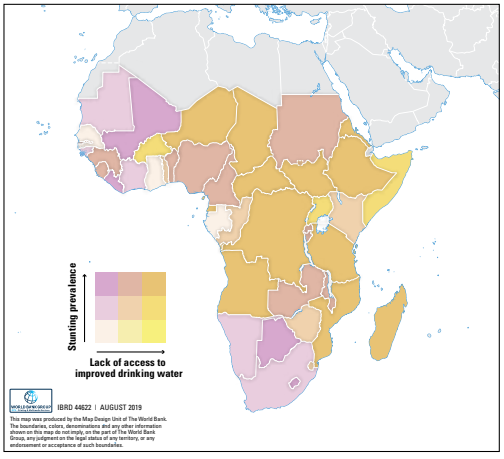


Sources: Household Data Database, WHO/UNICEF Joint Monitoring Programme [Accessed on October 29, 2018], https://washdata.org/data/household; Global Database on Child Growth and Malnutrition (Stunting 2018), UNICEF-WHO-The World Bank [Accessed on October 29, 2018], https://www.who.int/nutgrowthdb/database/en/.
Note: Stunting categories: <20%, 20%–30%, >30%. Lack of access to improved sanitation (IS) coverage categories: <61.4%, ≥61.4% and <80%, ≥80%. Open defecation (OD) categories <12.05%, ≥12.05% and <30%, ≥30%.
Highest stunting and highest IS coverage: Angola, Botswana, Burundi, Cameroon, Lesotho, Malawi, Rwanda.
Highest stunting and lowest IS coverage: Benin, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, Liberia, Madagascar, Niger, Sierra Leone, South Sudan.
Highest stunting and highest OD: Angola, Benin, Chad, Eritrea, Lesotho, Liberia, Madagascar, Mozambique, Niger, South Sudan.
Highest stunting and lowest OD: Burundi, Cameroon, the Comoros, Malawi, Mali, Rwanda, Tanzania.

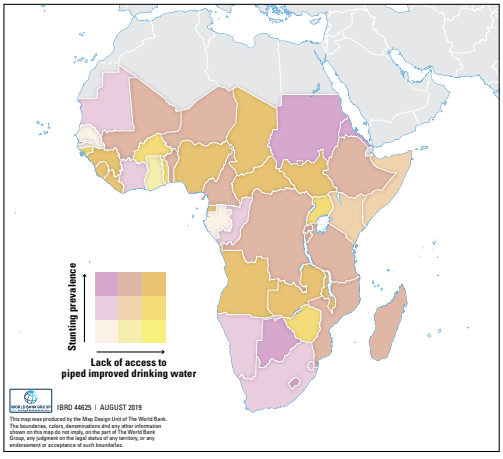
MAP 5.3

Relationship between Total and Piped Improved Drinking Water Coverage and Stunting Prevalence in Sub-Saharan Africa

a. Total improved



b. Piped improved



Source: Household Data Database, WHO/UNICEF Joint Monitoring Programme [Accessed on October 29, 2018], https://washdata.org/data/household.
Note: Stunting categories: <20%, 20%–30%, >30%. Lack of access to improved drinking water (IDW) categories: <31%, ≥31% and <45%, ≥45%. Lack of access to piped IDW categories: <58%, ≥58% and <70.5%, ≥70.5%.
Highest stunting and highest IDW coverage: Botswana, the Comoros, Lesotho, Liberia, Mali.
Highest stunting and lowest IDW coverage: Angola, Central Africa Republic, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, Madagascar, Mozambique, Niger, South Sudan, Sudan, Tanzania.
Highest stunting and highest piped IDW coverage: Botswana, the Comoros, Eritrea, Lesotho, Mali, Sudan.
Highest stunting and lowest piped IDW coverage: Angola, Central Africa Republic, Chad, Guinea, Liberia, Malawi, Nigeria, Sierra Leone, South Sudan, Zambia.

water and highest levels of stunting include Angola, Central Africa Republic, Chad, DRC, Eritrea, Ethiopia, Madagascar, Mozambique, Niger, South Sudan, Sudan and Tanzania. Lack of access to piped water supply and stunting also coincide in Angola, Central Africa Republic, Chad, Guinea, Liberia, Malawi, Nigeria, Sierra Leone, South Sudan, and Zambia.

WASH behaviors are important determinants of child health and nutrition outcomes (George et al. 2016), and they complement WASH infrastructure such as improved sanitation and drinking water supply. For example, a recent study in Mozambique found that children in households that practice unsafe disposal were 0.6 centimeters shorter nationally and 0.8 centimeters shorter in urban areas (World Bank 2018c). On average, 15 percent of households in Sub-Saharan African countries have basic handwashing facilities in 2015—the lowest level among all regions. Of those with basic handwashing facilities in Sub-Saharan Africa, three out of five lived in urban areas (JMP 2017). An estimated 47 percent of households safely dispose of child feces in the region.

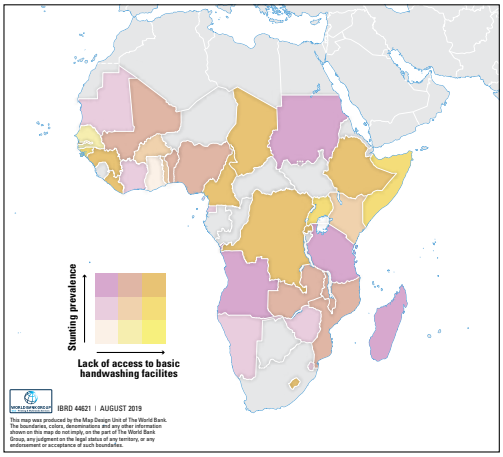
Map 5.4 illustrates the coverage of basic handwashing facilities (panel a) and child feces disposal (panel b) along with levels of stunting in the region. Of the 35 countries for which data are available, those with the lowest coverage of basic handwashing facilities and highest levels of stunting are Cameroon, Chad, DRC, Ethiopia, Guinea, Lesotho, Liberia, and Rwanda. Child feces are least likely to be disposed of safely in Angola, Benin, Chad, Ethiopia, Liberia, and Niger—where levels of stunting are highest.

Although levels of water stress are low on average for Sub-Saharan Africa, indicating low levels of freshwater withdrawal as a percentage of available freshwater resources, there are wide variations. For example, Sudan has a water stress level of 94 percent with freshwater availability of 940 cubic meters per inhabitant per year. This compares to 3.4 percent and 13,091 cubic meters per inhabitant per year on average for the region as a whole. As described previously, water stress and rainfall shocks in particular are risk factors for childhood stunting.

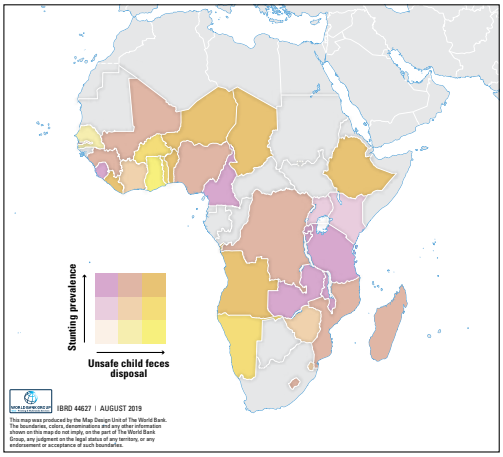
MAP 5.4

Relationship between Basic Handwashing Facility and Child Feces Disposal and Stunting Prevalence in Sub-Saharan Africa

a. Basic handwashing facility



b. Child feces disposal



Sources: Demographic and Health Surveys, United States Agency for International Development [survey years ranging from 2006–07 to 2016–17], https://www.dhsprogram.com; Household Data Database, WHO/UNICEF Joint Monitoring Programme [Accessed on October 29, 2018].
Note: Stunting categories: <20%, 20%–30%, >30%. Access to basic handwashing facility categories: <83.5%, ≥83.5% and <90.35%, ≥90.35%. Unsafe child feces disposal categories: <32.2%, ≥32.2% and <60%, ≥60%.
Highest stunting and highest handwashing facilities: Angola, Madagascar, Sudan, Tanzania.
Highest stunting and lowest handwashing facilities: Cameroon, Chad, Democratic Republic of Congo, Ethiopia, Guinea, Lesotho, Liberia, Rwanda.
Highest stunting and highest rate of child feces safely disposed: Burundi, Cameroon, the Comoros, Malawi, Rwanda, Sierra Leone, Tanzania, Zambia.
Highest stunting and lowest rate of child feces safely disposed: Angola, Benin, Chad, Ethiopia, Liberia, Niger.

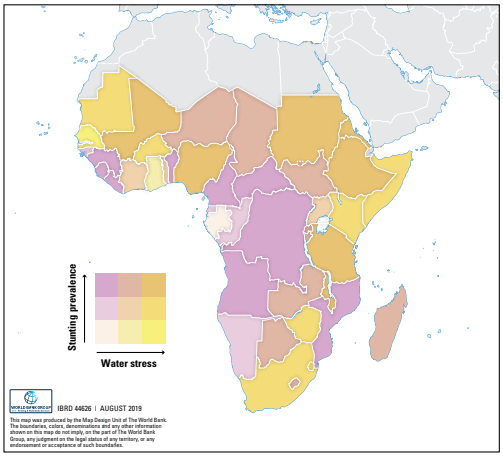
Map 5.5 illustrates the distribution of water stress (panel a) and freshwater availability (panel b) and levels of stunting for countries across Sub-Saharan Africa. Eritrea, Ethiopia, Malawi, Mali, Nigeria, Sudan, and Tanzania stand out as experiencing both the highest levels of water stress and the highest levels of stunting.

Countries that face water stress today will be at even greater risk in future decades given rapid population growth in Sub-Saharan Africa. This is especially the case in countries that already face elevated levels of water stress such as Burkina Faso, Mali, Nigeria, Somalia, and Tanzania, where fertility is currently more than five children per woman. These maps (map 5.6) illustrate the urgency of addressing water challenges in these countries, where the combination of water insecurity, population growth, and low levels of human capital create foretell a silent emergency.

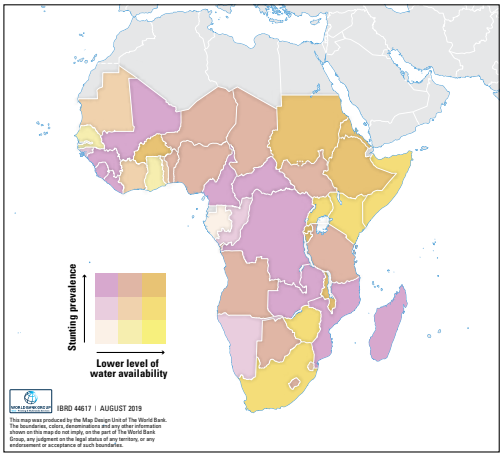
MAP 5.5

Relationship between Water Stress and Water Availability and Stunting Prevalence in Sub-Saharan Africa

a. Water stress



b. Water availability

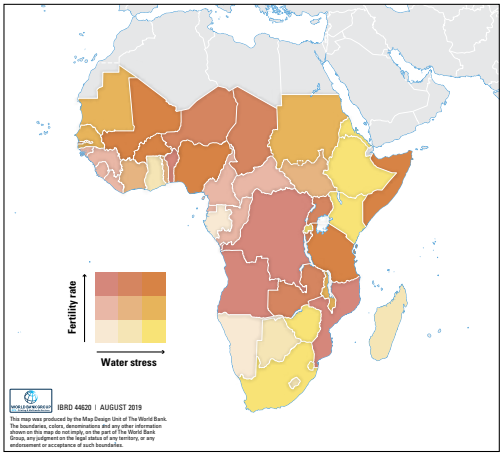


Source: Food and Agriculture Organization [Accessed on April 15, 2019] http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en.
Note: Stunting categories: <20%, 20%–30%, >30%. Water stress (WS) thresholds: <1%, ≥1% and <5.8%, ≥5.8% net available freshwater resources. Water availability (WA) thresholds: <1,550, ≥1,550 and <6,000, ≥6,000 cubic meters per inhabitant per year.
High stunting and highest WS level: Eritrea, Ethiopia, Malawi, Mali, Nigeria, Sudan, Tanzania.
High stunting and lowest WS level: Angola, Benin, Cameroon, Central African Republic, Democratic Republic of Congo (DRC), Guinea, Liberia, Mozambique, Sierra Leone.
High stunting and highest WA level: Cameroon, Central African Republic, DRC, Guinea, Liberia, Madagascar, Mali, Mozambique, Sierra Leone, Zambia.
High stunting and lowest WA level: Burundi, the Comoros, Eritrea, Ethiopia, Lesotho, Malawi, Rwanda, Sudan.

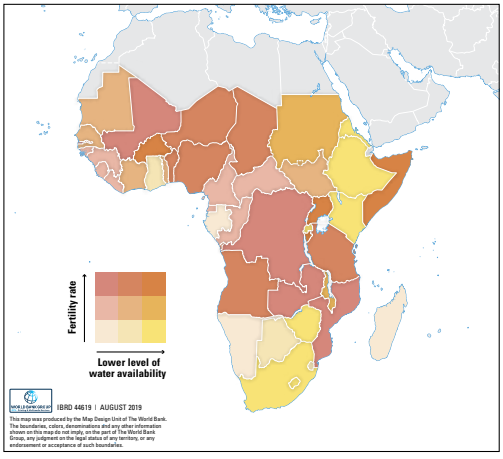
MAP 5.6

Relationship between Water Stress and Water Availability and Fertility Rate (Births per Woman) in Sub-Saharan Africa

a. Water stress



b. Water availability



Source: World Bank Databank [Accessed on April 9, 2019] https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?end=2017&locations=ZG&most_recent_year_desc=false&start=1989.
Note: Fertility rate categories: <4.5, ≥4.5 and <5, ≥5. Water stress (WS) thresholds: <1%, ≥1% and <5.8%, ≥5.8%. Water availability (WA) thresholds: <1,550, ≥1,550 and <6,000, ≥6,000.
Highest fertility rate and highest WS level: Burkina Faso, Mali, Nigeria, Somalia, Tanzania.
Highest fertility rate and lowest WS level: Angola, Benin, Democratic Republic of Congo (DRC), Mozambique.
Highest fertility rate and highest WA level: DRC, Mali, Mozambique, Zambia.
Highest fertility rate and lowest WA level: Burundi, Somalia, Uganda.

Several countries in Sub-Saharan Africa perform consistently poorly across the WASH, water availability, health, and fertility indicators (table 5.3). For example, Burkina Faso has the highest levels of open defecation, lowest levels of improved drinking water, highest water stress, and highest fertility rates, while Eritrea has the lowest levels of WSS access, highest water stress, and high stunting levels.

TABLE 5.3

Summary of Diagnostic Findings for Sub-Saharan Africa

Country	Lowest access to improved sanitation	Highest open defecation	Lowest access to improved drinking water	Lowest access to piped water
Angola		✓	✓	✓
Benin	✓	✓		
Botswana				
Burkina Faso		✓	✓	✓
Burundi				
Cabo Verde				
Cameroon				
Central African Republic			✓	✓
Chad	✓	✓	✓	✓
Comoros				
Congo, Dem. Rep.	✓		✓	
Congo, Rep.	✓			
Côte d'Ivoire				
Equatorial Guinea			✓	
Eritrea	✓	✓	✓	
Ethiopia	✓		✓	
Gabon				
Gambia, The				
Ghana	✓			
Guinea				✓
Guinea-Bissau				✓
Kenya				
Lesotho		✓		

	Lowest access to basic hand-washing facilities	Lowest stools safely disposed	Highest water stress	Lowest water availability	Highest stunting prevalence	Highest fertility rate
		✓			✓	✓
		✓			✓	✓
	n.a.	n.a.			✓	
		✓	✓	✓		✓
	n.a.			✓	✓	✓
	n.a.	n.a.	✓	✓		
	✓				✓	
	n.a.	n.a.			✓	
	✓	✓			✓	✓
				✓	✓	
	✓				✓	✓
	n.a.	n.a.				
		n.a.				
	n.a.	n.a.	✓	✓	✓	
	✓	✓	✓	✓	✓	
	n.a.	n.a.				
	✓					✓
		✓				
	✓				✓	
	✓	n.a.				
			✓	✓		
	✓			✓	✓	

table continues next page

TABLE 5.3 (CONTINUED)

Summary of Diagnostic Findings for Sub-Saharan Africa

Country	Lowest access to improved sanitation	Highest open defecation	Lowest access to improved drinking water	Lowest access to piped water
Liberia	✓	✓		✓
Madagascar	✓	✓	✓	
Malawi				✓
Mali				
Mauritania		✓		
Mozambique		✓	✓	
Namibia		✓		
Niger	✓	✓	✓	
Nigeria				✓
Rwanda				
São Tomé and Príncipe		✓		
Senegal				
Sierra Leone	✓			✓
Somalia	✓	✓	✓	
South Africa				
South Sudan	✓	✓	✓	✓
Sudan				
Swaziland				
Tanzania			✓	
Togo	✓	✓		✓
Uganda	✓		✓	✓
Zambia				✓
Zimbabwe				✓

Note: n.a. = not applicable.

	Lowest access to basic hand-washing facilities	Lowest stools safely disposed	Highest water stress	Lowest water availability	Highest stunting prevalence	Highest fertility rate
	✓	✓			✓	
					✓	
			✓	✓	✓	
			✓		✓	✓
		n.a.	✓			
					✓	✓
		✓				
	n.a.	✓			✓	✓
			✓		✓	✓
	✓			✓	✓	
		✓				
			✓			
	n.a.				✓	
	✓	n.a.	✓	✓		✓
	n.a.	n.a.	✓	✓		
	n.a.	n.a.			✓	
		n.a.	✓	✓	✓	
			✓			
			✓		✓	✓
		✓				
	✓			✓		✓
					✓	✓
			✓	✓		

CHAPTER 6

Governance and Policy Framework

There is a robust policy framework for water and nutrition at the global level embodied in Sustainable Development Goals (SDGs) 2 and 6 and their associated targets. Cross-sectoral collaboration between water supply, sanitation, and hygiene (WASH) and nutrition has strengthened in recent years, owing to advances in the evidence base linking them together. Similarly, there is increasing recognition of the interdependencies between water security, agriculture, and food security, which has resulted in greater cross-sectoral dialogue. However, there remains a need for closer coordination between the water and nutrition sectors to further capitalize on the synergies between SDGs 2 and 6 and to mitigate any counteracting effects.

Global Policy and Coordination Mechanisms

Coordination at the global policy level can be achieved by working jointly across development agencies, donors, and in partnership with the United Nations. The United Nations System Standing Committee on Nutrition (UNSCN) has spearheaded an expert working group to outline the links between nutrition (SDG 2) and water (SDG 6) that will aim to drive closer coordination. In parallel, there are several global initiatives that guide these efforts, albeit with a focus on specific links. The absence of a global convening entity that considers the joint challenges, opportunities, and synergies between water security and nutrition is a limitation to a more comprehensive approach.

Sanitation and Water for All (SWA)—Launched in 2010, SWA works to achieve safe drinking water, adequate sanitation, and good hygiene practices globally. It is a partnership between governments and their development partners to coordinate and monitor progress toward SDGs, including the elimination of malnutrition and hunger through WASH activities. At the United Nations General Assembly (UNGA) in 2018, SWA organized a high-level event to discuss how countries could better invest in early childhood development through nutrition and sanitation.

Scaling Up Nutrition (SUN)—SUN was launched in 2009 after an international recognition of the growing problem of malnutrition and current systems' limited capacity to solve it. SUN calls for more attention and actions to improve maternal and child nutritional status and to embrace nutrition-sensitive approaches and interventions to tackle the underlying problem.

The Global Framework for Water Scarcity in Agriculture (WASAG)—WASAG is a partnership that was launched during the 22nd Conference of the Parties (COP 22) in November 2016, which calls for concerted efforts among role players to respond to the challenges posed by water scarcity in agriculture, which are exacerbated by climate change and a growing world

population. A working group on Water and Nutrition under WASAG aims to create awareness, capacity, and evidence on the link between water and nutrition and initiate policy dialogue between agriculture and water ministries and those in charge of nutrition.

Initiative for Food and Nutrition Security in Africa (INFA)—INFA was declared in Nairobi in 2016 and aims to end hunger and malnutrition in the region through multisectoral initiatives. One of INFA's principles is to enable synergistic impacts between various sectors including health, agriculture, water, sanitation, and hygiene. It established a framework for collaboration between African governments and stakeholders, making joint efforts for nutritional improvement in line with SDGs.

Alliance for a Green Revolution in Africa (AGRA)—Inspired by former United Nations Secretary General Kofi Annan's call for a uniquely African "green revolution" to improve small-holder farm productivity while preserving the environment, AGRA was founded in 2006 through a partnership between the Rockefeller Foundation and the Bill & Melinda Gates Foundation. It has since expanded its donor base to include governments as well as other international organizations. AGRA is an independent organization based in Africa and led by Africans. It focuses on six primary pillars: policy; agriculture enterprises with an emphasis on support for small and medium-size African businesses; inputs including seeds, fertilizers, and water; access to market opportunities; crop processing and storage; and financing.

In addition to its relationships with major multilateral investment banks including the World Bank and the African Development Bank, as well as implementing partners such as the World Food Programme, AGRA works with a wide network of private sector partners, including Bayer, Mastercard Foundation, Syngenta, and Yara International, and across partnerships at the farmer, system, and national levels to coordinate investments. In 2019, AGRA and the Global Alliance for Improved Nutrition (GAIN) announced a formal collaboration at the World Economic Forum in Davos to showcase the links between agriculture and safe, nutritious foods.

Donor Institution Policy and Coordination Mechanisms

Within donor institutions, platforms and initiatives can drive closer collaboration between water and nutrition by aligning strategic objectives, raising the profile of cross-sectoral issues, and allocating financial resources toward investments.

For example, through its Multi-Sectoral Nutrition Action Plan launched at the end of 2018, the African Development Bank aims to build what they refer to as "grey matter infrastructure"—that is, healthy brain development that ensures children benefit from education and can compete in the economy of the future. The plan aims to reduce stunting by 40 percent in the Africa region by 2025 to unlock the human and economic potential of the region. It will do so by catalyzing

nutrition-sensitive investments across five key sectors of health, agriculture, WASH, social protection, and education. It aims to achieve nutrition-sensitive investments in 50 percent of agriculture and 15 percent of WASH investments.

In the World Bank, there are several multisectoral initiatives that provide the platform for action:

- **The Human Capital Project (HCP)**—HCP was launched at the Annual Meetings in Bali, Indonesia, in October 2018. It incorporates a Human Capital Index (HCI), which includes core indicators on child survival, stunting, and educational attainment. Starting from working with 28 countries (mainly in Africa and Asia), which are the "early adopters," the World Bank Group (WBG) will ultimately support all the countries in a phased manner to prepare national strategies, accelerating the HCP's progress. The number of HCP countries has more than doubled between the Annual Meeting in Bali and the 2019 Spring Meetings, with 61 countries being activated. Top world leaders have signed an open letter to support HCP. An HCP for Africa was also launched at the Spring Meetings in 2019 and includes results indicators on reduction in open defecation, along with those for reduction in stunting. WBG has committed an additional US$1 billion for health and education in Africa in 2019.

- **The Early Years Initiative**—This initiative was launched by the Human Development Practice Group in 2016 to spur investments in direct and indirect interventions that support children in the first 1,000 days to reach their full potential, with the physical, cognitive, and socioemotional capacities to learn, earn, innovate, and compete. In total, WBG sees 27 countries across the world as having great potential opportunities to contribute to scale-up of key interventions. Twenty-one countries are in the first wave, and 12 are in the second. A net commitment of US$2.9 billion has been invested in nutrition-sensitive WASH projects across the world.

- **Global Financing Facility (GFF)**—GFF was launched at the Conference on Financing for Development in Addis Ababa in July 2015 as part of a global conversation about how to finance the SDGs. It empowers the governments of low- and lower-middle-income countries to transform how they prioritize and finance the health and nutrition of children, women, and adolescents. Since its creation, GFF has been supporting 27 countries in Africa, Asia, and Latin America to solve their high maternal, newborn, and child mortality problems. Currently, 67 countries are eligible to receive GFF assistance. A total of US$1.005 million was pledged by donors in 2018. It was expected to link an additional contribution of US$7.5 billion from International Development Association (IDA)/ International Bank for Reconstruction and Development (IBRD) of the World Bank Group to tackle the problem.

BOX 6.1

"Recipe for Success": A Review of Integration of WASH and Nutrition in Policy

Integration of water supply, sanitation, and hygiene (WASH) into policy is essential to end chronic undernutrition. In WaterAid's The Recipe for Success: How Policy-makers Can Integrate Water, Sanitation and Hygiene into Actions to End Malnutrition report, 10 countries were selected for assessments of how nutrition objectives and priorities were included in WASH policies and plans and how WASH objectives and priorities were included in nutrition policies and plans.

The 10 countries included Cambodia, Chad, Ethiopia, Ghana, the Lao People's Democratic Republic (PDR), Mali, Namibia, Niger, Nigeria, and Zimbabwe. Of these, Cambodia, Niger, and Zimbabwe demonstrated the strongest integration of WASH in nutrition plans. Few policies and plans that were assessed prioritized WASH for nutrition outcomes as demonstrated by a specific objective. WASH interventions in nutrition plans frequently mentioned either infrastructural or behavioral components, but not both. Moreover, WASH-related ministries were infrequently involved in the development of nutrition plans and policies.

On the other hand, WASH policies and plans nearly always neglected the importance of nutrition integration. And though most WASH policies and plans did not include nutrition goals, some included nutrition-sensitive objectives—for example, prioritizing health centers and schools. Institutional dialogue and joint planning could potentially reinforce WASH plans to incorporate nutrition-sensitive actions.

The report identifies nine entry points for greater collaboration between the WASH and nutrition sectors:

1. Create a supportive enabling environment and institutional integration mechanisms to drive collaboration.
2. Ensure policy coherence through clearly defined roles for each stakeholder to avoid diluted responsibilities.
3. Getting the details right on what actions should be prioritized in plans can bring WASH and nutrition programs closer together.
4. Policies need to translate into concrete actions that are delivered in practice.
5. Stakeholders should collaboratively promote behavioral changes (for example, food hygiene and exclusive breastfeeding).

BOX 6.1 (CONTINUED)

"Recipe for Success": A Review of Integration of WASH and Nutrition in Policy

6. Programs should prioritize the most vulnerable population with low WASH coverage and malnutrition.
7. WASH interventions should be integrated into both undernutrition prevention and treatment.
8. The integration of WASH and nutrition should be mutually beneficial, though nutrition fundamentally depends on multiple sectors to achieve its goals and achieving WASH goals does not rely on nutrition. In this case, it is necessary to create the right incentives to work collaboratively.
9. Better understanding of the barriers to cross-sectoral work is important to strengthen future collaboration. Funding, monitoring and evaluation frameworks, and clear lines of responsibility and accountability can create incentives to work together.

Source: AAH, SHARE, WaterAid 2017

Country-Level Policy and Coordination Mechanisms

Responsibility for water services spans many sectors, and achieving positive nutrition outcomes requires coordinated action across many stakeholders, both within and beyond the water sector. This means that it is necessary to establish multisectoral platforms to enable dialogue between the main stakeholders and to develop and oversee coordinated plans of action at the country level. Experience shows that multisectoral platforms may be more effective and sustainable if they are hosted by agencies with a governance rather than a service provision role, such as planning; finance; or the office of the governor, prime minister, or president. However, it is important to instill a leadership mentality among the contributing sector stakeholders and, where possible, to identify sector champions to ensure that this dialogue translates into activities on the ground.

Country-level policy that recognizes the shared responsibility for nutrition outcomes is common for nutrition policy but is less apparent in water sector policy (box 6.1). For example, though the Lao People's Democratic Republic (PDR) National Strategy for Rural Water Supply, Sanitation and Hygiene 2019–30 draft recognizes the role of WASH services for the achievement of nutrition outcomes and emphasizes the integration and synchronization of interventions for nutrition and stunting, it does not link achievement of sectoral outcomes to health or nutrition. On the other hand, the National Nutrition Strategy to 2025 and Plan of Action 2016–2020, which aims to reduce

stunting from current levels to 25 percent by 2025 using a multisectoral convergent approach combining nutrition-specific and nutrition-sensitive interventions and leveraging common platforms, includes specific targets for WASH services in communities, households, schools, and health facilities.

It is also critical to provide fiscal incentives for the water sector to contribute to advancing nutrition outcomes, which may be viewed as the responsibility of the health sector. This implies allocating financial and human resources for water sector-related ministries to carry out nutrition-sensitive investments and activities. Public expenditure reviews in the water sector could provide an opportunity to capture current nutrition-sensitive allocations and public spending and serve as evidence to advocate for additional budget.

Finally, shared outcomes like nutrition are ideally measured and monitored through information systems that can be harmonized across multiple sectors. This avoids the problems of differences in definitions and duplicated efforts. Importantly, these data should then be accessible to users in other sectors so they can be used to target investments (such as to high stunting areas) and to monitor select health and nutrition outcomes that cannot be attributed to a particular project or intervention.

CHAPTER 7

Program Design and Operations

The current body of knowledge on the impacts of water on nutrition outcomes provides important clues on ways that water sector investments can be designed to achieve greater impacts on nutrition. It is necessary to enhance current approaches to service delivery and water management because these have mainly been designed with more upstream outcomes in mind, such as improvements in access and use for water and sanitation services and improvements in availability of food and income for irrigation investments. It is also necessary to identify ways to coordinate with other sectors to help ensure that children receive all the necessary nutrition inputs that lead to better outcomes, not only water-related inputs.

A companion guidance note on nutrition-sensitive water supply, sanitation, and hygiene (WASH) summarizes the evidence of direct impacts of WASH improvements on child stunting and the indirect effects through five pathways of (a) diarrhea, (b) gut health, (c) protozoa and helminth infections, (d) anemia, and (e) time use. Evidence along these pathways can inform the design of nutrition-sensitive WASH interventions.

Similarly, a guidance note on nutrition-sensitive irrigation and water management presents evidence for the effects of irrigation and water management on nutritional outcomes through four pathways of (a) food production, (b) income, (c) water supply, and (d) women's empowerment and recommends a series of enhancements for irrigation and water management operations.

Although evidence is growing, the potential for water investments to affect nutrition outcomes, especially through irrigation and water management, has not been fully explored. Building this evidence base requires enhancing existing monitoring and evaluation efforts to capture impacts along the key pathways to nutrition outcomes. Each guidance note presents a set of results framework indicators to support nutrition-sensitive monitoring and evaluation in lending operations.

CHAPTER 8

Profiles of Four Nutrition-Sensitive Water Engagements

There are many examples of water sector investments that have been designed with an aim to improve nutrition outcomes. Below are four engagements across irrigation, water management, and water supply and sanitation (WSS) that include nutrition as a key aim of the project to help demonstrate the range of opportunities.

Mozambique Sustainable Irrigation Development Project (PROIRRI)

The World Bank and the Japanese government collaborated for more than five years to support the Mozambique government's Sustainable Irrigation Development Project (PROIRRI), providing about US$ 70 million in financing in addition to the US$ 5.7 million allocated by the Mozambique government and a US$ 14.2 million grant from the Japanese government, bringing the project's total investment to almost US$ 90 million. The objective of the project is to increase agricultural production and raise farm productivity with new or improved irrigation schemes in the provinces of Manica, Sofala, and Zambezia in Mozambique. The project's results framework included targets for crop yields, nutrient-dense crop choices, and established business lines for rice and horticulture crops.

Improvements in irrigation systems in the rural district of Vanduzi in the Manica Province have enabled local smallholder farmers to grow maize and vegetable crops on irrigated land. Prior to the project's investments, water collection was insufficient and could barely cover the needs of farmers, which drove some to abandon agriculture altogether and migrate to cities. In the target provinces, the project is expected to ensure irrigation over a total of 3,000 hectares—1,700 are dedicated to rice production, 800 for horticulture, and 500 for contract production. So far, more than 6,000 people have directly benefited from the project in the three provinces where it is implemented. The government has named the development of irrigation as one of its priorities for agriculture and rural development. To that end, it adopted a new national irrigation strategy, whose implementation is materializing with the interventions such as those under the PROIRRI. Three out of 15 hydrogeological basins highlighted by the irrigation strategy (Buzi, Pungué, and Zambezi) are covered by the PROIRRI intervention. Within the scope of the project, the National Irrigation Institute (INIR) benefited from institutional and capacity building to cater to its policy, strategic, and operational mandates. INIR capacities to implement its policies were also reinforced. The project also supported government institutions in the preparation of legislation for irrigation associations as well as the national irrigation plan.

USAID's Feed the Future in Tajikistan

The United States Agency for International Development (USAID) program in Tajikistan has evolved over time to bring together water and nutrition for improved food security, health, and well-being of children. From 2004 to 2014, they focused on the creation and training of members and support of water user associations (WUAs) in southern Tajikistan. Many households rely upon the abstraction of water from canal systems for household garden plots and domestic use. These canals are maintained by WUAs, but the households that abstract water from the canals are denied membership and a voice in WUAs unless their uses qualify as commercial enterprises. Water scarcity is a growing concern, and some canals run dry for months in some years, creating uncertainty for irrigators and influencing their cropping and irrigation decisions. In 2015, USAID and partners launched Feed the Future in Tajikistan, leveraging stakeholder partnerships across the health, education, and agriculture sectors; with donors; and through public-private partnerships, which (a) promote the use of evidence-based maternal, neonatal, and child health practices in the first 1,000 days between a woman's pregnancy and her child's second birthday; (b) improve the healthy behaviors and practices among adolescent girls, women, and children in their homes and communities; and (c) incorporate gender-equitable and culturally sensitive approaches that empower women to improve their health and the health of their children. Complementing their work on health outcomes, Feed the Future also established the Land Market Development Activity (LDMA), which promotes market-based principles for land tenure and aims to establish a functional agricultural land market that allows for the transferability of land use rights (such as buying, selling, or leasing land use rights) to ensure a simple and transparent land registration process while promoting gender equality in rights and processes (Horbulyk and Balasubramanya 2018).

Cambodia Water Supply and Sanitation Improvement Project

Cambodia's National Strategy for Food Security and Nutrition (NSFSN) 2014–2018 emphasizes the need for a multisectoral approach to address stunting in the country. Increasing access to water and sanitation services and improving behavior related to hygiene practices are among the objectives highlighted in the NSFSN. Recent emphasis on addressing food security and nutrition in Cambodia at the national level builds on work established in 2004 by the Technical Working Group on Food Security, Nutrition, and Social Protection (TWG-FSN&SP). In 2014, Cambodia became a member of Scaling Up Nutrition (SUN), and in the following year, the TWG-FSN&SP established a subworking group with the responsibility to integrate water supply, sanitation, and hygiene (WASH) into the nutrition agenda (sub-TWG Nutrition and WASH).

High-level consultations between the Ministry of Rural Development (MRD) and the Ministry of Health (MoH) have been instrumental for aligning WASH and nutrition elements in the national, social, and behavior change campaigns with adoption of a common delivery platform

under WASH-Nutrition subgroup facilitated by the Council for Agriculture and Rural Development (CARD).

The World Bank is supporting the government of Cambodia's efforts to reduce child stunting through two aligned projects. The Water Supply and Sanitation Improvement Project ($55 million) and the Cambodia Nutrition Project (US$ 15 million), which is focused on scaling up national response to mother and child undernutrition. Finally, the World Bank is supporting regional policy dialogue across the Mekong aimed at reducing stunting in Cambodia, the Lao People's Democratic Republic (PDR), and Myanmar.

A key component of the World Bank project support is the development of a child-centered and child-focused WASH Behavior Change Communications (BCC) Campaign package. Gaps in the Social and Behavior Change Communication (SBCC) guidelines (Hand Washing with Soap and Household Water Treatment and Safe Storage) were identified, with a key focus on children younger than 5. Formative research informed the development of a WASH-Nutrition sectorwide behavior change intervention with consistent approaches and messages. By creating a national umbrella brand that can unify WASH-Nutrition-sensitive messages, MoH and MRD will align SBCC campaigns with the goal of reducing child stunting in Cambodia. Where the campaign is implemented in communities also supported by the Bank's proposed Cambodia Nutrition Project, campaign and community facilitation activities will be coordinated, including targeting households with children younger than 2, using common institutions and facilitators.

Lao PDR Scaling-Up Water Supply, Sanitation and Hygiene Project

The Lao PDR National Nutrition Strategy to 2025 and Plan of Action 2016–2020 aims to reduce stunting from current levels to 25 percent by 2025 using a multisectoral convergent approach combining nutrition-specific and nutrition-sensitive interventions and leveraging common platforms. The strategy and action plan cover 11 strategic objectives including improving nutrient intake; achieving adequate food consumption in the first 1,000 days of life; improving availability and access to nutritious foods; improving maternal and child health practices; improving water, sanitation, and environments; and improving access to health and nutrition services; among others. To achieve these objectives, 22 interventions are considered first-order priority interventions for improved nutrition.

The Lao PDR Scaling-Up Water Supply, Sanitation and Hygiene Project, approved in 2019, is an important pillar in the World Bank's support to multisector convergence approach to address childhood malnutrition in Lao PDR.

In addition to three active and four new lending operations, this project will be implemented in the same geographic areas where incidence of child stunting is high. It will also contribute to shared

efforts for social behavior change communications and contribute to mutually linked results and monitoring and evaluation frameworks. Other innovative features of this project include a single community-driven approach that integrates WASH and nutrition-sensitive behavior change. The project cycle consists of seven distinct steps: promotion, planning, design, sanitation, construction, post-works, and sustainability. The project cycle establishes a delivery mechanism that includes infrastructure service delivery and behavior change at the community and household levels, including health and nutrition awareness targeted to caregivers of small children. At each step, the project cycle's integrated approach ensures that a comprehensive set of hard (infrastructure) and soft (behavioral change and communication) interventions are carried out at the village and household levels and beneficiary engagement takes place in a structured and phased manner that leads to iterative and consistent reinforcement.

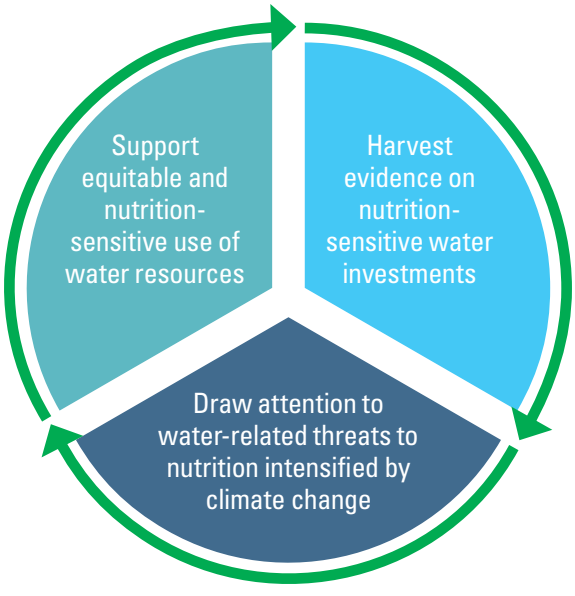
CHAPTER 9

Conclusion and Next Steps for Water and Nutrition Policy

The body of evidence supporting the effects of water security on nutrition outcomes is substantial, and there is increased interest in understanding how water investments could unlock food and nutrition security to reduce stunting and boost human capital. But for success to happen at the project level, a supportive policy environment is needed (figure 9.1). To begin with, there is a need to harvest evidence on nutrition-sensitive investments in water for agriculture that document impacts on health and nutrition outcomes through four key pathways of income; production; women's empowerment; and water supply, sanitation, and hygiene (WASH). This evidence needs to influence higher-level policy actions across water, food, agriculture, and nutrition and feed back into the design of interventions. Second, there is a need to draw attention to the water-related threats to nutrition that are intensified by climate change. Changes in climate predict greater water variability over a larger number of regions. Many of these areas already face high levels of

FIGURE 9.1

Policy Actions for Water and Nutrition



undernutrition that may only be exacerbated by climate change-induced water scarcity. Finally, there is the need for more experience and policy guidance to support equitable and nutrition-sensitive use of water resources both within and across countries. With the right policies in place, countries will be better positioned to harness the power of water for improving nutrition and strengthening human capital.

Glossary

Anemia is measured by hemoglobin concentration in the blood. Children (ages 6 to 59 months) with a hemoglobin concentration less than 11 grams per deciliter are classified as anemic. Among reproductive-age women, nonpregnant women with a hemoglobin concentration less than 12 grams per deciliter and pregnant women with a hemoglobin concentration less than 11 grams per deciliter are classified as anemic.

Anthropometry refers to the measurement of a human individual. It involves the systematic measurement of the physical properties of the human body, primarily dimensional descriptors of body size and shape.

Basic handwashing facility is one where households have a handwashing facility with soap and water available on the premises.

Body mass index (BMI) is calculated as weight (in kilograms) divided by height (in meters) squared. Women ages 15 to 49 who are not pregnant and have not had a birth in the two months before the survey are considered to be suffering from "undernutrition" if their BMI is below 18.5.

Child feces disposal Children's stools are considered to be disposed of safely if the child used a toilet or latrine or if the fecal matter was put/rinsed into a toilet or latrine.

Country's income level For the current 2019 fiscal year, **low-income** economies are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of US$ 995 or less in 2017; **lower-middle-income** economies are those with a GNI per capita between US$ 996 and US$ 3,895; **upper-middle-income** economies are those with a GNI per capita between US$ 3,896 and US$ 12,055; **high-income economies** are those with a GNI per capita of US$ 12,056 or more.

Diarrhea is defined by the World Health Organization (WHO) as having three or more loose or liquid stools per day or as having more stools than is normal for that person. Infection is spread through contaminated food or drinking water or from person to person as a result of poor hygiene.

Disability-adjusted life year (DALY) is defined by the WHO as a composite metric of mortality and morbidity (ill health or disability) and measures the overall disease burden.

Early childhood development refers to physical, cognitive, linguistic, and socioemotional development of a child from pregnancy to 6 years.

Environmental enteric dysfunction (EED) refers to an incompletely defined syndrome of inflammation, reduced absorptive capacity, and reduced barrier function in the small intestine. It is most common among children living in poor water supply, sanitation, and hygiene (WASH) conditions.

Exclusive breastfeeding It is recommended that during the first six months of children's lives, they should be exclusively breastfed, which means they should be given nothing but breast milk. This is because breast milk contains all the nutrients needed by children in the first six months of life and is an uncontaminated nutritional source.

Fertility rate is defined by United Nations Population Fund (UNFPA) as the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year.

First 1,000 days between a woman's pregnancy and her child's second birthday is a unique period of opportunity when the foundations for optimum health and development across the lifespan are established. The right nutrition and care during this period will influence not only whether the child will survive but also his or her ability to grow, learn, and get out of poverty, which further contributes to society's health, stability, and prosperity in the long term.

Food fortification is often used to meet people's nutritional needs. As defined by the WHO and the Food and Agricultural Organization (FAO) of the United Nations, food fortification refers to "the practice of deliberately increasing the content of an essential micronutrient—that is, vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health."

Food security, as defined by the United Nations Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life.

Improved sanitation is one "that effectively separates excreta from human contact and ensures that excreta do not re-enter the immediate household environment." Access to a flush toilet, a ventilated improved pit latrine, a pit latrine with slab, or a composting toilet would be considered an improved sanitation facility if it is not shared with other households.

Improved water source is one that is piped into the dwelling, yard, or plot; comes from a public tap or standpipe; comes from a tube well or a borewell; comes from a protected well or spring; or is rainwater.

Infant and young child feeding (IYCF) practices include exclusive breastfeeding in the first six months of life, continued breastfeeding through age 2, introduction of solid and semisolid foods

at 6 months, and gradual increases in the amount of food given and frequency of feeding as the child grows older.

Low birthweight is defined by the WHO as a birthweight of an infant of 2,499 grams or less, regardless of gestational age.

Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients. There are two broad groups of malnutrition, including conditions related to undernutrition (for example, stunting, wasting, underweight, and micronutrient deficiency) and overweight, obesity, and diet-related noncommunicable diseases.

Micronutrient deficiency is a major contributor to childhood morbidity and mortality. Micronutrients are available in foods and can also be provided through direct supplementation. Breastfed children benefit from supplements given to the mother.

Minimum acceptable diet (MAD) is a combination of minimum dietary diversity and minimum meal frequency. Without adequate diversity and meal frequency, infants and young children are vulnerable to undernutrition, especially stunting and micronutrient deficiencies, and increased morbidity and mortality. Breastfed children ages 6 to 23 months who had at least the minimum dietary diversity (MDD) and the minimum meal frequency (MMF) during the previous day and nonbreastfed children ages 6 to 23 months who received at least two milk feedings and had at least the MDD (not including milk feeds) and the MMF during the previous day are considered receiving a MAD.

Minimum dietary diversity (MDD) assesses food intake among children ages 6 to 23 months from at least four food groups. The cutoff of four food groups is associated with better-quality diets for both breastfed and nonbreastfed children. Consumption of food from at least four food groups means that the child has a high likelihood of consuming at least one animal source of food and at least one fruit or vegetable in addition to a staple food (grains, roots, or tubers) according to the WHO. The four food groups should come from a list of seven food groups: grains, roots, and tubers; legumes and nuts; dairy products (milk yogurt, and cheese); flesh foods (meat, fish, poultry, and liver/organ meat); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables.

Minimum meal frequency (MMF), a proxy for a child's energy requirements, examines the number of times children receives foods other than breastmilk. The minimum number is specific to the age and breastfeeding status of the child. Breastfed children are considered to be consuming MMF if they receive solid, semisolid, or soft foods at least twice a day for infants ages 6 to 8 months and at least three times a day for children ages 9 to 23 months. Nonbreastfed children ages 6 to 23 months are considered to be fed with an MMF if they receive solid, semisolid, or soft foods at least four times a day.

Nutrition-sensitive interventions are those that address the underlying determinants (food security, safety nets, early child development and education, access to health services, and a safe and hygienic environment).

Nutrition-specific interventions are those that address immediate determinants of fetal and child nutrition and development (adequate food and nutrient intake, feeding and caregiving practices, and infectious disease).

Open defecation (OD) refers to the practice of defecating in fields, forests, bushes, bodies of water, or other open spaces.

Overweight Children whose weight-for-height Z-score is more than two standard deviations above the median of the reference population are considered overweight.

Piped improved drinking water source is one that is "piped into dwelling, yard or plot, and protected from outside contamination, especially from fecal matter."

Safely managed drinking water in order to meet the criteria for a safely managed drinking water service, people must use an improved source meeting three criteria: (a) It should be accessible on premises; (b) water should be available when needed; and (c) the water supplied should be free from priority chemical and bacterial contamination. If the improved source does not meet any one of these criteria but a round trip to collect water takes 30 minutes or less, then it will be classified as a **basic drinking water** service. If water collection from an improved source exceeds 30 minutes, it will be categorized as a **limited drinking water** service.

Safely managed sanitation There are three main ways to meet the criteria for having a safely managed sanitation service. People should use improved sanitation facilities that are not shared with other households, and the excreta produced should either be (a) treated and disposed in situ; (b) stored temporarily and then emptied and transported to treatment off-site; or (c) transported through a sewer with wastewater and then treated off-site. If the excreta from improved sanitation facilities are not safely managed, then people using those facilities will be classed as having a **basic sanitation** service. People using improved facilities that are shared with other households will be classified as having a **limited sanitation** service.

Stunting is defined as the number of children younger than 5 falling below minus two standard deviations (moderate and severe) and below minus three standard deviations (severe) from the median height-for-age of the reference population/children younger than 5 in the surveyed population.

Supplementation can provide micronutrients to children. Breastfed children also benefit from supplements given to the mother.

Undernutrition is an outcome of insufficient food intake and repeated infectious diseases. It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted), and deficient in vitamins and minerals (micronutrient malnutrition).

Underweight, or weight-for-age, is a composite index of height-for-age and weight-for-height that accounts for both acute and chronic undernutrition. Children whose weight-for-age Z-score is below minus two standard deviations from the median of the reference population are classified as underweight. Children whose weight-for-age Z-score is below minus three standard deviations from the median are considered severely underweight.

Wasting is defined as the number of children younger than 5 falling below minus two standard deviations (moderate and severe) and below minus three standard deviations (severe) from the median weight-for-height of the reference population/children younger than 5 in the surveyed population.

Water security is defined by United Nations Water as the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development, for ensuring protection against waterborne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.

Water availability refers to the total renewable freshwater resources per capita, defined as the total annual actual renewable water resources in cubic meters per inhabitant per year.

Water stress refers to fresh water withdrawal (both primary and secondary) as a proportion of net available freshwater resources.

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