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A Destiny Shaped by Water

A Diagnostic of Water Supply, Sanitation, and Hygiene (WASH) and Poverty in Niger

NIGER

WORLD BANK GROUP

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1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

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Acknowledgments

The WASH Poverty Diagnostic for Niger is led by Aude-Sophie Rodella (Senior Economist, Water Global Practice [GP]), Aly Sanoh (Economist, Poverty GP), and Taibou Maiga (Senior Water Supply and Sanitation Specialist, Water GP).

Over the duration of the task, team members included Helene Grandvoinnet (Lead Governance Specialist, Governance GP), Michel Mallberg (Senior Governance Specialist, Governance GP), Ali Sharman (Consultant), Katja Vinha (Consultant), Cristiana Chiarella (Consultant), Dikshya Thapa (Consultant), and Kaleb Tamiru (Consultant).

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Executive Summary

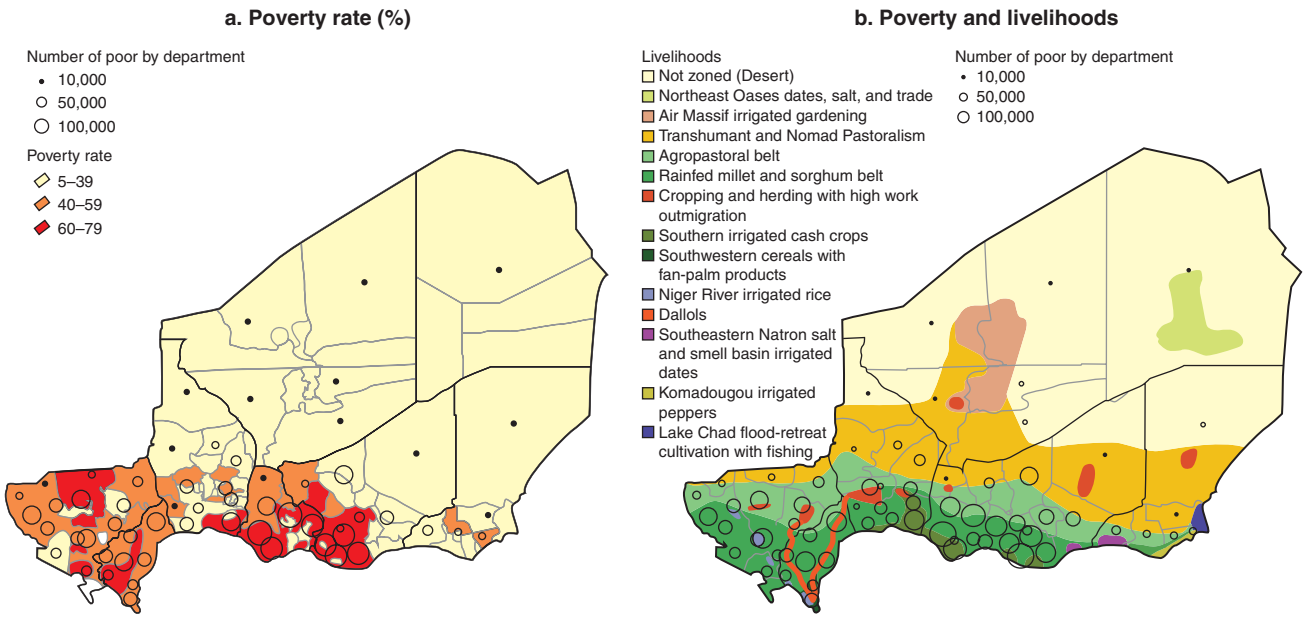
The Water Supply, Sanitation, and Hygiene (WASH) Poverty Diagnostic (PD) in Niger is part of a global initiative to improve evidence on the linkages between WASH and poverty. The Diagnostic provides a detailed analysis of sector status, strengths, and weaknesses to inform the attainment of the new Sustainable Development Goals (SDGs) that aim for universal access to safely managed water supply and sanitation.

High, Multidimensional, and Rural Poverty in Niger

Niger is one of the poorest countries in the world: in spite of a recent reduction in its poverty rate, the number of poor has increased—particularly in rural areas (map ES.1). Niger remains one of the poorest countries in the world, with a per capita gross domestic product (GDP) of just US$895 in 2015 (constant 2011 U.S. dollars). Poverty is pervasive, and despite a 9 percent decline since 2005, it remains very high (44.5 percent in 2014). Poverty declined in rural and urban areas, but the reduction was much more substantive in the capital city and in other urban areas, declining from 29.6 percent in 2005 to 8.7 percent in 2014. It presents a high degree of chronicity (27 percent). Despite this drop in poverty, the absolute number of poor increased by 1.8 million people. The number of poor has notably increased in Dosso, Maradi, and Zinder (as well as Diffa).

Multidimensional poverty is high and human development indicators are among the lowest in the world. In spite of improvement over the past decade, Niger continues to rank at the bottom of the UN Human Development Index and other indicators of multidimensional poverty (OPHI 2016). The gap is seen across key human development indicators. Life expectancy is among the lowest in the world, though just above the average of Sub-Saharan Africa (60 versus 57 years).

Map ES.1: Poverty Rates in Niger



Source: Based on the 2012 census and 2014 LSMS.
Note: Poverty is high everywhere but some agriculture-focused departments concentrate a higher number of poor.

The average level of education is 1.4 years. Early marriage is common (the median age of first marriage for girls is 15 years); maternal mortality rates are high: 630 per 100,000 live births compared to those of 506 for Sub-Saharan African; and only 15 percent of births are attended by a skilled health professional.

Poverty is mainly a rural phenomenon with a high degree of chronicity and is shaped by water availability. Niger is a primarily rural and agriculture-based country and will remain so for the foreseeable future. While the urbanization has taken place, Niger remains largely rural and reliant on rain-fed agriculture (map ES.1). Niger has one of the lowest shares of urban population in Africa. Unsurprisingly, the vast majority of Niger's 8.2 million poor (2014 estimate) live in rural areas. Additionally, the rural poor have become much poorer than their urban counterparts. In 2005, the rural poor per capita consumption represented 60 percent of that of the urban poor, but in 2014 it declined to 43 percent. Poverty remains mainly a rural phenomenon, with a high degree of chronic poverty but also an important churning in and out of poverty as a result of weather-related shocks. A low urbanization (the fourth lowest in Africa) also means that poverty will remain a rural phenomenon for the foreseeable future.

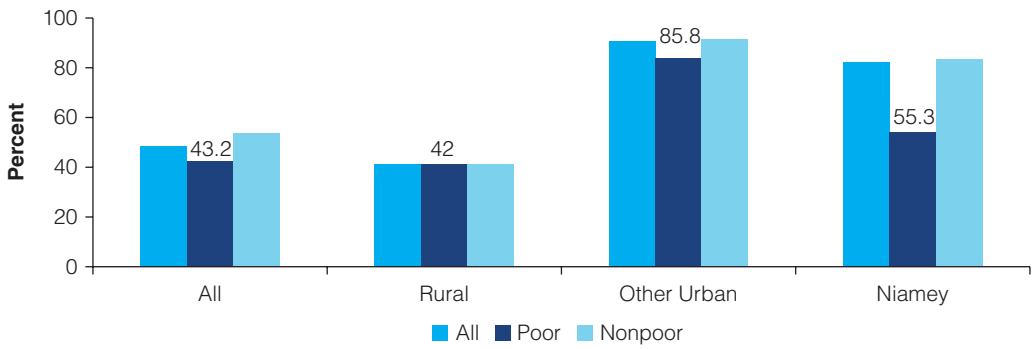
Niger faces two important challenges to reduce poverty: it has one of the world's largest demographic growth and has a high vulnerability to climate variability. The country's demographic growth (3.9 percent per year) is an outlier even in Africa. Niger is among the 10 countries projected to increase their population by at least fivefold by 2100. This demographic growth constrains poverty reduction and creates a high vulnerability to climatic shocks (both droughts and floods), which is heightened by Niger's location in the Sahel and a high dependence on rainfed agriculture.

Niger has limited scope with which to diversify its economy and invest in human capital through education, health, and basic services such as WASH. Niger has limited opportunities to drastically change its situation in the foreseeable future. Niger achieved its reduction of poverty rate under rather favorable conditions in terms of climate, commodity prices, and security. Yet gross domestic product (GDP) per capita remains at the same level as it was in 1990. A deterioration of regional security, a rise in extremism, the end of the commodity price boom, and the threat of climate change are putting additional pressure on Niger's limited resources. At the same time, the universal access targets of the new SDGs imply major efforts given the present situation of WASH services in Niger. Niger provides the ultimate test for the World Bank's twin goals of ending extreme poverty and promoting shared prosperity, and the realism of the new SDGs.

Severe Problems with WASH Services in Niger

Access to improved WASH services is low in Niger, and progress has been uneven. There has been some notable improvement in access to improved water, but improved sanitation remains sorely lagging. According to the World Health Organization–United Nations International Children's Fund (WHO-UNICEF) Joint Monitoring Programme (JMP), overall improved water facilities are available to 58.2 percent of the population in Niger as of 2015, while just over 10 percent of the population has access to improved sanitation. Still, those numbers hide important differences across urban or rural areas. The expansion of access to improved water in urban areas by 39 percentage points between 1990 and 2015 contributed to Niger meeting the Millennium Development Goals (MDGs). These rates are below Sub-Saharan averages; in spite of high access to urban water, low access to improved water in rural areas place Niger in the bottom 10 countries. Of its direct neighbors, only Chad performs worse. The sanitation situation is especially poor. Only South Sudan performs worse than Niger in terms of access to improved sanitation (6 percent versus 10.9 percent) and Niger is in the top three countries of the continents with the highest prevalence of open defecation (over 70 percent). The contrast is also stark when comparing Niger to its neighbor Mali, which presents much similarity with Niger in terms of development, socioeconomic profile, and geoclimatic context, but only has a national open defecation rate of 10 percent.

Figure ES.1: Access to Improved Water by Poverty Status (Expenditure) in Niger, 2014



Source: World Bank calculation using 2014 LSMS.

WASH improvement has been especially marked in the water sector, especially in urban areas. Access to improved water expanded across urban and rural areas. Two facts are worth highlighting. First, there was considerable expansion of private piped water in Niamey, which as of 2014 expanded by a staggering 19 percentage points. While the increase is smaller in other urban areas (9 percentage points), this is no less of a remarkable accomplishment. However, the second salient point pertains to reliance on unprotected sources such as open wells and groundwater springs by most of the rural population. It is clear that the rural population experiences a much lower service quality than its urban counterpart. The gap between the two access rates is more pronounced than in other African countries due to the comparatively high coverage observed in Niamey and other urban areas.

The trend in access to sanitation is most concerning: open defecation has increased due to population growth with over 14 million people relying on this practice as of 2014. Sanitation is especially preoccupying in Niger—improved indicators for sanitation are extremely low in both urban and rural, and population growth makes maintaining and expanding those poor access rates particularly challenging. Outside of Niamey, open defecation dominates (90 percent in rural areas in 2014).

The poor in Niger have less access to improved water supply and sanitation in Niger; differences are more muted in rural areas at lower level of access. Among the 44 percent of the population living below the national poverty line, access to safe water is just over 40 percent and access to improved sanitation is close to nonexistent for the poor (0.5 percent); both figures are over 10 percentage points below the access of the nonpoor. The difference between the poor and nonpoor is more marked in urban areas, while rural populations have lower access regardless of their poverty status. Access to improved water by the poor increased in rural areas (from 37.36 percent in 2011 to 42 percent in 2014) and in Niamey (51.9 percent in 2011 to 55.3 percent in 2014). The differences for sanitation are more muted at lower access rates across welfare status. Even among the top 60 percent (T60), close to 65 percent of households rely on open defecation. Not surprisingly, so do the poor, with an increase from 87 percent in 2011 to 92 percent in 2014.

Attempts to Bridge WASH Gap with New SDGs

Due to demographic growth, Niger is struggling to stand still and provide WASH services; population growth erodes improvement in access while it widens access gaps. While Niger saw an expansion of access to improved water (an increase of 24 percentage points since 1990 according to the JMP) and to a much smaller extent in improved sanitation (an increase of

7 percentage points), the reality of a very dynamic population growth means that in absolute numbers, people without access to improved water supply and sanitation have in fact increased. Even using the basic MDG definition for improved water supply and sanitation shows the scale of the challenge: by 2030, 15 million Nigerien will need to gain access to improved water supply and over 32 million will need to gain access to improved sanitation.

Niger will need to run much harder for the SDGs that have set ambitious new targets for WASH: universal access to truly safe facilities by 2030. In the new framework, the aim is to provide all Nigerien with water sources that are not only technically "improved" as the MDGs target, but on premises, continuously available, and free of contamination. For sanitation, the new SDG target also goes beyond the MDG aim of nonshared "improved" facilities and requires a handwashing facility with water and cleansing agent as well as the safe disposal of fecal matter. This type of high-quality access is currently very rare in urban Niger and nonexistent in rural areas.

Yet setting the bar higher is necessary because "improved" sources are just not safe enough. While the SDGs may look unrealistic for a country like Niger, they are important to guide policy and interventions since they recognize the importance of safe access rather than just focusing on the type of access. While data on point-of-use water quality are not available in Niger, evidence from other countries in Africa presenting similarities in terms of WASH access show high E. coli contamination even with piped access in the capital and near complete contamination in peri-urban and rural areas (World Bank 2017) In Niger, previous studies have shown a high contamination of groundwater with high levels of oxidizable nitrogen and bacteriological pollution (coliform and fecal streptococcus), which make the water unfit for human consumption. Furthermore, poor sanitation and poor management of fecal sludge represent a threat to the quality of underground water. Incidentally, the SDGs enjoin policy makers and stakeholders to leapfrog the expansion of WASH access to include consideration for quality —particularly in light of its implication to address another key challenge for Niger: malnutrition.

Chronic Malnutrition and its Link to Poor WASH Access

A silent emergency is placing Niger's poor and rapidly growing population at risk of permanent disconnect: widespread malnutrition to which WASH is a key contributing factor. Food insecurity and malnutrition are rampant in Niger. Data from the latest national survey (DHS 2012) reveal that a staggering 44 percent of Nigerien children under five years old are chronically malnourished, and 55 percent suffer from some type of anthropometric failure (i.e., height or weight deficiencies undermining children physical and cognitive development) (see figure ES.2). Stunting has only slightly decreased since 1992 (48 percent), indicating a long persisting problem. The prevalence of stunting in Niger is rather uniform across the wealth distribution with only the top quintile significantly less stunted than the other wealth group.

Figure ES.2: Pervasive Malnutrition in Niger

Source: DHS 2012.

Malnutrition is an acute and long-term health risk and is linked to poor WASH. Stunting is a powerful risk factor and is associated with 53 percent of infectious disease-related deaths in low-income countries (LICs). Malnutrition can also have long-lasting negative effects including a reduced capacity for manual work, poor mental development, and behavioral abnormalities. As a result, malnutrition risks long-term disadvantages for affected individuals and compromises the development of Niger as a whole. A growing literature has shown how poor WASH contributes to malnutrition by transmitting pathogens and infections that inhibit nutritional uptake through diarrhea, parasites, and enteric inflammation and dysfunction (Cumming and Cairncross 2016).

This diagnostic confirms that unsafe WASH is associated 0with poorer nutritional outcomes and that better household access to WASH reduces the effect of climatic shocks on anthropometric failures. WASH is second factor associated with death and disability in Niger as both risk and cause after, respectively, child and maternal malnutrition and malaria (IHME based on GBD 2015a and 2015b). Regression analysis using the 2006 and 2012 DHS data shows that access to piped water and improved sanitation is associated with a reduction of the negative effect of shocks on anthropometric outcomes (particularly for shocks suffered in utero and to a lesser extent for those experienced the year prior to the survey). This is notably the case in the event of floods, which are associated with negative anthropometric outcomes resulting from a compromised environmental context (i.e., increased risk of contamination). Those results flag the potential role of WASH to increase households' resilience to climatic variability and shocks. The analysis also emphasizes how behaviors and norms may well be the missing link to connect all interventions aimed at improving nutrition to yield sustainable outcomes, but they require more systematic cross-sectoral coordination.

Core WASH Service Challenges and their Institutional Origins

Progress toward the SDGs will require a focus on core WASH service challenges. In the water sector, three challenges stand out: (a) the erosion of urban supply in the face of demographic growth, (b) inequality in access between urban areas and rural zones, and (c) the cross-cutting problem of water quality. Access to sanitation is low in urban areas, with a near-total absence of services to manage and treat sludge, while open defecation dominates and has increased in rural areas. These gaps cannot be closed by more finance alone, but require new efforts to respond to the institutional challenges impeding the long-term delivery of safely managed WASH services.

The institutional structure of the Niger WASH sector continues to be characterized by three interlinked challenges: institutional fragmentation, a financing bias toward urban areas and capacity gaps. The WASH sector involves a plethora of actors at all levels. The Ministry for Water Supply and Sanitation (*Ministère de l'Hydraulique et de l'Assainissement*, MHA) is the main state actor, but must coordinate with at least six other central ministries. Each has regional and departmental structures that liaise with the communal level. This complex organizational architecture increases risks of overlaps and competition for scarce resources. Capacity gaps, especially at the decentralized level, are critical problem, with the shifting of responsibilities to underresourced and low-capacity communes set out by the January 2016 decree. That decree transferred the responsibilities for health, education, environment and water sector to local governments (municipalities and regional councils).

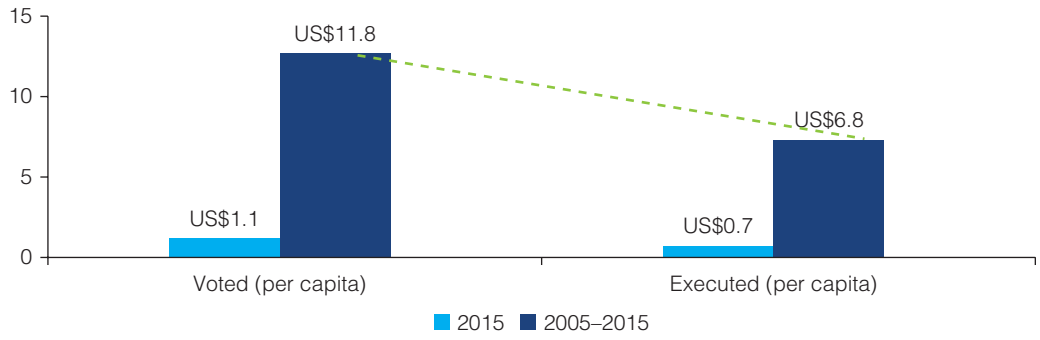
The resources allocated to the four subsectors are not commensurate with the needs, and external resources have tipped the scale toward urban areas. The resources allocated are not commensurate with the current and projected needs of the sector. Since 2005, investment in the WASH sector represents, on average, 1 percent of the voted budget (0.8 percent of the executed budget) (figure ES.3). This budget allocation falls very short since it is from the estimated requirement to reach the SDGs. Resources are inadequate and not pro-poor, and

Table ES.1: Institutional Constraints of the WASH Sector in Niger

Policy and legal framework	• Agenda moved forward thanks to substantial progress on policy dialogue
Fragmentation	• Difficult coordination due to multiplicity of donors and government actors at central level
Financing	• Financing is lacking at all subsectors but urban water • Existing financing does not prioritize toward poverty reduction and is poorly coordinated
Capacity	• Local government nominally and de facto in charge of delivering WASH services (per decentralization law) • Decentralization is ongoing process with many bottlenecks impeding progress in WASH

Note: WASH = water supply, sanitation, and hygiene.

Figure ES.3: Total Investment in WASH per Capita in Niger, Voted and Executed, 2005–15



Sources: BOOST Niger; World Bank calculation.

public financial management weaknesses prevent their full utilization. For now, urban water fares much better than other subsectors, an illustration of the large share of donor support in the total budget (notably the International Development Association [IDA]). This also reflects a bias of public expenditures toward the more affluent population in the capital city; large investments over maintenance; and visible, rent-compatible large investment projects. In a context of high demographic growth, this financing gap further emphasizes the need for an informed prioritization of investments.

Core services challenges are intrinsically linked to institutional weaknesses and the broader governance context in Niger. A context of unfinished decentralization heightens the challenges of the sector to deliver services to Nigeriens. In urban areas, where a minority of the population resides, a focus on Société d'Exploitation des Eaux du Niger (SEEN; operating company for water utilities) and Société de Patrimoine des Eaux du *Niger (*SPEN; *asset-holding company for water utilities)* have contributed to an expansion in improved access to water. However, most of the improved access is not on premise. In addition, there is an important deterioration for the poor when factoring time and there is the remaining question as to the cost of water for those not connecting to the system. These factors raise the issue of whether the SDG is

feasible even for this comparably well-performing subsector. In rural areas, in spite of WASH expansion, access to improve water continues to be insufficient due to a lack of focus and a weak capacity to contract party actors involved in rural water delegation (regulator, public sector, and private operator). A lack of clarity of the roles and responsibilities of actors involved in the management of Reports of the World Situation (RWSSs) has further hampered the development of the sector, all the more so in sanitation. Urban sanitation services are close to nonexistent due to the lack of political leadership and disengaged communes lacking capacity to address the needs. The sluggish development of the sanitation subsector in both urban and rural areas has also hindered private sector interest, further limiting the implementation capacity of the sector.

Overhauled Policy Framework and New Building Blocks for WASH Sector

Over the past decade, Niger has overhauled its policy framework for WASH, establishing new building blocks for the sector. Most recently, the new sectoral program for WASH, Programme sectoriel Eau Hygiène et Assainissement (PROSEHA 2016–2030), sets the objectives of universal access and sustainable management of both water supply and sanitation and will shape policy and operational dialogues moving forward. It builds on the 2010 Water Law, which outlines the distribution of responsibilities in the WASH sector. It incorporates the principle of subsidiarity aligned with the country's decentralization process, as well as on the Operational Strategy for the Promotion of Hygiene and Basic Sanitation (SOPHAB).

The principles guiding the PROSEHA are ambitious, inclusive, and wide-ranging, and PROSEHA's objectives can help prioritize actions in the sector for the next 15 years. PROSEHA epitomizes the progress made on the policy front of the WASH sectors over the past decades. It constitutes a remarkable achievement in perseverance and paves the way for substantial changes in the sectors to reduce existing gaps. The main principles include equity of access and affordability; specific attention to women, girls, and vulnerable populations; and increased citizen participation. For water in urban areas, the program supports improving network and water quality, the formalization of the strategy for peri-urban areas, and continued public-private partnerships (PPPs). For water in rural areas, the program supports increasing coverage and access to improved sources based on a PPP approach and sectoral programming, and strengthening the implementation capacity of local governments and the private operators.

With a solid WASH policy framework, Niger has an unprecedented opportunity to connect with the larger water resource management with the new Plan for the Management of Water Resources (PANGIRE). Water closely intersects with the three bindings constraints identified in the recent Systematic Country Diagnostic (SCD): "(i.) Low rural productivity, with increased access to water critical to improve agricultural yields; (ii.) Inadequate human capital, with malnutrition and poor health outcomes brought on by food insecurity and anthropometric failures related to poor WASH; (iii.) and finally poor governance, which undermines the delivery of services in the sector and those related to it." (World Bank, 2017). A more deliberate connection of the PANGIRE to the PROSEHA could help solidify the policy and institutional gains achieved and build the new foundations of a sector grounded in the sustainable use of water (in both quality and quantity) for all users in a context of climate vulnerability.

Challenge of Meeting SDG Targets

Niger is at a major crossroads: after a decade of limited progress, the country must rise to the challenge of the SDG targets in a context of regional fragility, high poverty, demographic growth and climate vulnerability. While the challenge is immense, making significant progress is critical to avoid a permanent disconnect of the country's vulnerable population. The WASH Poverty

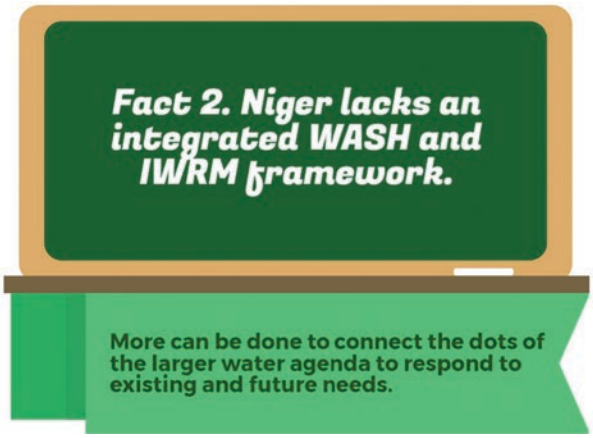
Diagnostic identifies three priority pillars that need to be addressed simultaneously in future policy and interventions to respond to the scale of the challenge in Niger:

- Tackle the remaining access and service gaps with a focus on the poor
- Plan for increased demand in a climate vulnerable context
- Protect the basics particularly where infrastructure expansion is not feasible or realistic through cross-sectoral interventions

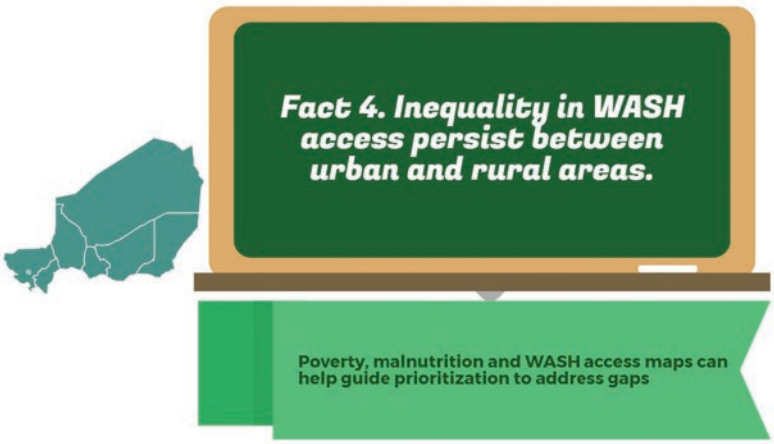
Facts and Key Messages

Message 1: Advances on the policy front won't be sufficient to meet the SDGs in light of existing gaps, growing needs resulting from a high demographic growth, and the higher requirement of the new goals. A mobilization of donors is required to build on the existing policy blocks to improve service delivery and enable a greater involvement of the private sector.

Message 2: Niger needs a closer integration of the WASH and integrated water resource management (IWRM) agendas. The new PROSEHA and PANGIRE offer opportunities to improve both the coordination and execution around the issue of water access and management, which are key to meeting the SDGs. Niger's geography and exposure to climate variability make indispensable a joint consideration of the expansion of water supply and sanitation access—irrigation and other underground water uses—to ensure sustainability for all.



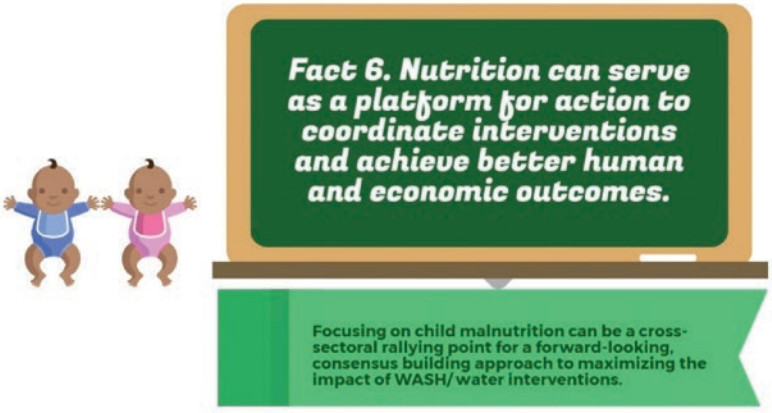
Message 3: In urban and rural areas, sanitation needs to be raised to the top of the political agenda, accompanied by adequate financing, for any progress to be achieved. The agenda has been advanced as much as could be expected from the policy and strategy fronts (SOPHAB; PROSEHA). Results-based financing that would jointly target water supply and sanitation could help channel efforts toward concrete, incremental goals to enable local institutions to deliver on sanitation.



Message 4: Reducing open defecation and expanding sanitation need to include safe disposal and treatment of fecal sludge, which represents an important potential for job creation in private and public sectors. Fecal sludge management is a relatively new concept for the public sector in Niger and, despite the progress made, there is a lot of new ground to cover. Allocation to the sector has been limited: the only known commitment is in Niamey with its commitment of US$75,000 per year to support the private operator to manage its fecal sludge for three years. Not only is the treatment of fecal sludge a priority for public health and environmental preservation but it also constitutes another dimension of the economic opportunities the sector presents. Those opportunities come in addition to the 100,000 to 300,000 full-time private- and public-sector jobs that could be created to provide an MDG-type of improved access to water supply and sanitation to all Nigeriens by 2030, with SDG-level access further raising the economic potential of the sector.

Message 5: A rebalancing and increase of financing toward rural areas are needed. Financing has prioritized urban areas, but the combination of growing needs resulting from a high demographic growth and the higher requirement of the SDGs calls for a rebalancing toward rural areas where the gap in access and quality of service are the most pronounced. Three regions exemplify this overlap of high poverty, high open defecation and malnutrition: Maradi, Zinder, and Tillabéri.

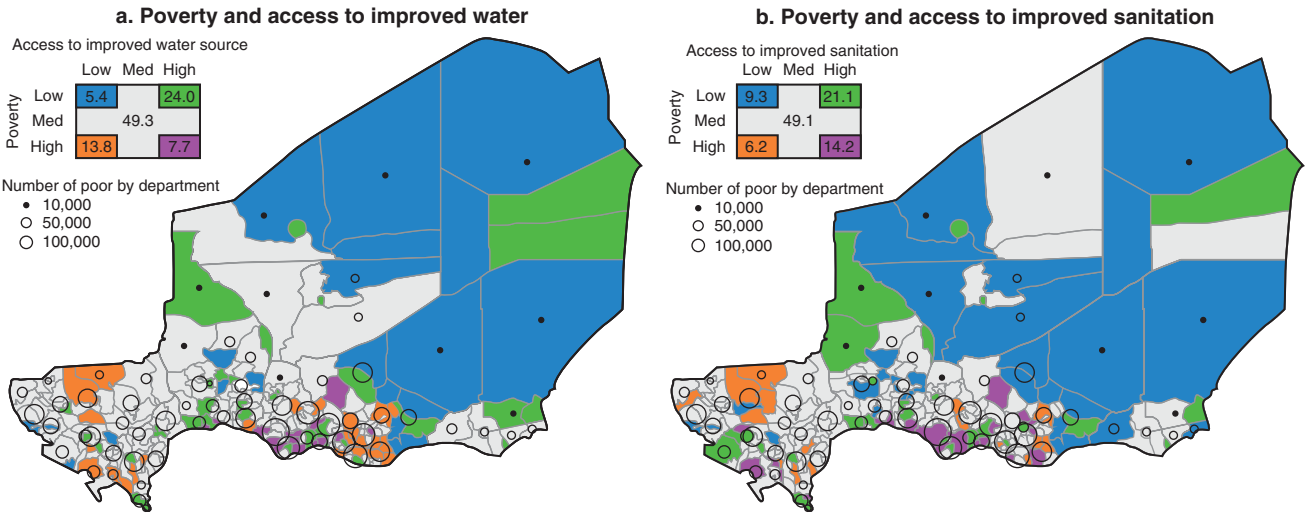
The poverty map for Niger updated in the context of the Niger WASH Poverty Diagnostic can provide a granular spatial lens and help identify priority communes in which access is particularly lagging and poverty (in both rate and number) elevated (map ES.2, panels a–b). While needs clearly extend beyond those outliers of high poverty and low access, those "hot spots" can be a starting point to a phased-in approach. They can also help cross-sectoral collaboration to provide integrated interventions most likely to yield tangible results in a context of multiple deprivations extending well beyond the WASH sector.



Message 6: The issue of water quality in Niger needs to be leapfrogged to the top of the policy agenda. An effective water supply and sanitation (WSS) and water resources management (WRM) regulation body is required to enforce and monitor laws, policies, and standards indispensable to ensure water quality.

It matters on two levels: now, to address the reality that improved water is just not safe enough in a context of poor sanitation and has important implication for health and nutrition; and in the longer term, for the management of

Map ES.2: Outliers in Poverty and Access to WASH at the Commune Level, Niger



Source: Census 2012; LSMS 2013.

water resources, particularly groundwater. Water quality is therefore key to both resilience and sustainability. The Niger River provides most of the water through the system in cities in Niger while a sizeable share of the population relies on water from groundwater. In both cases, there are already quality concerns that can be expected to worsen in light of climate variability and population growth. First, an assessment of the water quality in 19 water supply schemes in Niger indicated that 18 out of 19 centers do not have a chlorination system and that water quality is poor in four centers (Maiga 2016). Second, a high share of improved water access not being on premise (especially in other urban areas, and of course in rural ones) further raises the contamination risk between point-of-collection and point-of-use. Third, and of particular concern for rural areas, previous studies have shown a high contamination of groundwater with high levels of oxidizable nitrogen and bacteriological pollution (coliform and fecal streptococcus) in addition to natural risk of geogenic contamination (iron and other minerals).

Message 7: Strengthen cross-sectoral coordination around the core issue of (child) malnutrition and resilience. Child malnutrition is one of the most serious long-term health impacts to which poor water quality contributes along with other key factors such as food security, education, and social safety nets. Focusing on child malnutrition can be a cross-sectoral rallying point for a forward-looking, consensus-building approach to maximizing the impact of WASH and water interventions in a context of high climate vulnerability. A malnutrition lens can also help prioritize regions where the incidence of stunting is particularly elevated (Maradi, Zinder, Tillabéri, and Diffa). It can also help integrate more systematically resilience-enhancing strategies covering the full spectrum of water-related interventions, from irrigation to WASH, from infrastructure to behaviors.

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Abbreviations

3N	Nigeriens Feed Nigeriens (les Nigériens Nourrissent les Nigériens)
AEP	Access to Drinking Water (Adduction en Eau Potable)
ANFICT	National Agency for the Financing of Local Communities (Agence Nationale de Financement des Collectivités Territoriales)
B40	bottom 40 percent of the population
CFSVA	Analysis of Food Security and Vulnerability (Analyse de la Sécurité Alimentaire et de la Vulnérabilité 2005)
CLTS	community-led total sanitation
CIAF	Composite Index of Anthropometric Failures
CNEA	National Water and Sanitation Commission (Commission Nationale de l'Eau et de l'Assainissement)
CREA	Regional Water and Sanitation Commission (Commission Régionale de l'Eau et de l'Assainissement)
CSO	community service organization
CUN	Urban Community of Niamey (Communauté Urbaine de Niamey)
DALYS	disability-adjusted life years
DDHA	Departmental Direction for Water Supply and Sanitation (Direction Départementale pour l'Hydraulique et l'Assainissement)
DDVSA	Direction du Développement et de la Vulgarisation des Services d'Assainissement
DGA	Direction Générale de l'Assainissement
DHS	Demographic and Health Survey
DIHA/MU	Direction des Infrastructures d'Hygiène et d'Assainissement en Milieu Urbain
DIHA/MR	Direction des infrastructures d'Hygiène et d'Assainissement en Milieu Rural
DLI	disbursement-linked indicator
EA	enumeration area
ECVM/A	Enquete sur les Conditions de Vie des Ménages et l'Agriculture (National Survey on Household Living Conditions and Agriculture)
EDSN-MICS	Niger's Demographic and Health Survey with Multiple Indicators (Enquête, Démographique et de Santé et à Indicateurs, Multiples du Niger)

ENCBM	National Survey on Households' Consumption and Budget (Enquête Nationale sur le Budget et la consommation des Menages)
ETa	seasonal evapotranspiration
GHI	Global Hunger Index
GoN	Government of Niger
GPS	global positioning system
HAZ	height-for-age z-scores
HOI	Human Opportunity Index
IDA	International Development Association
INS	Institut National de la Statistique du Niger
JMP	Joint Monitoring Programme
LIC	low-income country
LSMS	Living Standards Measurement Survey
MDG	Millennium Development Goal
MHA	Ministry of Water Supply and Sanitation (Ministère de l'Hydraulique et de l'Assainissement)
MICS	Multiple Indicator Cluster Survey
MODA	Multiple Overlapping Deprivation Analysis
MPI	Multidimensional Poverty Index
MSP	Ministry of Public Health (Ministère de la Santé Publique)
NDVI	Normalized Difference Vegetation Index
NGO	nongovernmental organization
O&M	operations and maintenance
OLS	ordinary least squares
OPHI	Oxford Poverty and Human Development Initiative
MICS	Multiple Indicator Cluster Survey
NDVI	Normalized Difference Vegetation Index
PANGIRE	Integrated Plan for the Management of Water Resources (Plan d'Action National de Gestion Intégrée des Ressources en Eau)
PDC	Communal Development Plans (Plans de Développement Communaux)

PDES	National Plan for Economic and Social Development (Plan de Développement Économique et Social)
PDL	local development plan (plan de développement local)
PFM	public financial management
PLEA	Local Plan for Water Supply and Sanitation (Plan Local sur l'Eau et l'Assainissement)
PN-AEPA	National Program for Drinking Water Supply and Sanitation (Programme Nationale d'Alimentation en Eau Potable et d'Assainissement)
PNSN	National Food Security Policy
PPP	public-private partnership
PforR	Program-for-Results
PROSEHA	Sectoral Program for Water, Sanitation, and Hygiene (Programme sectoriel Eau Hygiène et Assainissement)
PSU	primary sampling unit
QER	Quality Enhancement Review
QUIBB	Questionnaire Unifié sur les Indicateurs de Base de Bien-Etre
RFE	rainfall estimate
RGPH	General Population and Housing Census (Recensement Général de la Population et de l'Habitat)
RWSS	rural water supply and sanitation
RWSS	Reports of the World Situation
SCD	Systematic Country Diagnostic
SDG	Sustainable Development Goal
SDI	Service Delivery Indicator
SEEN	Société d'Exploitation des Eaux du Niger (operating company for water utilities in Niger)
SMEA	Municipal Services for Water Supply and Sanitation (Services municipaux pour l'Eau et l'Assainissement)
SPEN	Société de Patrimoine des Eaux du Niger (asset-holding company for water utilities in Niger)
SPI	Standard Precipitation Index
SOPHAB	Operational Strategy for the Promotion of Hygiene and Basic Sanitation (Stratégie Opérationnelle de promotion Hygiène et Assainissement de Base)

SUN	Scaling up Nutrition
T60	top 60 percent of the population
UNICEF	United Nations Children's Fund
UNPD	United Nations Procurement Division
UWS	urban water supply
VAT	value added tax
VIC	Variable Infiltration Capacity
WHA	World Health Assembly
WHO	World Health Organization
WiN	WASH in Nut
WPD	WASH Poverty Diagnostic
WRM	water resource management
WRSI	Water Requirement Satisfaction Index
WSP	Water and Sanitation Program
WSS	water supply and sanitation
YLDs	years lived with disability
YLLs	years of life lost

Chapter 1
Introduction

The Water Supply, Sanitation, and Hygiene (WASH) Poverty Diagnostic (PD) in Niger is part of a global initiative with the objective of improving the evidence on the linkages between WASH and poverty, as well as opportunities and bottlenecks in the sector. Following the structure of all WASH WPDs, this diagnostic uses existing and newly collected data to answer four core questions:

- Who and where are the poor and bottom 40 (B40) percent of the national distribution (consumption)?
- What is the level of access and quality of WASH services experienced by the poor and B40 as compared to the nonpoor and to the top 60 (T60) percent?
- What are the linkages and synergies between WASH and other sectors?
- What are the WASH service-delivery constraints and potential solutions to improving services to the poor and B40?

The present report aims at providing a data-driven diagnostic to inform the way forward. By answering the following core questions, the WPD aims to provide a comprehensive analysis of the current state of WASH in Niger and strategies for improving outcomes, in particular for the poorest. The challenges of demographic growth, water scarcity, and climate vulnerability in a context of high poverty, aid dependence, and regional insecurity are given particular consideration in the case of Niger. The new Sustainable Development Goals (SDGs) aim for universal access to safe water supply and sanitation, which raise the bar for the WASH sector. Niger exemplifies the breadth and depth of the challenge, which are articulated around **three pillars** further discussed in the WPD:

- *Access.* Addressing the remaining access gaps to Millennium Development Goals (MDGs) and raising the bar to include quality with a pro-poor focus
- *Climate vulnerability, WASH and water services.* Planning for increased demand resulting from Niger's demographic growth accounting for the country's high climate vulnerability
- *Malnutrition.* Protecting the basics—notably in terms of nutrition—where infrastructure expansion is not feasible or realistic through cross-sectoral interventions.

Chapter 2
Overcoming the Odds—Niger's Pervasive Poverty

Main Points

- Niger remains one of the poorest countries in the world with limited opportunities to drastically change this situation due to constraints reflecting its geography and climate—both of which expose the country to important climate variability
- Important demographic growth constrains poverty reduction and raises the requirements to provide services and infrastructure to the population; goals are to close the current gap and more to anticipate future needs
- Poverty is pervasive, primarily rural, and closely related to the geography of water
- Niger is further constrained by weak governance and a regional context of fragility
- Protracted concerns for food security and high malnutrition confirm that the very foundations of poverty reduction and human development are not secured
- Important endowment in underground water resources could present an untapped potential to address both water access and agricultural productivity
- Sustainable use of precious water resources is fundamental—as is the protection of their quality.

Daunting Odds to Reduce Poverty and Promote Shared Prosperity

Challenging Geography and Climatic Context

Niger is a land-locked Sahelian country in which survival is directly tied to the Niger River. The Niger River, which crosses the south, shapes its spatial organization. People live in four agro-ecological zones (except for the Sahara), defined by gradient of rainfall, itself correlated with the distance to the Niger River, on which depends agriculture and animal-rearing economic activities. Rainfall is mainly received in the form of violent storms resulting in heavy runoff during the rainy season (June–September).

Niger is a primarily rural and agriculture-based country, and it will remain so for the foreseeable future. While urbanization has taken place, Niger remains largely rural and reliant on rainfed agriculture. Niger has one of the lowest shares of urban population (less than 20 percent)

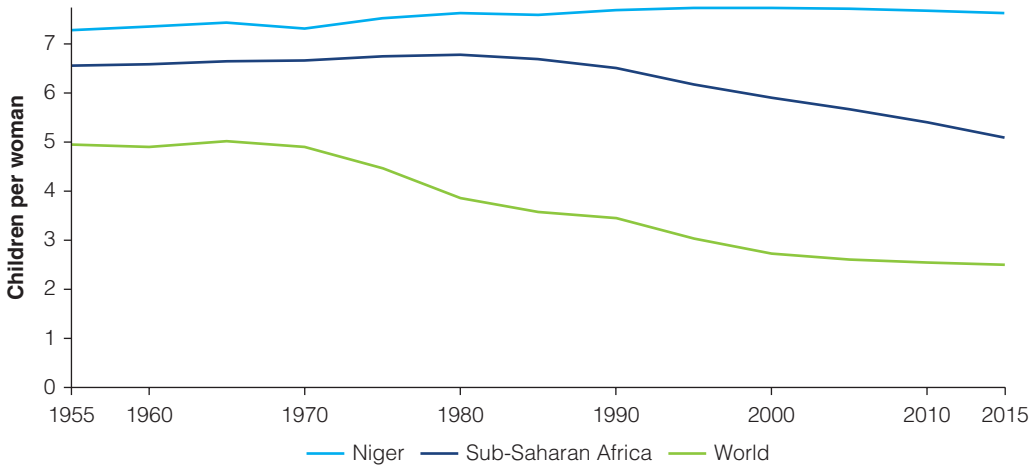
in the world, and urbanization has been much less dynamic than other countries of the continent. In Africa, only Burundi, Malawi, and Uganda have a lower share of their population living in urban areas (UN DESA 2014). Niger is also characterized by low intra-country migration. More than 90 percent of the rural population have lived in the same village as where they were born. Yet the country sees seasonal migration to neighboring countries, such as Nigeria.

Low Human Development Indicators and Very High Demographic Growth

Niger is one of the poorest countries in the world with limited opportunities to change this situation in the near future. Niger remains one of the poorest countries in the world, with a per capita gross domestic product (GDP) of just US$895 in 2015 (constant 2011 U.S. dollars). Niger is a net food importer.[1] Niger's poverty is reflected across human development indicators: the average level of education is 1.4 years; only 52 percent of children under two years of age have received a complete set of vaccinations; and 44 percent of children under five years are stunted; Seventy-two percent of children and 46 percent of pregnant women are anemic; maternal mortality rates are high: 630 per 100,000 live births compared to those of 506 for Sub-Saharan African; and only 15 percent of births are attended by a skilled health professional. As discussed in the recent Systematic Country Diagnostic (World Bank, 2017). Niger has limited opportunities to drastically change this situation due to constraints reflecting its geography and climate—both of which also expose the country to important climate variability.

The country has one of the world's highest rates of demographic growth (3.9 percent per year), which is even an outlier in Africa (figure 2.1). Niger is among the 10 countries projected to increase their population by at least fivefold by 2100.[2] By 2050, Niger will have the population of France. This important demographic growth constrains poverty reduction. It also raises the requirements to provide services and infrastructure to the population to close the current gap and more so to anticipate near-future needs. The country is faced with the conundrum of "running hard to stand still" in terms of service provision and infrastructures.[3]

Figure 2.1: Children per Woman (Total Fertility Rate) in Niger, 1955–2015



Source: UN population division (Fertility), 2015 revision
Note: "Total fertility rate" is 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.

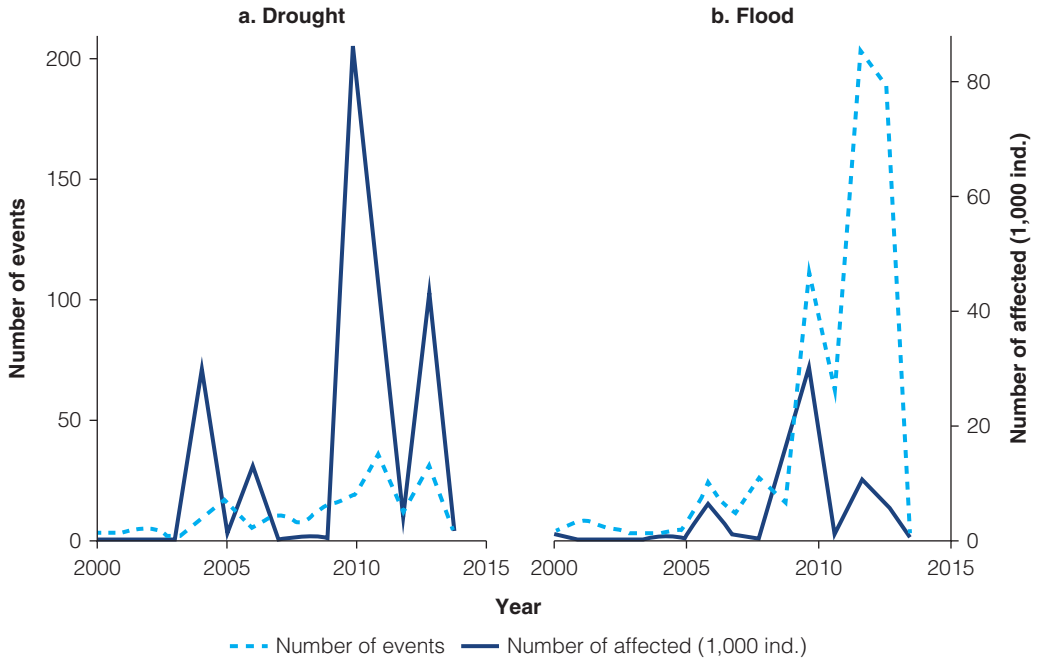
Vulnerability to Climate Variability and Concerns for Food Security and Poverty

Niger presents a high vulnerability to climate variability, which is expected to further increase with climate change. Niger is particularly exposed to climate risks due to its geographic position as a landlocked Sahelian country. The country already experiences important climate shocks both in terms of droughts, to which the region is traditionally associated, and floods, which have significantly increased in recent years (figure 2.2). Weather variability and extreme events are expected to increase with climate change (World Bank 2013).[4]

This high exposure to climate variability and shocks is amplified by the country's high dependence on rainfed subsistence agriculture. Figure 2.2 shows that shocks (drought or flood) are identified by households as the main reason explaining their poverty status. This is not surprising given that the subsistence agriculture that barely sustains the population (40 percent of the GDP, 80 percent of the workforce) is nearly totally reliant on the rainfall that shapes the country's four agro-ecological zones (map 2.1).[5] Niger's subsistence agriculture is based on cereal crops (millet and sorghum) and cowpeas, which constitute the staple diet.

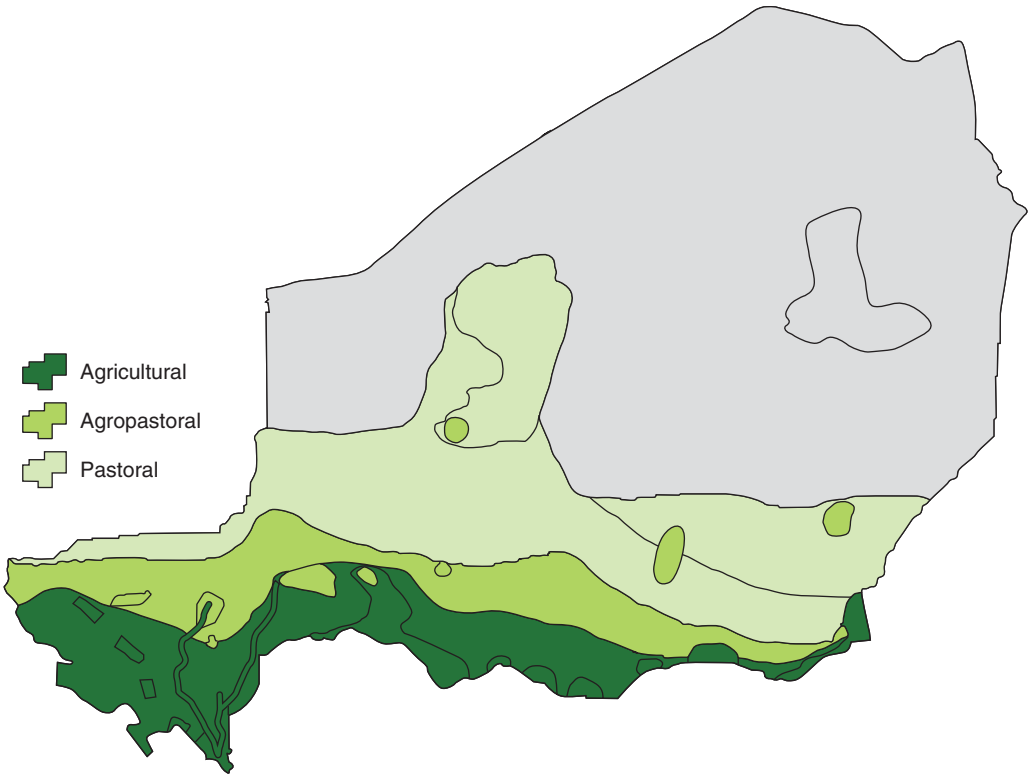
Food security is a daily concern for a significant part of the population, with malnutrition an impediment to Niger's development. Most of the population live dangerously close to the survival threshold. According to WFP as of 2017, more than 1.5 million people in Niger are affected by food insecurity, and millions more facing transitory food shortages during the lean season.[6] Nearly 20 percent of the population cannot meet their food needs because of inadequate yields, poor diversification of incomes, climate change, security constraints, and increasing pressure on land due to population growth. This figure increases to nearly 30 percent during periods of poor rainfall. As a result, malnutrition is high and stunting has remained almost much unchanged since the 1990s at around 40 percent.

Figure 2.2: Events and Individuals Affected by Droughts and Floods in Niger, 2000–14



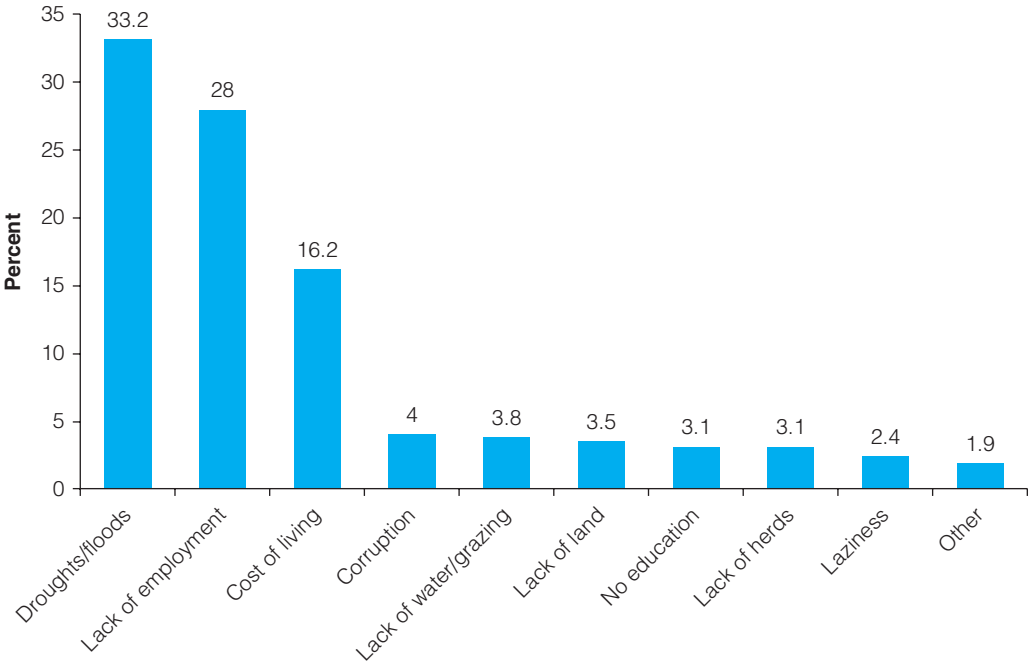
Source: LSMS/ISA 2011.

Map 2.1: Agro-Ecological Zones, Niger, August 2011



Source: World Bank calculation based on DesInventar database 2014.

Figure 2.3: Household Reasons for Poverty in Niger, 2011



Source: World Bank calculations based on LSMS-ISA 2011.
Note: Households identify shocks as the main reason for their poverty status.

Indeed, 42.2 percent of children under five suffer from chronic malnutrition (stunting) and 10.3 percent are acutely malnourished. Such high rates of malnutrition impede the proper development of Niger's human capital, compromise its future development, and threaten the country with a permanent disconnect of the country's vulnerable population.

Generally Poor Governance Indicators and Weak Public Administration

Niger is characterized by a complex governance equilibrium. A limited set of key actors cater to elite interests from the top to the bottom of the political structure, percolating through the public administration. This context results in a competitive political settlement made all the more difficult to manage by a fragmented administration and the politicization of key public service positions. Low incentives for performance, impunity, and lack of accountability all contribute to a poor delivery of services to the population (further detailed for the WASH sector in chapters 3 and 5).

Poverty reduction has not necessarily informed policies. With the exception of couple of key strategies aimed at reducing vulnerability and food security, such as the 3N (Nigeriens Feed Nigeriens [les Nigériens Nourrissent les Nigériens]) strategy, poverty has not informed Niger's policy—nor the prioritization of frontlines—with most staff and resources allocated to the capital (less than 1 million people). A high level of patronage and favoritism, compounded by corruption concerns, undermine an adequate allocation of resources toward priority needs.

A heavy dependence on aid and a fragmentation of donors and partners heighten institutional weaknesses in a context of unfinished decentralization. Between 2007 and 2016 donors contributed 8 percent to GDP (11 percent in 2015) and financed about a third of the budget. This dependence (further discussed in chapter 6) has many implications for Niger's governance, including a tendency toward the creation of duplicative structures in low capacity environments and a strong emphasis on legal and regulatory framework (with sometimes large disconnect with implementation needs and reality). In a context of unfinished decentralization, which has notably put local governments in charge of WASH, this results in little attention to the transfer of resources in a context in which the state is not present locally.

Regional Context of Political Fragility

Niger's history has been fraught with upheavals, but the country has been stable over the past decade. Following independence in 1960, the country has experienced three coups (1974, 1996, and 2010), one presidential assassination (1999), and four returns to civil rule (1989, 1996, 1999, and 2011). Rebellions (1990 and 2007), coup attempts (1976, 1983, 2003, and 2015), soldier mutiny (1991, 2002) and major droughts and hunger in 1968–73, 2005, and 2010 add to the volatile mix of Niger's politics. In spite of the new threats of militant Islamism in northern region (Arlit and Agadez) as well as at the border with northern Nigeria and Chad (Boko Haram) and at the northwestern border with Mali (Tillabéri and Tahoua regions), the country has been relatively stable compared to its neighbors (see appendix K, map K.1, for localization of recent conflict events in Niger and poverty).

A fragile regional context puts pressure of the government's spending priority toward security. Niger is at the heart of a turbulent region marked by political and religious violence. Spillovers from crises in northeast Nigeria, Libya, Chad, and northern Mali affect the country. Niger is battling an insurgency by the Islamic militant group Boko Haram and has declared a state of emergency in the Diffa region (about a third of Diffa's population was forcibly displaced) (World Bank and UNHCR 2016).[7] Supported by the international community, Niger is increasing its support to its security sector. Declining commodity prices have had a negative

impact on public resources, with dire consequences in a country whose significant mineral wealth deposits of uranium, gold, coal, and petroleum used to generate up to a quarter of all government revenue.

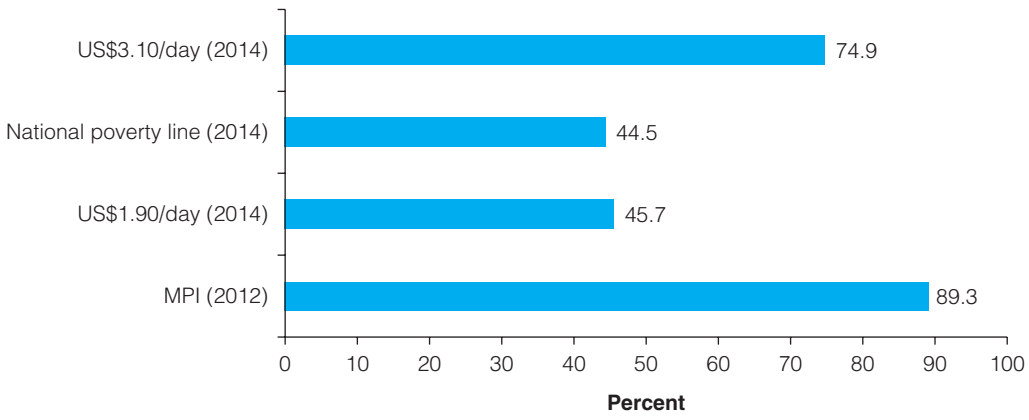
Pervasive and Primarily Rural Poverty Now and for Foreseeable Future

Poverty is pervasive regardless of the measure used. As of 2014, 44.5 percent of the Nigerien population is poor. Regardless of the lines of measure used, Niger is one of the poorest country in the word (figure 2.4) Using the US$1.90 poverty line, Niger is just above the average for Sub-Saharan Africa (43.65 percent) and its poverty levels is comparable to other Sahelian countries, including its neighbor Mali. This situation is also observed in terms of multidimensional poverty, with Niger having the world's worst Multidimensional Poverty Index (MPI), which shows the interaction between poverty and harsh environmental conditions (Alkire et al. 2016).

The share of poverty incidence has decreased, but the number of poor has increased, particularly in rural areas. The incidence of poverty remains very high, despite a 9 percent decline since 2005.[8] Poverty incidence declined from 53.7 percent in 2005 to 44.5 percent in 2014. Poverty declined in rural and urban areas, but the reduction was much more substantive in the capital city and in other urban areas, declining from 29.6 percent in 2005 to 8.7 percent in 2014. Still, while the absolute number of poor in Niamey declined from 200,000 in 2005 to 58,000 in 2014, it represents a high degree of chronicity (27 percent). Despite this percentage drop in poverty, the absolute number of poor increased by 1.8 million people as a result of rapid population growth. The number of poor has notably increased in Dosso, Maradi, and Zinder (as well as Diffa).

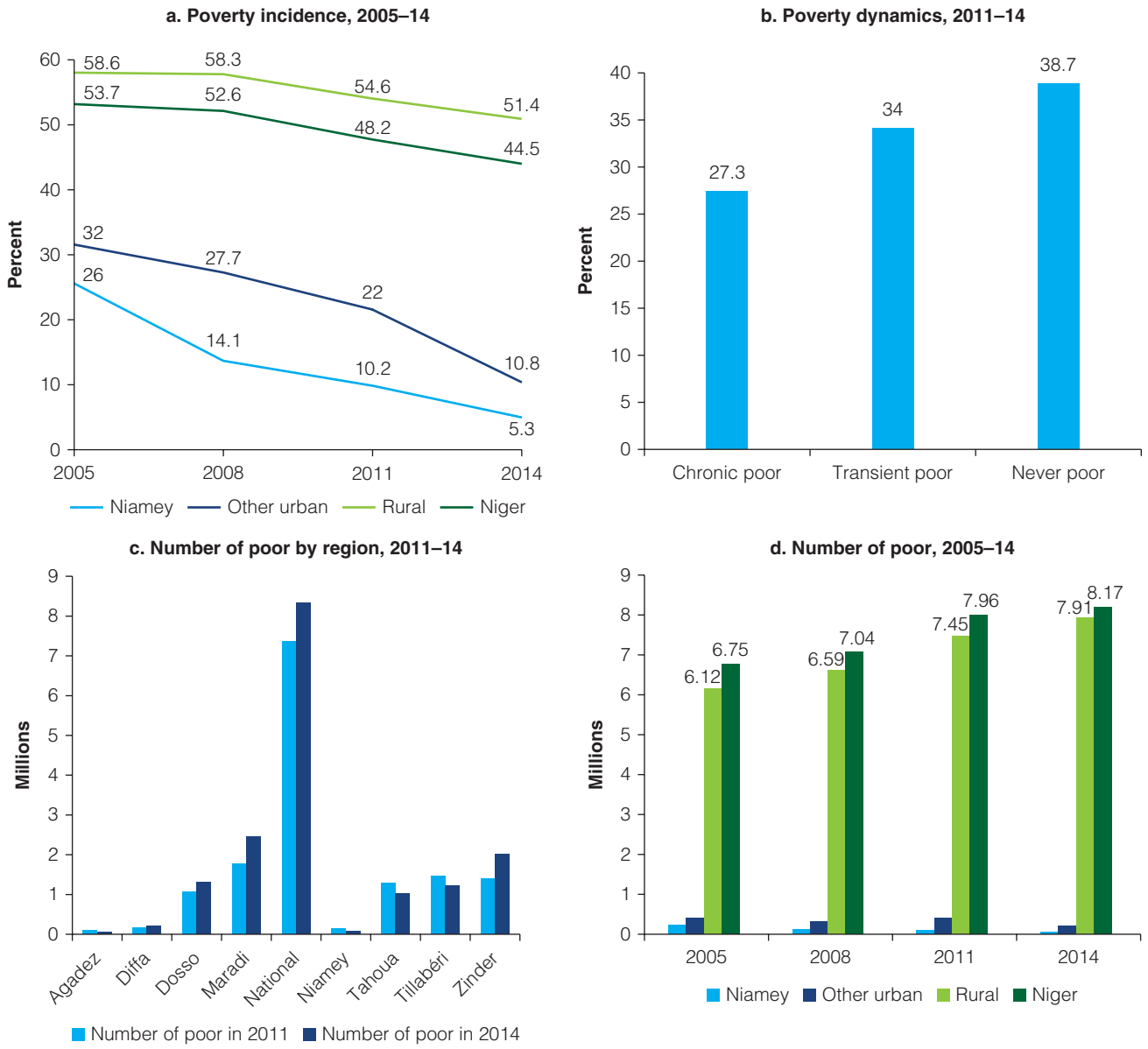
Poverty is mainly a rural phenomenon with a high degree of chronic poverty (figure 2.5, panels a-d). Most of Niger's 8.2 million poor (2014 estimate) live in rural areas. Additionally, the rural poor have become much poorer than their urban counterparts. In 2005, the rural poor per capita consumption represented 60 percent of that of the urban poor, but in 2014 it has declined to 43 percent. Poverty is mainly a rural phenomenon, with many households experiencing a high degree of chronic poverty and a churning in and out of poverty as a result of weather-related shocks. A low urbanization (the fourth lowest in Africa) also means that poverty will remain a rural phenomenon for the foreseeable future.

Figure 2.4: Poverty Across Lines and Indicators in Niger, c. 2012, 2014



Source: LSMS 2014; DHS 2012.
Note: MPI = Multidimensional Poverty Index.

Figure 2.5: Poverty Incidence, Poverty Dynamics, and Number of Poor in Niger

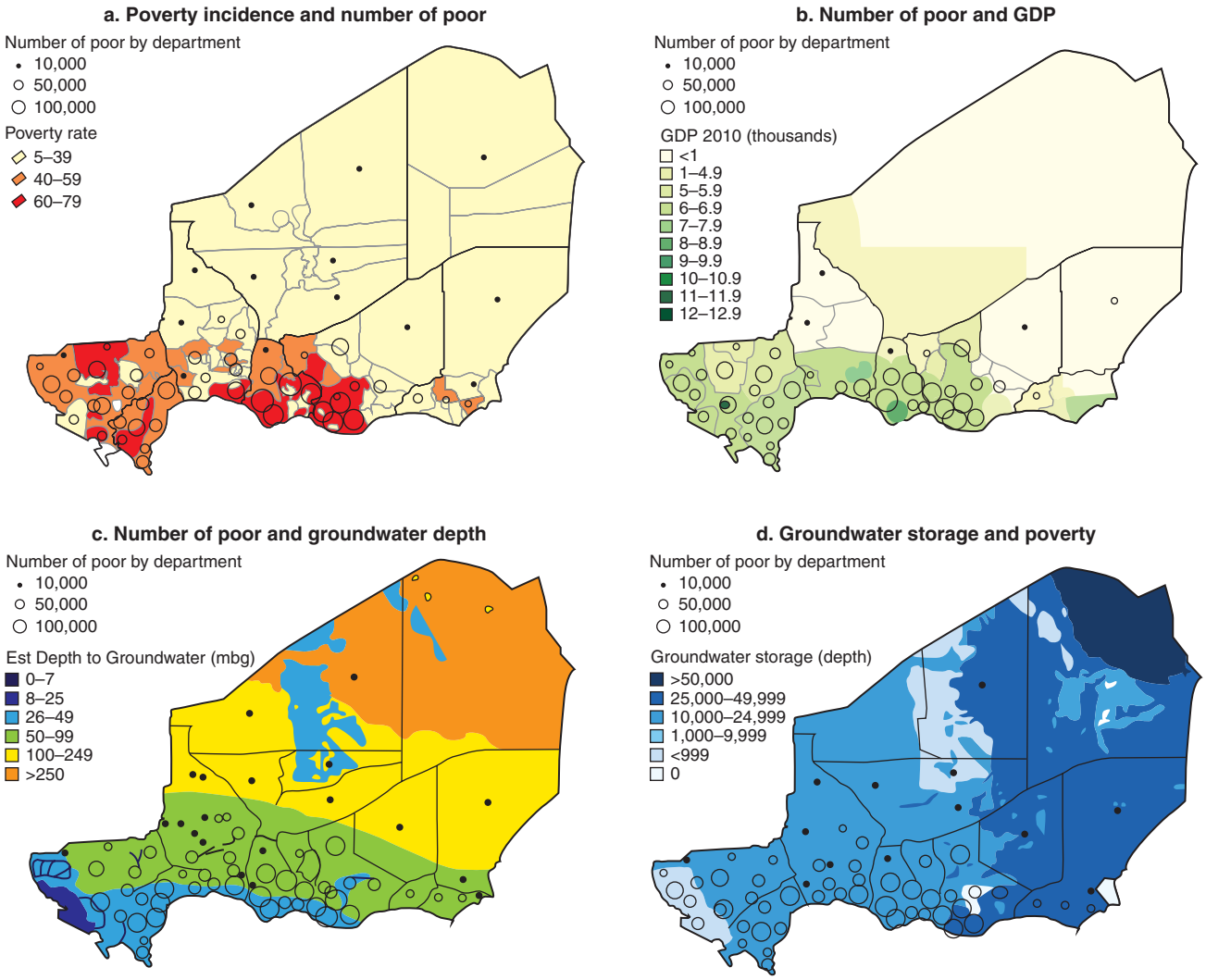


Sources: World Bank calculations using ENBC 2008, LSMS-ISA 2011 and 2014, and QUIBB 2005.

Connection Between Water Supply and Poverty Rates and Numbers

The distribution of poverty in both rates and numbers is very spatially defined: shaped by water endowment and availability. The poor are located where economic activity is related to agriculture, both of which are shaped by water endowment and availability (map 1.2, panels a–d). Niger's four agro-ecological regions are defined by their proximity to the Niger River and their rainfall. As in other countries of the Sahel, water in Niger is scarce and the soil quality is poor, in part because of human-induced degradation. While the exact nature and cause of observed changes in patterns of rainfall in this region is debatable, there appears to have been an overall shift toward increased temperatures and lower annual average rainfall since the 1960s in the semiarid regions of West Africa (Kotir 2011; World Bank 2013).

Map 2.2: Poverty, Agriculture, and Water in Niger



Sources: World Bank calculations using the Niger poverty map 2016 based on the 2012 census and 2014 LSMS for poverty and for water-related data using MacDonald et al. 2012.
Note: The distribution of the poor, in both rates and numbers, is spatially defined, with the poor located where agricultural activity takes place (panels a–b). Provided it is tapped sustainably, the presence of groundwater at low depth in areas where many poor live creates scope for poverty reduction by increasing agricultural productivity through irrigation (panel c). Agriculture, in turn, is largely driven by water availability (panel d).

These conditions have undermined agricultural production in the region since the 1970s (Barrios, Ouattara and Strobl, 2008)

Niger's groundwater resources are largely untapped but need to be exploited wisely and sustainably. If Niger's Sahelian location can be unforgiving in terms of climate (low rainfall, sizeable variability), its soils are well-endowed in underground water resources. Groundwater could increase water access for households and productive use, notably in terms of irrigation using solar pumping technology, as noted by the recent Niger SCD (World Bank, 2017). However, a strategic and long-term consideration of a sustainable use of this precious resource is critical. This is true both in terms of quantity (i.e., what is a best and equitable use of resource with limited replenishment) and quality (accessing the resources raises the risk of both anthropogenic—especially in a context of low sanitation—and geogenic contamination).

Notes

1. Food is the second most important import good after capital goods.
2. The other countries are Angola, Burundi, the Democratic Republic of Congo, Malawi, Mali, Somalia, Uganda, Tanzania, and Zambia.
3. In reference to Red Queen's race in Lewis Carroll's *Through the Looking Glass, and What Alice Found There* (1871), which tells the story of the adventures of the Red Queen and Alice constantly running but remaining in the same spot.
4. However, it is also important to note that although rainfallx patterns are crucial for the Sahel region and a drying since the 1960s is well documented, climate model projections of precipitation in this region diverge widely, not just for the generation of models at the time of IPCC's AR4 but also for the latest CMIP5 generation of models used for AR5 (Roehrig et al. 2013).
5. The first zone is the pastoral zone with rainfall of 100–300 millimeters per year and a subdesert climate. It is home, primarily, to transhumant cattle herders. The second is an agropastoral zone, which receives 300–600 millimeters of rain per year and is suitable for extensive farming (of millet mostly). Most households in this zone do not produce enough food to feed themselves and engage in goat rearing, casual labor, small trade, and seasonal migration to make ends meet. The third zone (the Maradi and Zinder regions) is characterized by semi-intensive, rainfed agricultural practices and livestock rearing. Finally, irrigated cash crops are grown in selected areas along the Niger River (World Bank 2017).
6. The period between harvests that lasts from May to August in the Sahel.
7. Data provided by UNHCR Niger in May 2015.
8. Poverty numbers presented in this document are consistent with the Niger SCD (2017). However, as in the case of the SCD, those estimates differ from official poverty numbers for Niger for two reasons. The available consumption data from the surveys have been transformed to assure comparability across time. The reported decline in poverty is encouraging but may be somewhat overstating actual progress made since the 2005 survey came following a drought year, whereas the 2014 survey was implemented during a relatively normal year. The decline is less than the decline suggested by Niger's official poverty numbers, which put poverty at 62 percent in 2005, 60 percent in 2011, and 48 percent in 2011 (INS 2015).

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Chapter 3
Looking Through the Glass—Poverty and WASH in Niger

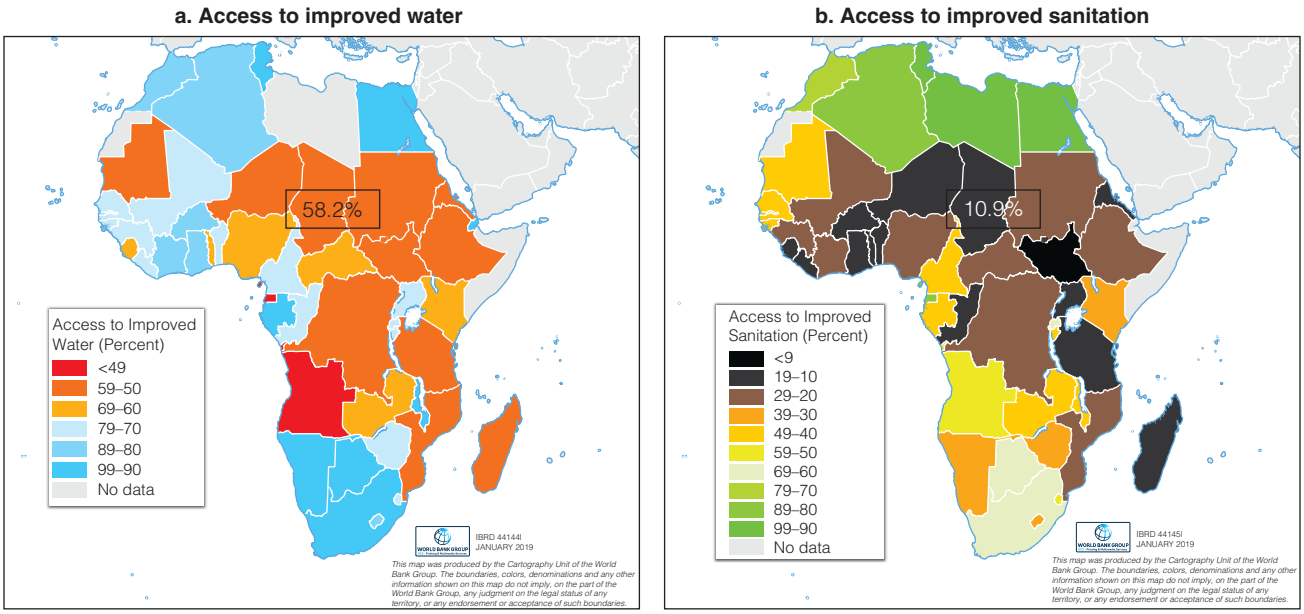
Main Points

- **Water supply and sanitation are at the crossroads of development challenges in Niger in terms of human capital, access to services, and infrastructure.**
- **Already struggling to maintain delivery of water supply, sanitation, and hygiene (WASH) services to its population at the Millennium Development Goal (MDG) level, Niger will need to push harder to move the needle of the Sustainable Development Goals (SDGs). Prioritizing interventions is indispensable.**
- **There are some notable improvements in water—mainly urban—but dwarfed by the remaining challenges in rural areas.**
- **Access to piped water is high in urban areas, but most is not on premises.**
- **Most of the rural population continues to rely on unprotected sources such as open wells and groundwater springs (51 percent according to WHO/UNICEF, 2015).**
- **Improvement in rates hides a more nuanced reality: demographic growth makes closing the access gap especially difficult in Niger.**
- **Location strongly determines access, notably to improved water; the gap is less marked in sanitation due to low overall access, although a gradient of access types also exists.**
- **The trend in access to sanitation is most concerning: open defecation is high and increasing in rural areas; close to 14 million rely on this practice.**
- **The poor in Niger have less access to improved water** supply **and sanitation; differences are more muted in rural areas at lower levels of access across incomes.**
- **Considering time to improved source (less than 30 minutes round trip), the access rate of the poor substantially decreases, particularly in other urban areas (by 32 percentage points as of 2014).**

Trends in Water Supply and Sanitation

Taking stock of the evolution of the access to improved water supply and sanitation in Niger at the closing of the MDGs provides a contrasted picture: some notable improvement in terms of access to improved water but sanitation remains sorely lagging. According to the World Health Organization–United Nations Children's Fund (WHO-UNICEF) JMP, overall improved water facilities are available to 58.2 percent of the population in Niger, while just over 10 percent of the population have access to improved sanitation. Still, those numbers hide important differences across urban and rural areas.

Map 3.1: Access to Improved Water Supply and Sanitation, Niger and Africa, 2015



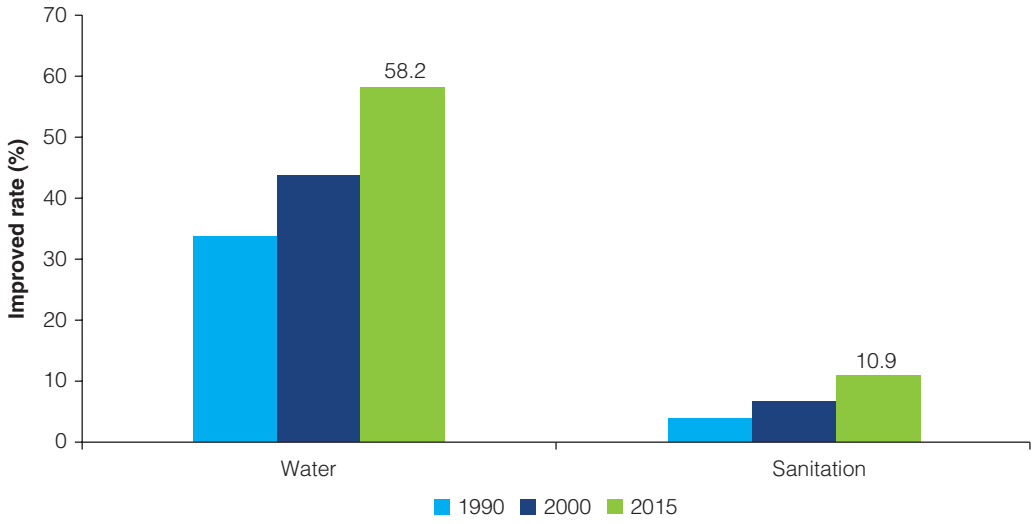
The important expansion of access to improved water in urban areas (39 percentage points between 1990 and 2015) contributed to Niger meeting the MDGs goals in urban areas and the advancement toward this goal to be rated as "good progress." The expansion in rural areas over this period, while important (rising from 29 percent to 49 percent), was insufficient to reach the MDGs. On the other hand, no progress on access to sanitation was registered over the period in Niger. (See map 3.1, panels a and b.)

These WASH rates are low and below Sub-Saharan averages. In spite of high access to urban water, low access to improved water in rural areas places Niger in the bottom tier for the continent. Of its direct neighbors, only Chad performs worse. The situation in terms of sanitation is especially poor. Only South Sudan performs worse than Niger in terms of access to improved sanitation (6 percent versus 10.9 percent), and Niger is in the top three countries of the continent with the highest prevalence of open defecation (over 70 percent) (see appendix M, figure M.1, for JMP estimates and discussion of differences in estimation).[1] The contrast is also stark when comparing Niger to its neighbor Mali, which presents much similarity with Niger in terms of development, socioeconomic profile, and geoclimatic context but has a national open defecation rate of only 10 percent.

Due to demographic growth, Niger is struggling just to stand still: population growth erodes improvement in access while it widens access gaps. While Niger saw an expansion of access to improved water (an increase of 24 percentage points since 1990, according to the JMP) and to a much smaller extent in improved sanitation (an increase of 7 percentage points), the reality of a very dynamic population growth means that in absolute numbers, people without access to improved water supply and sanitation have increased. As seen in figures 3.1 and 3.2, while an improvement in access rate can be observed over 25 years, the number of people without improved access as defined by the MDGs rose, more so for sanitation.

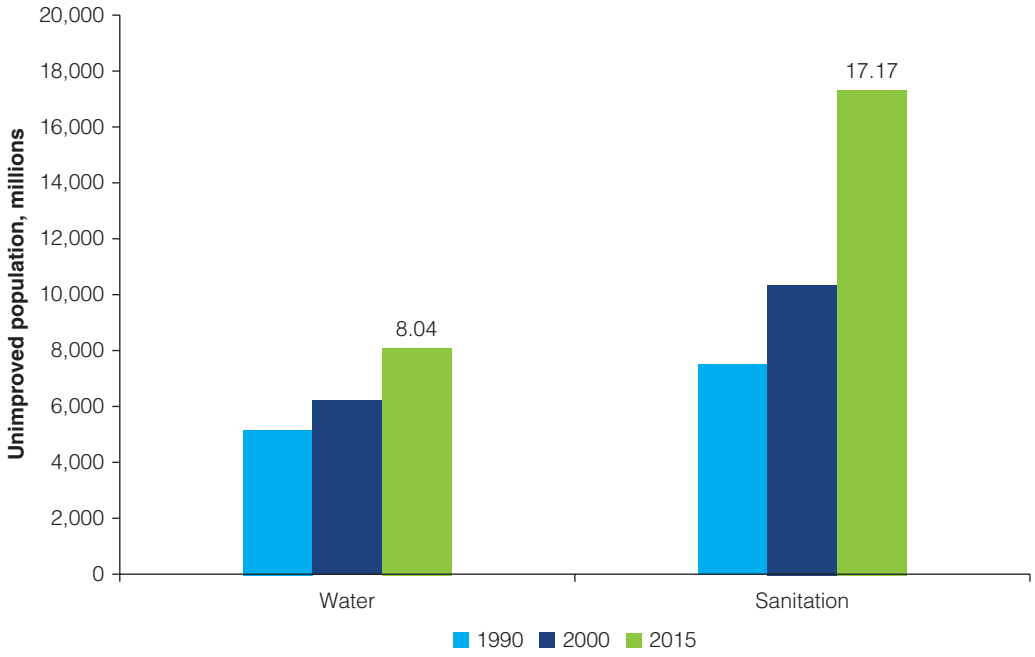
Looking ahead, the population that needs to be covered by 2030 is virtiginous, even using MDG-defined access indicators. As seen in figure 3.3, over 15 million Nigeriens will need access to improved water and over 32 million to improved sanitation.[2] The scope of the challenge is huge and daunting, requiring a good understanding of the evolution of the WASH sector to remedy access gaps and expand access, including in terms of quality. The rest of the section provides this systematic overview. Given the lags in access to improved water supply and sanitation in Niger based on the MDG definition of those indicators, the section proceeds with using this

Figure 3.1: Share of Population with Access to Improved Water Supply and Sanitation in Niger, 1990, 2000, and 2015



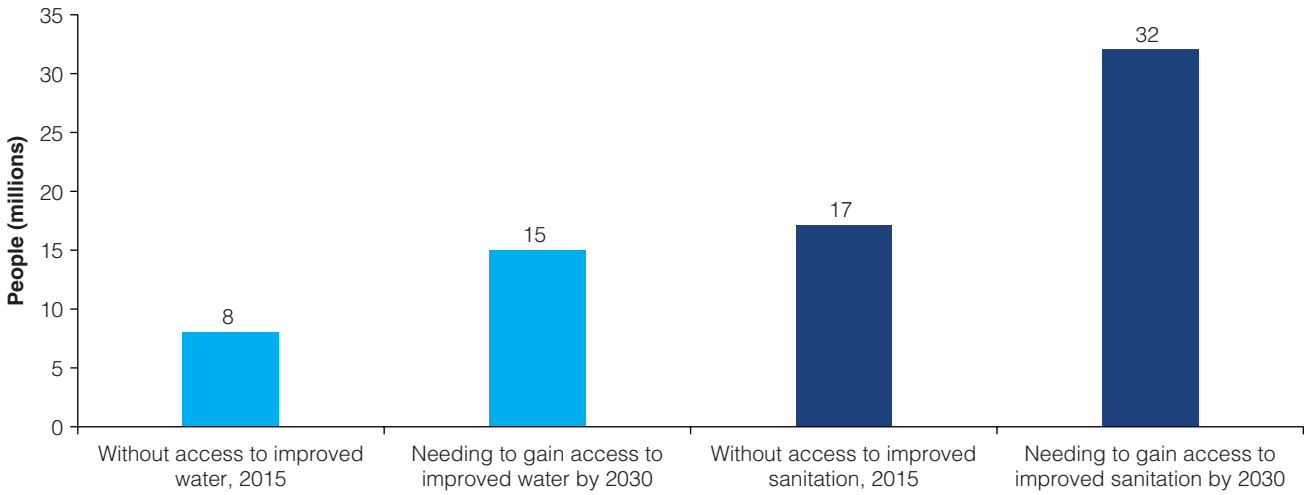
Source: JMP UNICEF 2015.

Figure 3.2: Number of People without Access to Improved Water Supply and Sanitation in Niger, 1990, 2000, and 2015



Source: JMP UNICEF 2015.

Figure 3.3: Population without Access to Improved Water Supply and Sanitation in Niger, 2015 and by 2030



Sources: UNICEF 2015; UN Urbanization prospects.
Note: Based on MDG definition of water supply and sanitation access.

definition while integrating in the analysis dimensions of the new SDG definition. The reason to choose the MDG definition stems from two facts. First, this was the indicator of reference over the period of reference. Second, due to the persistent access gaps using the MDG definition—particularly with respect to sanitation—using the new SDG definition could lead to the wrong perception that the new SDG yardstick is behind the poor indicators observed, thus interfering with the much needed mobilization around the sector.

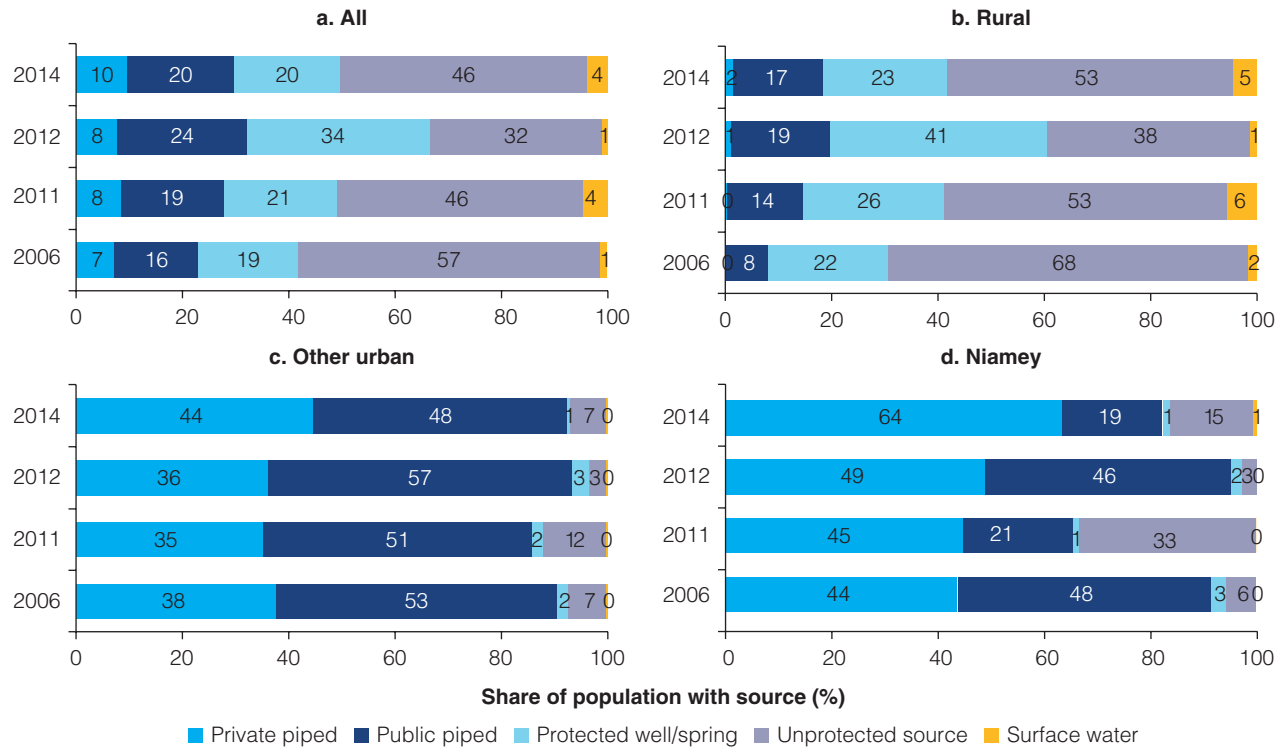
Evolution in Service Quality

Service quality has been improved in the water sector, especially in urban areas. As seen in figure 3.4, panels a–d, access to improved water expanded across areas. While some difference is observed between the types of national surveys (Demographic and Health Survey [DHS] 2006 and 2012, and the Living Standard Measurement Survey [LSMS] 2011 and 2014) both attest to an increase in the share of the overall population having access to improved water sources.[3]

Two facts are worth highlighting. First, there is the considerable expansion of private piped water in Niamey, which increased by a staggering 19 percentage points from 2011 to 2014. While the increase is smaller in other urban areas (9 percentage points from 2011 to 2014), this is no less of a remarkable accomplishment. However, the second salient point pertains to reliance on unprotected sources such as open wells and groundwater springs by a majority of the rural population. The large increase in access to protected wells and springs observed by the DHS surveys between 2006 and 2012 is not found in the more recent LSMSs (2011 and 2014). Regardless of the differences between surveys, it is clear that the rural population experiences a much lower service quality than its urban counterpart. The gap between the two access rates is more pronounced than in other African countries due to the comparatively high coverage observed in Niamey and other urban areas (see appendix O for a regional comparison.

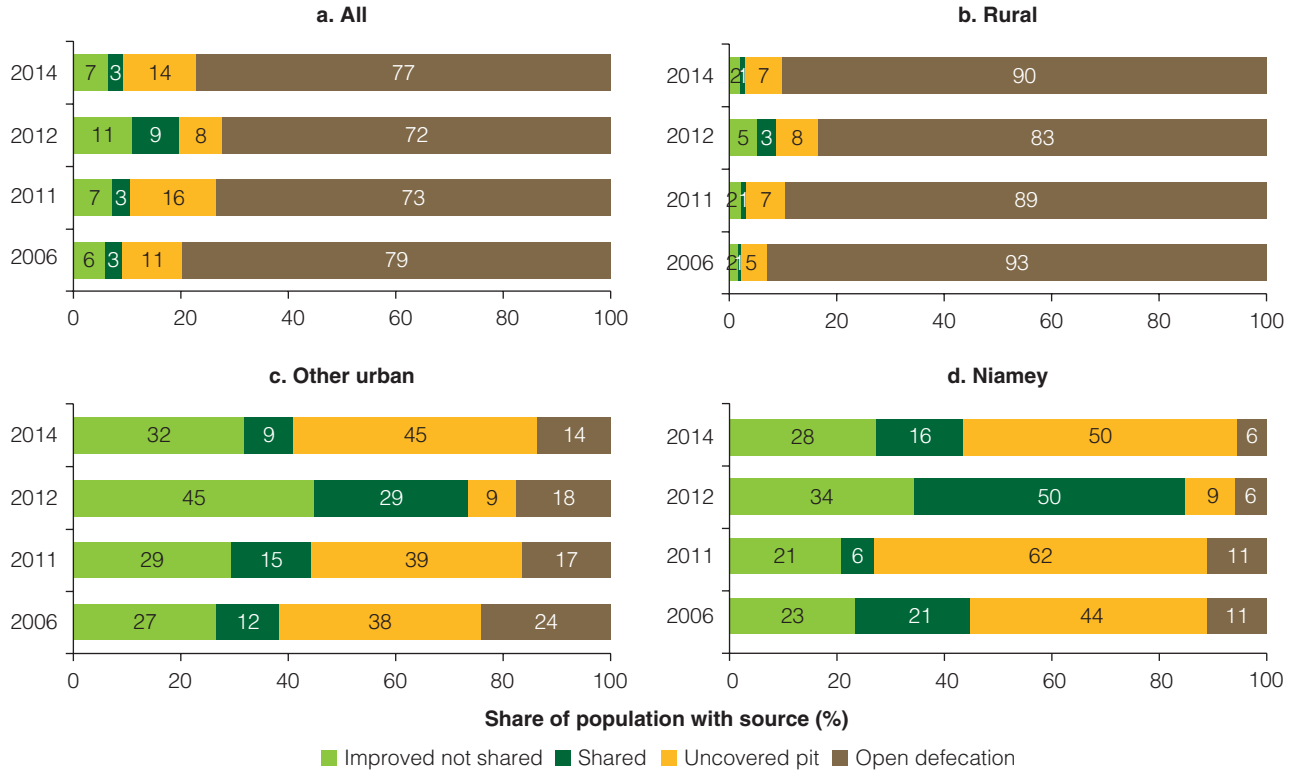
The trend in access to sanitation is concerning, especially outside of Niamey where open defecation dominates (90 percent in rural areas as of 2014). Sanitation is an urgent issue in Niger: improved indicators for sanitation are extremely low in urban and rural areas, and population growth makes maintaining and expanding those poor access rates particularly challenging.[4] As seen in figure 3.5, panels a–d, though important differences can be seen

Figure 3.4: Access to Water by Service Type in Niger, 2006–14



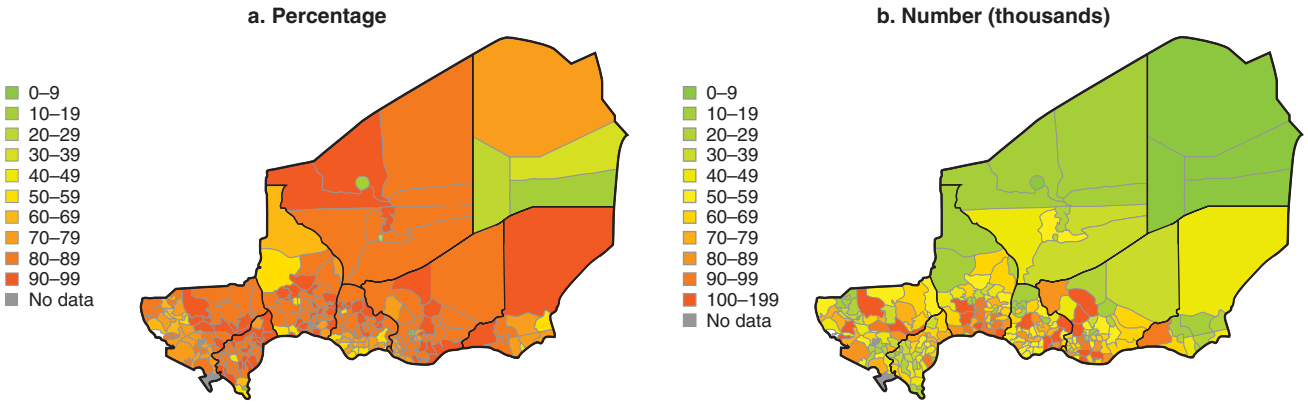
Source: World Bank calculations using DHS 2006, 2012; LSMS 2011, 2014.
Note: Improved water for 2011 and 2014 is an average between wet and dry seasons.

Figure 3.5: Access by Sanitation Service Type in Niger, 2006–14



Source: World Bank calculations using DHS 2006, 2012; LSMS 2011, 2014.
Note: Improved sanitation is not adjusted for shared.

Map 3.2: Share and Numbers of Population Relying on Open Defecation, Niger, 2012



Source: World Bank calculation based on 2012 RGPH population census.
Note: Data organized by communes based on the 2012 census.

across surveys, urban unimproved sanitation and rural open defecation dominate. All surveys point to open defecation as the prevalent situation in rural settings. Using the data of the 2012 census to contrast open defecation rates with the absolute number of people relying on open defecation provides a first cut of the priority communes in which the largest number of Nigeriens rely on open defecation (map 3.2, panels a–b). Unsurprisingly, this highlights area of important population density in rural areas.

A further grave sanitation-related problem is the widespread lack of a functional service chain for the safe disposal of fecal matter. There is no piped sewerage of scale even in Niamey, and thus no wastewater treatment. For the predominant on-site solutions, professional emptying and transport of accumulated fecal matter remains rare and limited to Niamey. No safe public disposal or treatment sites exist even in the largest cities. In other words, even "improved" latrines that safely contain fecal matter in the short term generally cannot be considered safe from a public health perspective, because accumulated fecal matter ultimately overflows or is unsafely dumped in irregular disposal sites. Thus, while open defecation is especially preoccupying, the absence of fecal sludge management is of no less of a concern. Policy makers must give it renewed attention along with the expansion of access to sanitation (improved and otherwise).

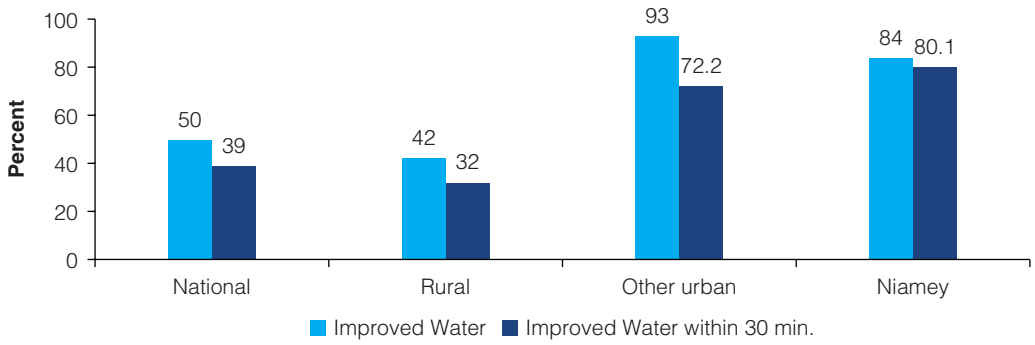
Gaps in the WASH Sector toward Achieving SDGs

Looking beyond access and toward the SDG flags, Niger presents a considerable gap in the WASH sector, even compared to other Sub-Saharan countries. The UN SDGs for the post-2015 period aim to capture a more complex understanding of WASH services than the binary "improved" and "unimproved" categories of MDG, including such factors as time to water sources, water quality, quantity and continuity of supply, affordability and quality of service management, handwashing, and child feces disposal. Only some of these variables are captured in routine household surveys, but those that are indicate low sector performance and limited improvements in "access plus." For instance, time to fetch water is way above the average for Sub-Saharan Africa, having even increased between 2006 and 2012 to close to 50 minutes (round trip) (figure 3.7). In urban areas, the trend of increase in time for water fetching is in part reflective of the expansion of access to water on premises, but nonetheless preoccupying for households without such access (which tend to be poorer). In rural areas, the increase in fetching time is especially problematic. With the new SDGs raising the bar of access to improved water to include a maximum round-trip time less than 30 minutes, Niger's access rates will take an additional stumble, particularly in rural and other urban areas. According to the 2014 LSMS, including this round-trip time in the definition of improved access

to water drops access to improved water in other urban settings by 21 percentage points, while in rural settings, the drop is 9 percentage points (figure 3.6).

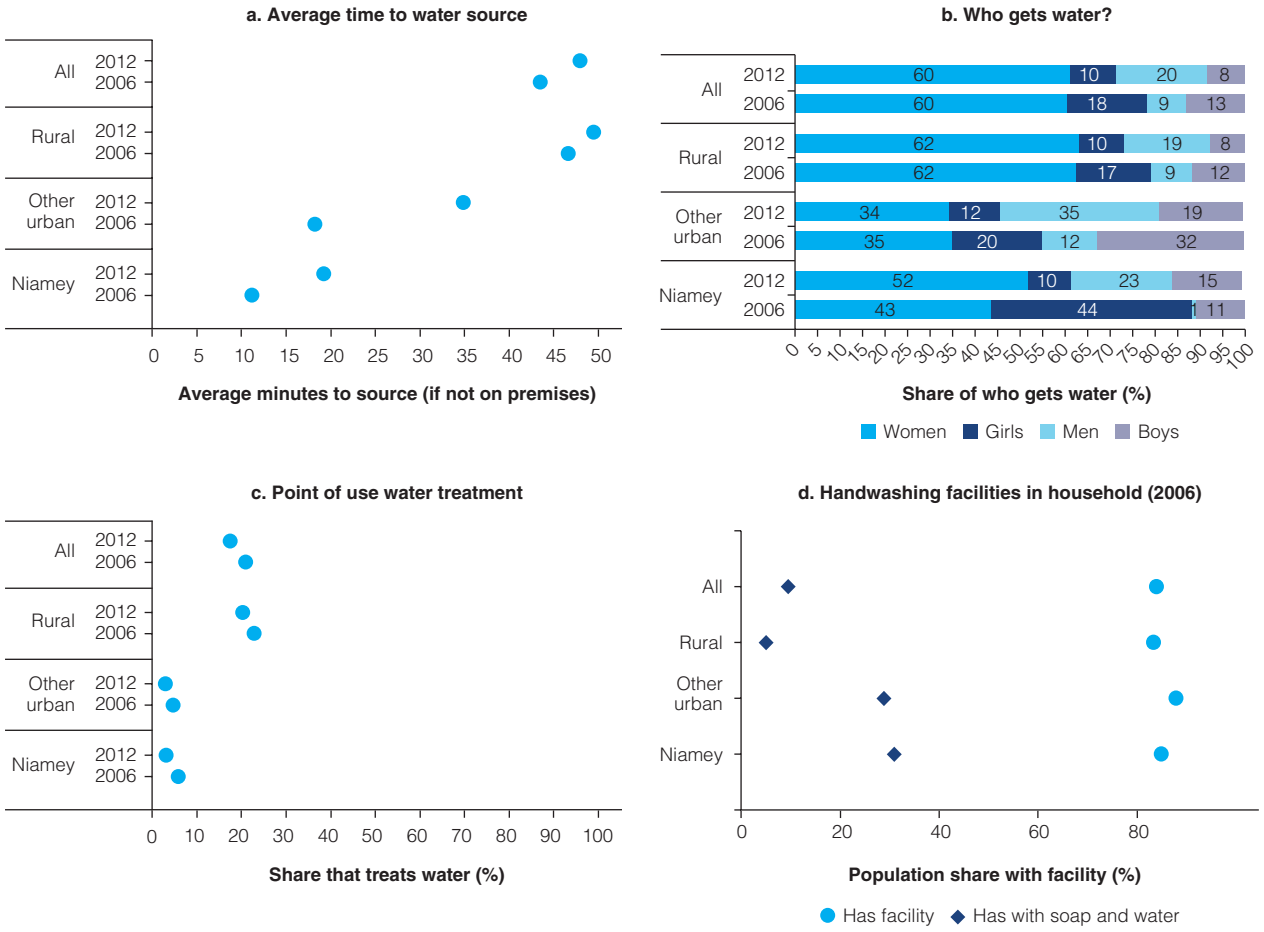
As seen in figure 3.7, panel d, handwashing, another dimension for the upper tiers of the new improved sanitation SDG indicator, is particularly low when considering whether the facility has soap and water. Both time to improved water source and low handwashing raise additional concerns for water quality.[5]

Figure 3.6: Access and Distance to Improved Water in Niger, 2014



Source: World Bank calculation based on 2014 LSMS.
Note: Accounting for distance to water source further challenges indicators of water access.

Figure 3.7: Selected "Access Plus" Indicators in Niger, 2006, 2012



Source: World Bank calculations using DHS 2006, 2012.

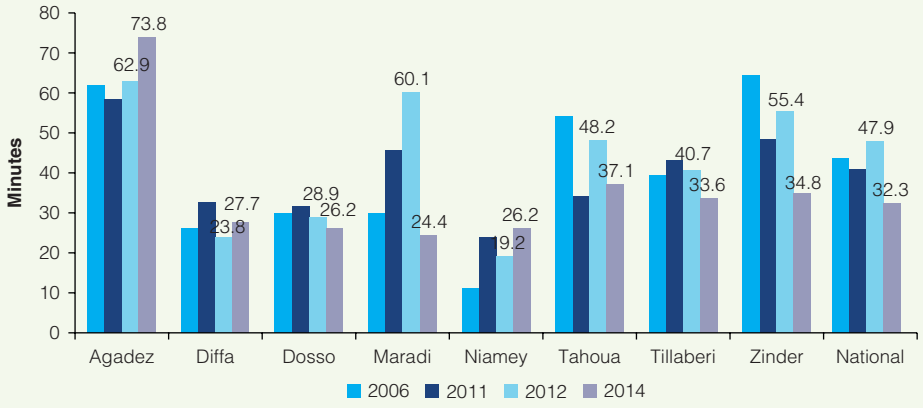
Box 3.1: Precious and Finite: Time and Water Scarcity

Time spent just to reach water fetching points (improved or not) is particularly high in Niger, with wide regional disparities (see figure B3.1); these reflect, notably, location and climatic conditions. The regions of Agadez and Zinder not only face higher time to water source but also are exposed to climatic variations of water sources, as reflected in the important variation across years.

Still, nationally, average fetch time was close to 50 minutes in 2012 (DHS). Using this figure, this means that on average—women and girls (as well as for about a fourth of the situations—men and boys) spend about 13 full days per year traveling to fetch the water! This time does not factor in the number of rounds this chore has to be repeated, which we know from anecdotal evidence to be several times to respond to the need of large families, particularly in rural areas.

Field visits in the region of Dosso (September 2016) confirmed that water collection is the responsibility of women, typically mobilizing up to six hours per days for a household (about 10 people, including water needs for cattle and garden, to retrieve 12 by 25 liters (water jerry cans). Incidentally, time to source, while a good measure of access, does not fully capture the extent of the burden placed primarily on women and girls to collect water. This has far-reaching implications for personal safety. Two of them are particularly worth highlighting. First, distance to water source exposes women, girls, and boys to assault on the way to collect water. Women try to mitigate this risk in coordinating trips, but such strategies are not always sufficient. Second, time allocated to fetch water is time unavailable for other productive usage. This is particularly problematic for girls, but also for boys. While the low level of education in Niger makes it difficult to capture the effect of such time burden on educational outcomes of girls and boys, there is little doubt that this represents an additional hurdle to the accumulation of social capital, particularly in rural settings.

Figure B3.1.1: Average Time to Water Source (Round Trip in min.) by Region in Nigeria, 2006–14



Sources: World Bank calculation using DHS 2006 and 2012 and LSMS 2011 and 2014 data.

box continues next page

Box 3.1: Continued

The panel data of the 2011–14 LSMS indicate a national downward trend (in spite of the large increase in Agadez in 2014). A cautious optimism should be applied and conditioned on the next round of data collection, given the wide disparity between data sources, even those collected a year apart (e.g., between the LSMS and DHS). More data are needed to grasp the full extent of water chores on households' members to contextualize the new SDG indicators.

Table 3.1: Types of Water Treatment Used by Households in Niger, 2006 and 2012

Water treatment type	Area	2006 DHS	2012 DHS
Households treating water by boiling	Total	0.1	0.1
	Urban	0	0.1
	Rural	0.2	0.1
Households treating water by adding bleach/chlorine	Total	0.1	0.3
	Urban	0.1	0.3
	Rural	0.1	0.2
Households treating water by straining through a cloth	Total	17.1	15
	Urban	2.5	3
	Rural	20.1	17.4
Households treating water using a ceramic, sand or other filter	Total	0.2	0.4
	Urban	0	0.1
	Rural	0.3	0.5
Households treating water using other methods	Total	0.1	1.6
	Urban	0	0.1
	Rural	0.1	1.9
Households not treating water	**Total**	**71.3**	**83**
	Urban	**95.2**	**96.5**
	Rural	**73.7**	**80.4**

Sources: DHS 2006 and 2012.

Water quality and limited water treatment are especially preoccupying. Despite the considerable increase in piped water, unprotected sources nonetheless represent 15 percent of access in Niamey, which is particularly problematic due population density and poor sanitation. These factors are likely to increase health exposure of those relying on this source of water. Household surveys do not typically collect data that include water testing. To reflect the gradient and ladder of water access within the improved category, piped water access is used as a proxy for "safe" water. While piped water is certainly preferable to the alternative, contamination is likely still be high even in the case of piped water, if only due to contamination between the point-of-collection and -use. While piped water on premise (private piped) is expectedly low in rural areas (less than 2 percent), even in urban areas outside of Niamey only 44 percent of households enjoy such access (versus 64 percent in Niamey). A context of low access to sanitation and high vulnerability to shocks further heightens the pathways to water contamination. This is particularly true in a context of abysmally low rates of water treatment by households and faltering treatment by water schemes.[6] Regardless of the type of procedure or treatment used, the point-of-use water treatment is low and virtually unchanged between 2006 and 2012 (table 3.1). In fact,

a larger share of household uses no water treatment in 2012 (83 percent) than in 2006 (71.3 percent). While the expansion of piped water could explain such trend in urban areas, a similar increase in the share of rural households not treating their water (from 74 percent in 2006 to 80 percent in 2012) is of concern.

Low WASH Access for the Poor and Lack of Safe Services

As could be expected, the poor have less access to improved water supply and sanitation than the nonpoor. Among the 44 percent of the population living below the national poverty line, access to safe water is just over 40 percent and access to improved sanitation in close to nonexistent (0.5 percent): both more than 10 percent points below the access of the nonpoor. As seen in table 3.2, access increases with household expenditure. For instance, while piped water is nearly nonexistent for the poor, 15 percent of the top 60 (T60) percent have access to piped water (the situation is further contrasted across living areas). However, close to 27 percent of households in the top 10th decile (by expenditure levels) still rely on unimproved water sources, and a majority uses unimproved sanitation (with over 30 percent relying on open defecation, whose prevalence cuts across all expenditure groups—a shocking equalizer). Incidentally, while richer Nigeriens do have better access to basic water supply and sanitation services, unsatisfactory access is prevalent across expenditure levels, particularly in terms of sanitation. Looking at poverty from an asset wealth instead of income wealth perspective emphasizes the fault lines between poor and nonpoor (table 3.3).

The difference between the poor and nonpoor in access rate is more marked in urban areas, while rural populations have lower access regardless of their poverty status. Access to improved water by the poor increased in rural areas (from 37.36 percent in 2011 to 41.2 percent in 2014) and Niamey (51.9 percent in 2011 to 55.2 percent in 2014). It remained unchanged in urban areas outside of Niamey at a relatively high 86 percent. Important differences exist between the poor and the nonpoor in urban areas, particularly in Niamey. Yet, the poor in Niamey enjoy better access than even the rural nonpoor (figure 3.8).

Across areas, the poor have benefited from an improvement in a higher quality of access to improved water. Looking at access to improved water in less than a 30-minute round trip shows that even the poor saw an improvement in the type of improved access at their disposal.

Table 3.2: Access to Improved Water Supply and Sanitation by Household Expenditure Level in Niger, 2014

Household expenditure level	Improved water	Piped on premises	Improved sanitation (not shared)	Open defecation
Below poverty line (%)	43.19	1	0.46	92.45
Above poverty line (%)	54.97	16.44	11.74	64.51
B40 (%)	42.99	0.79	0.19	93.47
T60 (%)	54.20	15.46	11.06	65.97
10th decile (%)	73.34	48	27.29	32.92
1st decile (%)	42.47	0.13	0	93.59
National (%)	**49.72**	**9.59**	**6.71**	**76.98**
Number of people	**8,795,503**	**1,726,500**	**1,227,582**	**14,100,000**

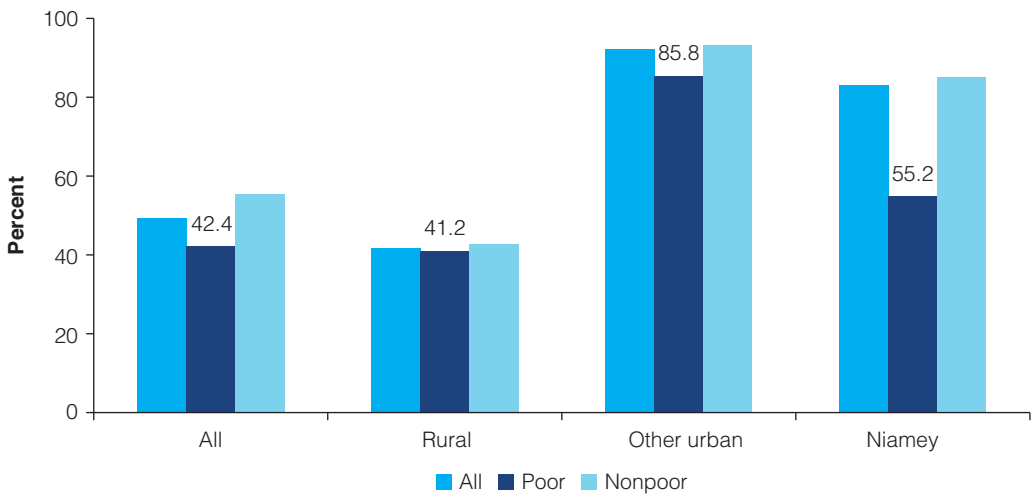
Source: World Bank calculation based on LSMS 2014.
Note: B40 = bottom 40% of the population; T60 = top 60% of the population.

Table 3.3: Access to Improved Water Supply and Sanitation by Household Wealth Index in Niger, 2012
Percent

Asset	Improved water	Piped on premises	Improved sanitation	Open defecation
B40	47.5	0	0	100
T60	79.1	12.9	18.4	53.2
10th decile	96.7	61.8	52.6	1.6
1st decile	28	0	0	100
National	**66.5**	**7.8**	**11**	**72**

Source: World Bank calculation based on DHS 2012.
Note: B40 = bottom 40% of the population; T60 = top 60% of the population.

Figure 3.8: Access to Improved Water by Poverty Status (Expenditure) in Niger, 2014



Source: World Bank calculation based on 2014 LSMS.

Nationally and in rural areas, the poor saw the largest increase in access to improved water within 30 minutes between 2011 and 2014 (respectively, increases of 12.7 percentage points nationally and 14 percentage points rurally) (table 3.4 and figure 3.9).

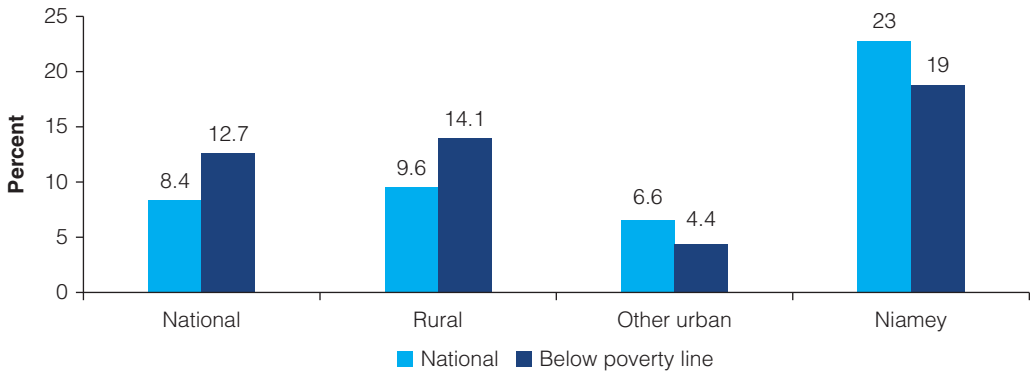
But the relatively high access to improved water by the poor living in urban areas outside of Niamey is much more nuanced when taking time into consideration. While all improved water access indicators decrease when accounting for a distance to source less than 30 minutes away round trip, the gap is most pronounced in the case of other urban areas (figure 3.10). Indeed, more than any other areas, improved access in other areas substantially decreases (by 32 percentage points) when considering an improved water source less than 30 minutes round trip (from 86 percent for simple access to improved water to 54 percent for improved access [less than 30 minutes round trip] in 2014). Interestingly, the poor in Niamey who do enjoy an improved access to water enjoy it less than 30 minutes from their residence (the difference is only 5 percentage points between the different types of access compared to close to 10 percentage points when considering all the capital residents). For rural households, the difference between the two types of improved water access is 10 percentage points for the poor, the same as it is for all rural residents, dropping access to an improved source of water to 33 percent when accounting for time. This means that the inequality in the quality of access to improved water between the poor and the nonpoor is more pronounced in other

Table 3.4: Access to Improved Water Less Than 30 Minutes Away in Niger, National and Below Poverty Line, 2011 and 2014
Percent

	National		Rural		Other urban		Niamey	
	2011	2014	2011	2014	2011	2014	2011	2014
National	**29.3**	**37.7**	**21.4**	**31.1**	**63.5**	**70.1**	**51.8**	**74.8**
Below poverty line	20.7	33.4	18.6	32.7	49.7	54.2	31.3	50.6

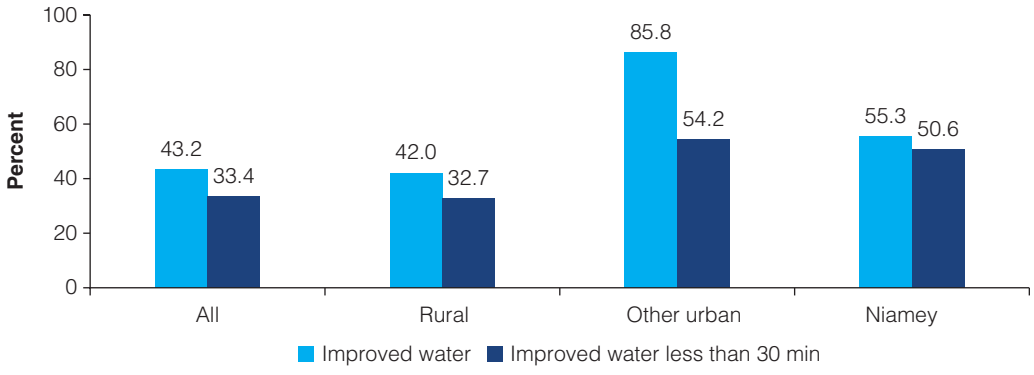
Sources: World Bank calculation based on 2011 and 2014 LSMS.

Figure 3.9: Changes in Access to Improved Water Less Than 30 Minutes Away in Niger, 2011–14



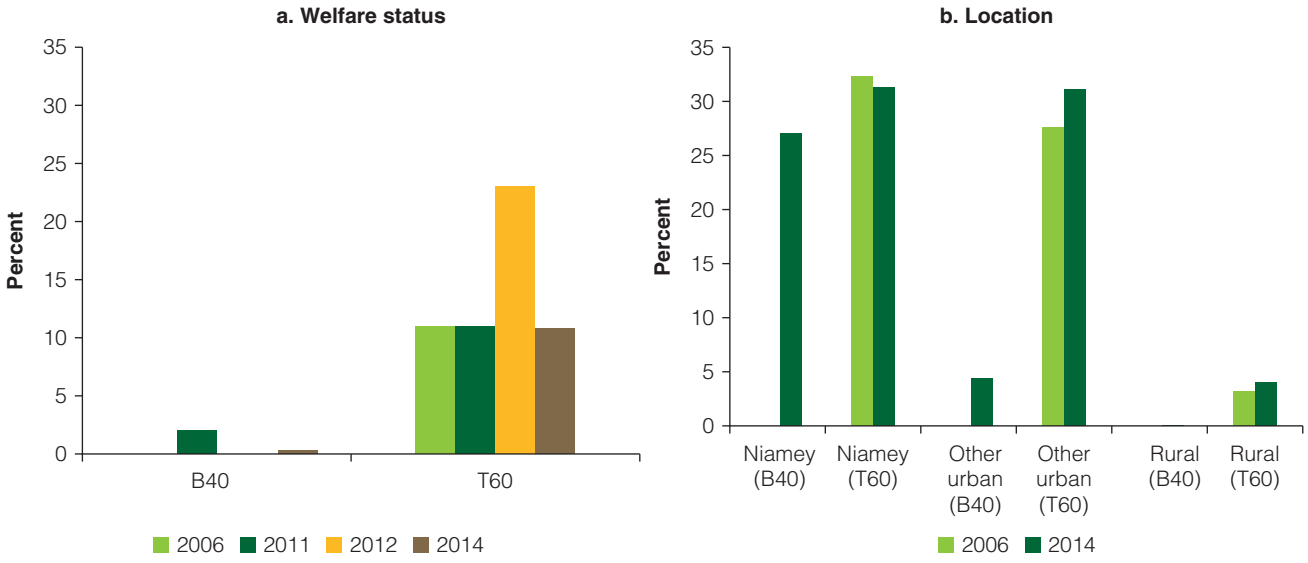
Sources: World Bank calculations based on 2011 and 2014 LSMS.

Figure 3.10: Improved Water Compared to Improved Water Less Than 30 Minutes Away for those Below Poverty Line in Niger, 2014



Source: World Bank calculation based on 2014 LSMS.

Figure 3.11: Access to Improved Sanitation, by Welfare Status (B40/T60) and Location



Sources: World Bank calculation using DHS 2006 and 2012 and the LSMS 2011 and 2014.
Note: Adjusted shared sanitation; B40 = bottom 40 percent of the population; T60 = top 60 percent of the population.

urban areas. Still, in those areas and in Niamey, even the poor enjoy access rates above 50 percent to an improved source less than 30 minutes away, whereas only 33 percent of poor rural residents do.

Access to improved sanitation: smaller urban v. rural access gap but resulting from low access rates across welfare status. The gap between urban and rural is much less in the case of sanitation. However, the lack of inequality of access reflects only the low level of sanitation coverage for all. The richest (T60) enjoy higher access to improved sanitation, but the rate remains low (figure 3.11).[7] Again, as in the case of water, the poor in Niamey have better access than the nonpoor in rural areas. If access is poor across areas, the type of access nonetheless varies by location. While the poor have low access to improved sanitation everywhere (less than 7.2 percent for nonshared improved sanitation even in Niamey; less than 6 percent in other urban areas), 34 percent of the T60 in other urban areas and 28 percent in Niamey enjoy such facility as of 2014 (compared to less than 5 percent of the T60 in rural areas).

Open defecation has increased due to population growth, with more than 14 million people relying on this practice in 2014 (table 3.5). Except for the richest decile of the population, open defecation increased between 2011 and 2014. Even among the T60, open defecation rates did not decrease, and over 65 percent of households relied on open defecation in 2014. Not surprisingly, the poor are consistent with this trend, with an increase from 87 percent in 2011 to 92 percent in 2014.

Effects of Location on WASH Service Access and Poverty

Location trumps poverty: location is the strongest determinant of access. Whether using a basic regression analysis to look at the determinants of access (using the 2014 LSMS

Table 3.5: Evolution of Open Defecation across Welfare Categories in Niger, 2011 and 2014

Household expenditure level	2011	2014
Below poverty line (%)	86.94	92.45
Above poverty line (%)	61.12	64.51
B40 (%)	87.57	93.47
T60 (%)	63.86	65.97
10th decile (%)	86.38	32.92
1st decile (%)	86.38	93.59
National (%)	**73.42**	**76.98**
Number of people (millions)	**11.5**	**14.1**

Sources: World Bank calculation using 2011 and 2014 LSMS.
Note: B40 = bottom 40 percent of the population; T60 = top 60 percent of the population.

Box 3.2: Reasons for Open Defecation in Niger

Niger stands out as an outlier when it comes to the prevalence of open defecation—even when compared to its direct neighbors (such as Mali). As in other countries experiencing a high persistence of open defecation, the reasons behind Niger's high rate are complex and multidetermined, comprising a combination of supply-side issues (e.g., access to latrines, affordable building materials) and demand-side, or "user-centered," issues (e.g., cultural and religious beliefs, relative convenience, and affordability; for a recent review, see O'Connell [2014]).

In 2014, the World Bank Water Supply and Sanitation Program (WSP) conducted a formative research on behaviors toward sanitation (WSP 2014). The results show that high rates of open defecation are driven by lack of access, *not by preferences*. Most respondents (82 percent) did not mention any advantage of open defecation, with no difference between male and female respondents. The majority of respondents (73 percent) indicated not being satisfied with the available place for defecation; 86 percent of respondents who relied on open defecation claimed they would stop if they had a latrine; and 95 percent, if they had a latrine in their compound. However, it is also clear that the cost of building a latrine is not the only impediment given the low access to even the most basic form of unimproved sanitation. Those results are thus also indicative of a de facto social acceptance of the practice and of the need to intervene at the community level to affect change in practice.

The policy challenge is how to support people in constructing latrines that are sanitary, provide privacy, and are convenient. Additionally, concerns for the protection of the underground water quality should be factored into the interventions that promote latrine construction (Graham and Polizzotto 2013).

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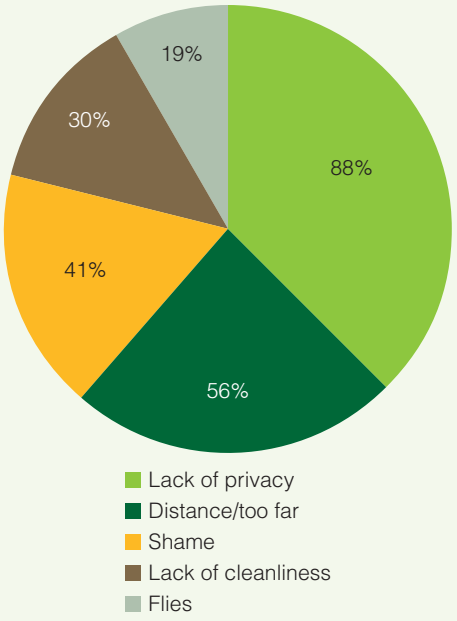
Box 3.2: Continued

Figure B3.2.1: Concern for Privacy, Not Health and Sanitation, Drives Dislike for Open Defecation

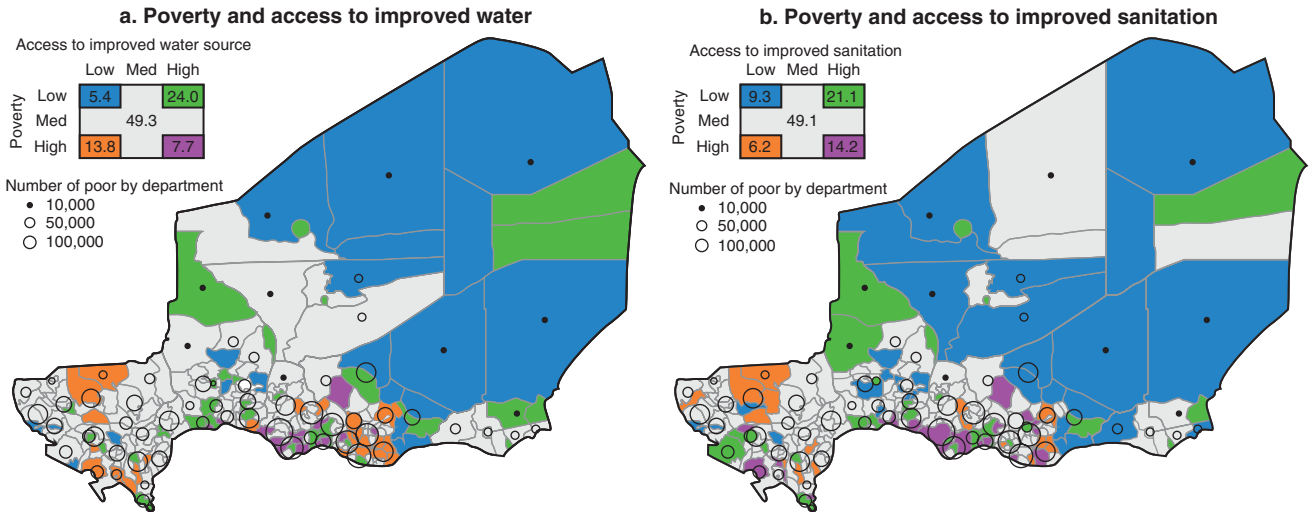


Source: WSP 2014.

[appendix Q, table Q.1]) or the latest poverty map for Niger, it is clear that location matters more for access than poverty status: rural areas in Niger appear to be inherently disadvantaged in terms of WASH service access.

However, differences exist, even within poor rural areas, and looking at outliers (positive and negative) can help inform action. Using the new Niger poverty map to zoom in to look at the 100 poorest communes shows a contrasted picture in the relation between poverty and access to water supply and sanitation, further pointing to the importance in looking at outliers. Those 100 communes are 20 percentage points poorer than the national average for all communes, but only 10 points poorer when compared to rural communes only. While their access rate is lower (15.4 percent) than the country as a whole (23.5 percent), it is, surprisingly, slightly higher when compared to all rural communes (13.8 percent). For the access to water, again the outcome is surprising: the poorest communes have an access rate similar to the national level and significantly better than all rural communes (see tables, figures, and map in appendix S for a more detailed discussion and list of those 100 poorest communes). Using the Niger poverty map can refine this further and identify typologies of WASH access and Poverty of interest for policy makers (map 3.3, panels a–b, and accompanying table 3.6).

Map 3.3: Poverty and Access to WASH – Localizing Outliers



Source: Niger Poverty Maps (2017) – based on the Niger Census (2012) and LSMS (2014).

Table 3.6: Analysis of Map 3.3, Panels A–B, Comparing Priority and Lesser Priority Communes in Niger

Priority communes:	Lesser priority communes:
• Communes performing better than would be expected (high poverty, high access, in purple): these are positive deviants. Learning why these communes are performing better than expected, for instance through qualitative work, could help inform strategies to expand access. • Poor communes with poor access to WASH (in orange). • Poor communes with poor access to WASH and large number of poor (in orange with circles) • Communes with average poverty and average access (in gray in the maps), but potentially concentrating an important number of poor (circles on the maps).	• Communes performing worse than would be expected (low poverty, low access, in blue): a category that may unearth the reasons explaining this poor performance, particularly for those concentrating a high number of poor (circles). • Better-off communes (comparatively lower poverty, high access, in green).

Implications of Access, Poverty, and Location for Policy Makers

A close analysis of the available data on WASH access in Niger reveals several major policy challenges in view of the new universal SDG access targets. The majority of the population and most of those lacking access to improved water remains rural. The question of rural access is closely linked to that of access for the poor, because it is the rural poor who suffer from extremely low access to improved water, while the urban poor tend to profit from generally better supply in cities. Universal access as targeted by the SDGs will not be achieved without major efforts to improve water supply in rural areas where it has traditionally lagged. Although improved water access is overall higher in cities at present, it is eroding in the face of rapid population growth and because most urban Nigeriens do not have access to water on premise.

Quality of access—in particular water quality—is a major concern that cuts across location and source types. As is recognized by the new SDGs, if human health and development are the ultimate aim, access to technically "improved" water is not meaningful if it is not easily available or truly safe to drink. Unfortunately, the available evidence suggests that improved sources are often far from households, which increases contamination pathways as well as safety risks, especially for women and children, and takes up time that could be used in other ways. An additional concern is that most households—urban and rural—and most water supply systems do not sufficiently treat water or treat water at all, exposing even piped water to the risk of contamination at point-of-use.

In the sanitation sector, "improved" access is woefully inadequate in both urban and rural areas. The particularly problematic practice of open defecation has stubbornly persisted and even increased. In expanding urban areas, an improved access rate stagnating below 40 percent (with 14 percent of open defecation) is nothing short of a public health crisis—more so in a context of climate vulnerability. The shift toward a more qualitatively oriented definition of sanitation under the SDGs (which seek to include handwashing and safe disposal of fecal matter) further highlights the gaps in improved access that Niger faces. Access to the highest SDG sanitation tier is all but unheard of in Niger. Considering this, the SDG target of universal access in just 15 years is overambitious without a reprioritization of the issue.

The new poverty map for Niger can help prioritize areas where poverty is high and access particularly lagging (see appendix). Over 15 million of people will need access to improved water, and 32 million to improve sanitation. In a country already struggling to maintain current rates of WASH service delivery at the MDG level, Niger will need to push twice as hard to move the needle of the SDG. Prioritizing interventions is indispensable. This spatial zoom at the commune level not only highlights priority areas but also links with the new responsibilities of those communes in terms of WASH (further discussed in chapters 4–5), helping to sketch the perimeter of the integrated interventions that could this challenge.

This challenge is sobering, but as Chapter 3 will outline, the enormous impacts of unsafe water supply and sanitation on health and human development, more so in a country exposed to climate vulnerability, only highlight the importance of achieving the SDGs, which should not only be a moral but an economic obligation for policy makers.

Notes

1. The reason for the apparent JMP overestimate of national level access (i.e., the trend line appears above most individual estimates is that the JMP does not take the national survey results directly from the surveys; instead, it takes the rural and urban results separately, and then reaggregates these to a national value using the United Nations Procurement Division (UNPD) population estimates, thus obtaining a national level access estimate different from the one in the original survey.
2. "Population that needs to gain access" equals population currently without access (as per LSMS or DHS) plus all projected population growth to 2030 as per UN Urbanization Prospects. No expansion of access at current rate factored in. The figure rises to, respectively, 27.5 million and 33 million using the 2014 LSMS/ISA estimates.
3. Overall percentages of individual surveys differ slightly from the WHO/UNICEF JMP figures, which are computed as a trend line estimate, effectively averaging results from multiple surveys. See appendix N for further details on those computations.
4. Even when using the JMP estimates, which tend to give more positive estimates due to the computation method used to harmonize surveys across countries, Niger has a massive lag in access to improved sanitation (only 38 percent have improved access in urban and just 5 percent in rural as of 2015) and has an overwhelming prevalence of rural open defecation (WHO/UNICEF 2015). The 2012 DHS survey stands as an outlier in its estimations of urban improved sanitation. The 2011 and 2014 LSMS show lower access to improved

sanitation, particularly in other urban settings, but also in Niamey. Given the proximity of dates of those three surveys, it is unlikely that such differences are due to variation in sanitation infrastructure but are rather data-driven. Sewage connection, not included in the MDG sanitation, measures at less than 10 percent of urban sanitation across surveys and years. See appendix N on JMP computation versus estimates from survey.

5. Handwashing data were not well-collected for the 2012 DHS and thus only the 2006 data can be used for analysis.
6. An assessment of the water quality in 19 water supply schemes in Niger indicated that 18 out of 19 centers do not have a chlorination system and that water quality is poor in four centers (Maiga 2016).
7. Consistency in estimates between 2011 and 2014 (LSMS) would seem to confirm that 2012 (DHS) stands as an exception likely driven by measurement issues. The data point is nonetheless included in the analysis because it has been integrated in the JMP estimates for Niger.

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Chapter 4
Climate Vulnerability—Linkages Among Nutrition, Health, and WASH

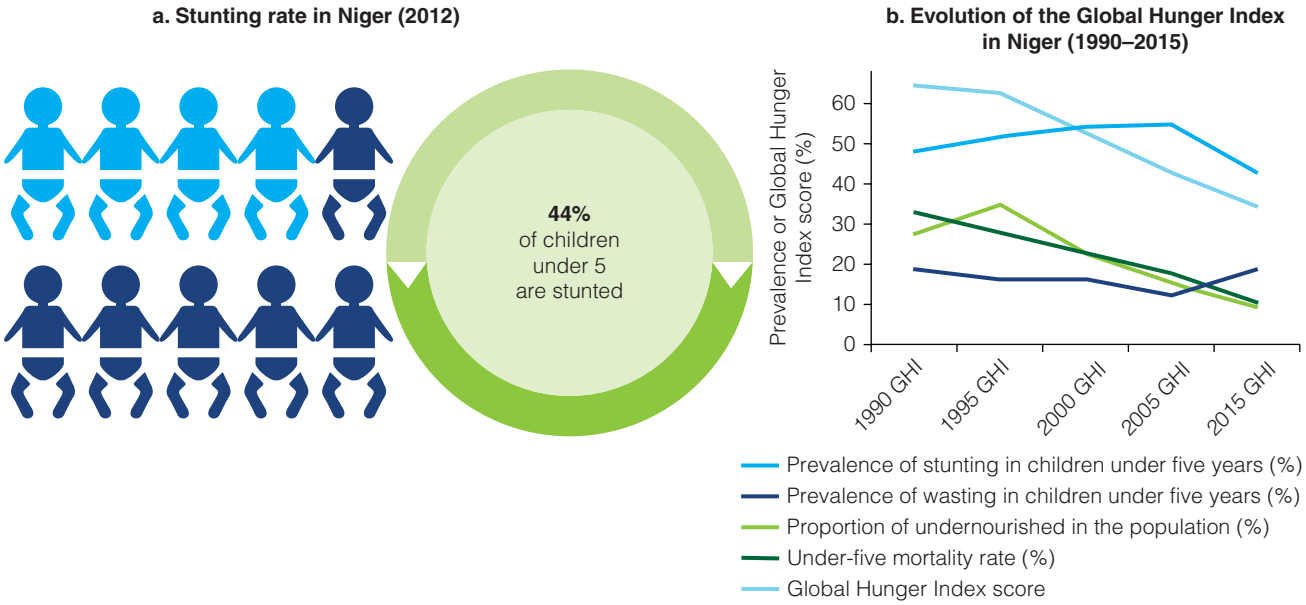
Main Points

- Niger is at a crossroads in terms of poverty reduction; key to building its human capital and to avoid this disconnect is addressing the country's high malnutrition (44 percent in 2012).
- Addressing this priority can guide the prioritization and coordination of interventions across sectors, including in water supply and sanitation.
- WASH is closely interlinked with malnutrition in Niger, and water supply, sanitation, and hygiene (WASH) is a key pathway of shocks (droughts and floods) to households.
- Direct undernutrition interventions, even when scaled up to 90 percent coverage rates, have been estimated to address only 20 percent of the stunting burden. With water supply and sanitation as key underlying drivers of improving nutrition, the sector can play a key role to addressing the other 80 percent.
- Improved WASH (and particularly improved water) can increase a household's resilience to shocks and "protect" children's nutritional status, but a community-level coverage is necessary, and access to improved sanitation needs to be combined with sludge treatment and management to protect water quality and limit the risk to public health.
- Infrastructure to close the WASH access gap is needed to lay the ground to better future nutritional and health outcomes, accounting for climate vulnerability.
- Infrastructure alone is not enough and not always possible in the short- and medium-term: fail-safe interventions are needed that target populations with poor WASH access, and which are thus most exposed to adverse outcomes, particularly in areas in which improvement in access can't be expected in the short- and medium-term, notably in water quality treatment.

Foundations of Human Development Weakened by Malnutrition and WASH Access

Malnutrition in Niger is appallingly high and compromises Niger's potential for growth and poverty reduction. There is growing recognition that the economic costs of malnutrition in general, and undernutrition in particular, are significant. In the latter case, costs related to lost productivity and economic growth have been estimated at up to 8 percent to 11 percent of lost gross domestic product (GDP) in Africa (IFPRI 2015). Niger is particularly exposed to this threat since it is ranked as one of the top 10 countries with the highest prevalence of hunger.

Figure 4.1: Stunting Rates in Niger, 1990–2015



Sources: IFPRI Global Hunger Index database 2016; World Bank calculation based on DHS 2012.
Note: As the data show, stunting is high in Niger and the country remains among the most exposed to the risk of hunger. GHI = Global Hunger Index.

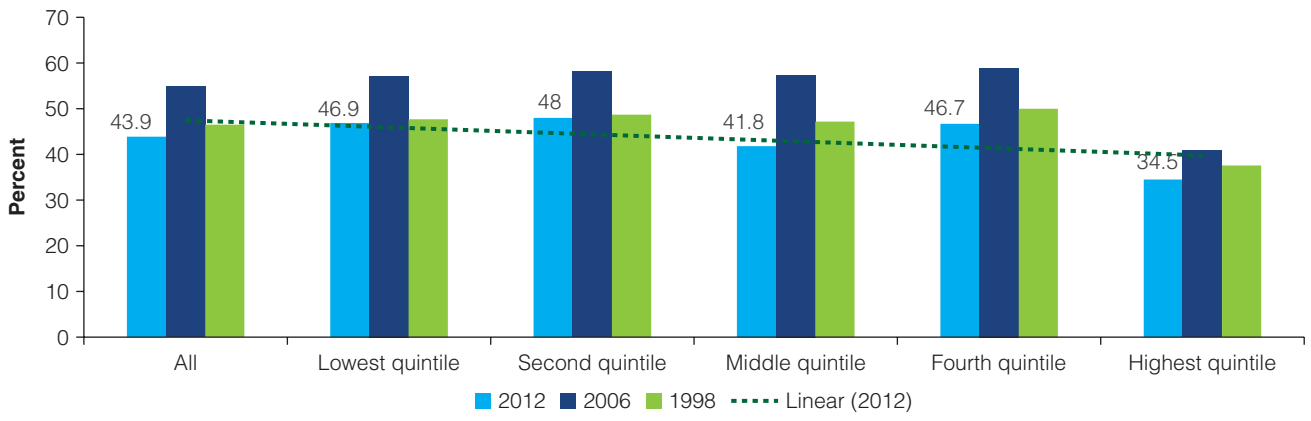
As of 2016, Niger is ranked at the "serious" level on the Global Hunger Index (GHI) (33.7 out of 100) (figure 4.1).[1] The data from the latest national survey (DHS 2012) reveal that 55.5 percent of under-five year-olds in Niger suffer from some type of anthropometric failure, with a staggering 44 percent chronically malnourished.[2] Close to 21.6 percent are severely malnourished. Stunting has only slightly decreased since 1992 (48 percent), indicating a persistent problem. The prevalence of other types of anthropometric failures such as wasting (18 percent) and underweight (36.4 percent) is equally problematic.

Malnutrition in Niger is pervasive across wealth quintiles, with only the richest doing significantly better. The prevalence of stunting in Niger is uniform across the wealth distribution with only the top quintile significantly less stunted than the other wealth groups. A similar pattern is observed for wasting and underweight with a notable increase in wasting across wealth quintiles when comparing the two latest rounds of DHS (figure 4.2).

While child malnutrition is common across Niger, it is more prevalent in rural areas, and important spatial variation can be observed. Stunting is much more prevalent in rural areas (46 percent) than in urban areas (30 percent). While under-five malnutrition is relatively low in Niamey (20 percent), it towers at over 50 percent in the regions of Maradi, Diffa, and Zinder (figure 4.3, panels a–b).

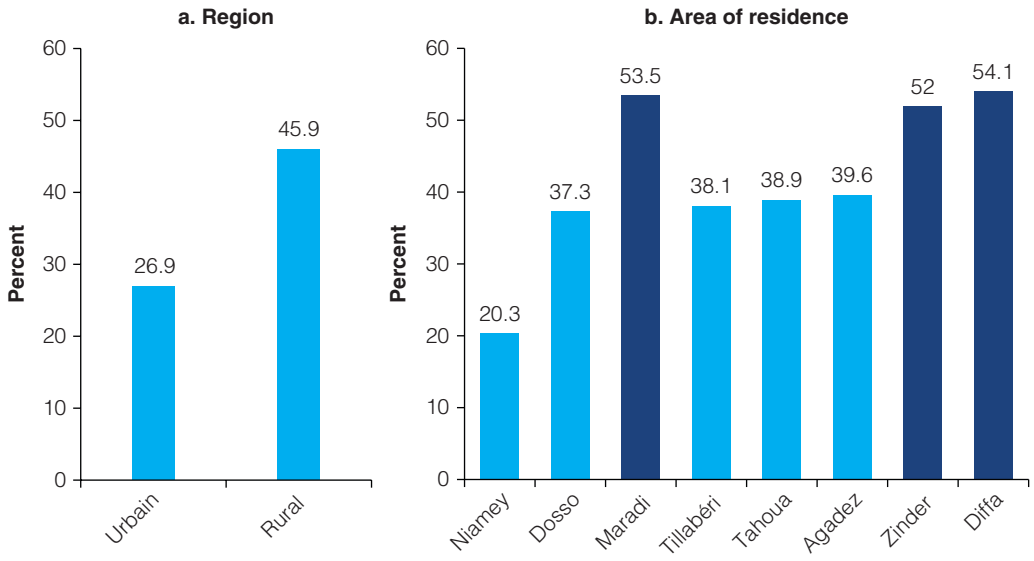
Malnutrition is an acute health risk and can have long-term negative effects on physical and cognitive development. Stunting is a powerful risk factor for subsequent disease and death and is associated with 53 percent of the infectious disease-related deaths in low-income countries (LICs) (Schaible and Kaufmann, 2007). The risk of dying is increased by 1.6-fold in a moderately stunted child and by more than 4.1-fold in a severely stunted child (Black et al. 2008; Caufield et al. 2004). Malnutrition can also have long-lasting negative physiologic effects including "a reduced capacity for manual work… poor mental development and school achievement as well as behavioral abnormalities' (Martins et al. 2011, p. 1,832). In addition, Guerrant et al. (2008, p. 4) note, "even malabsorption of drugs needed to combat diseases like AIDS, tuberculosis, and malaria, which often coexist with malnutrition and diarrhea." This risks long-term disadvantages for affected individuals through their life cycle, extending into

Figure 4.2: Stunting in Niger Based on Wealth Quintile, 1998–2012



Sources: World Bank calculation using DHS 1998, 2006, 2012.
Note: As the data show, the share of stunting high regardless of the wealth quintile, and changes over the past 15 years have been limited.

Figure 4.3: Stunting in Niger, by Region and Area of Residence, 2012



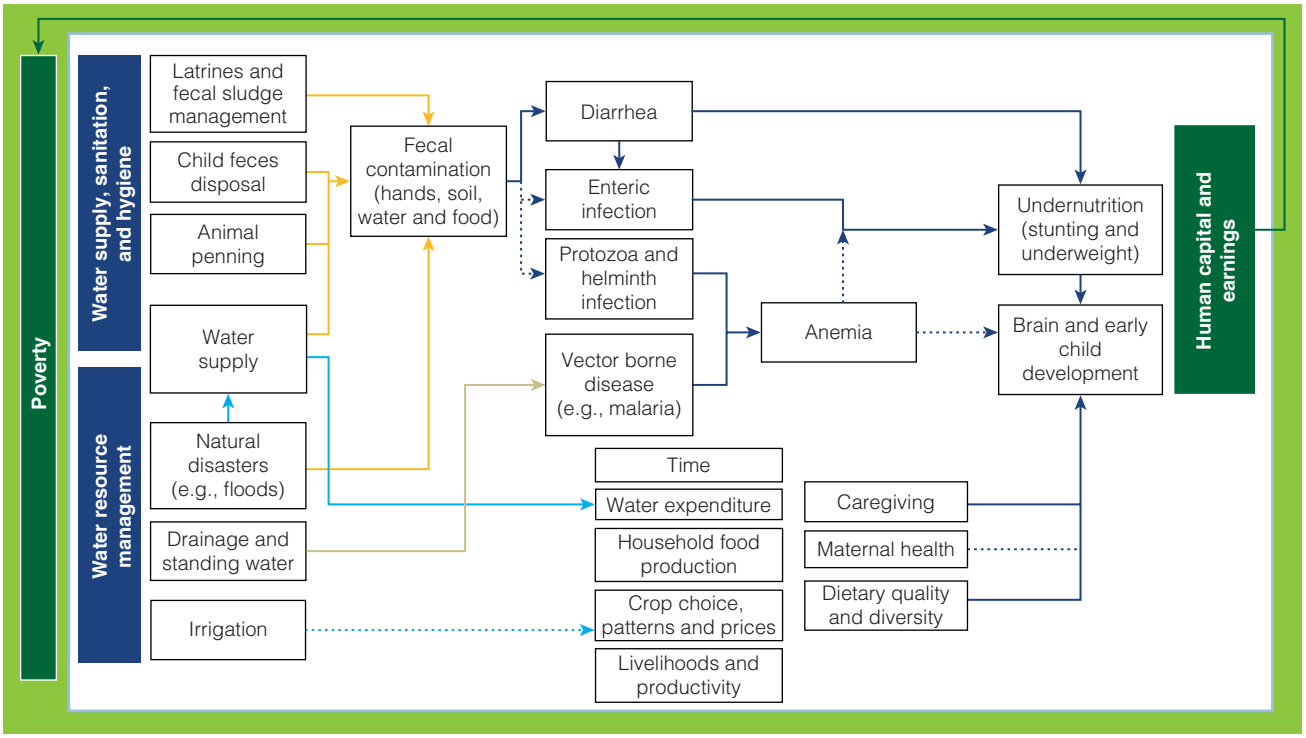
Source: World Bank calculation using 2012 DHS.
Note: Dark blue bars in panel b indicate areas with the highest stunting rates.

that of their children's, and in Niger's case of extremely widespread malnutrition, affect the development of the country as a whole.

Link between WASH Access, Health, and Malnutrition

Concern about WASH lies at the very origin of the discipline of public health. John Snow's famous discovery of a fecally contaminated well as the source of a major cholera outbreak in London in 1855 is often cited as the start of public health as a concern of public policy. Low-quality access to WASH has since been linked to many disease outcomes, including diarrhea, parasitical infections and malaria (Prüss-Ustün et al. 2014).

Figure 4.4: Conceptual Pathways between Water and Nutrition



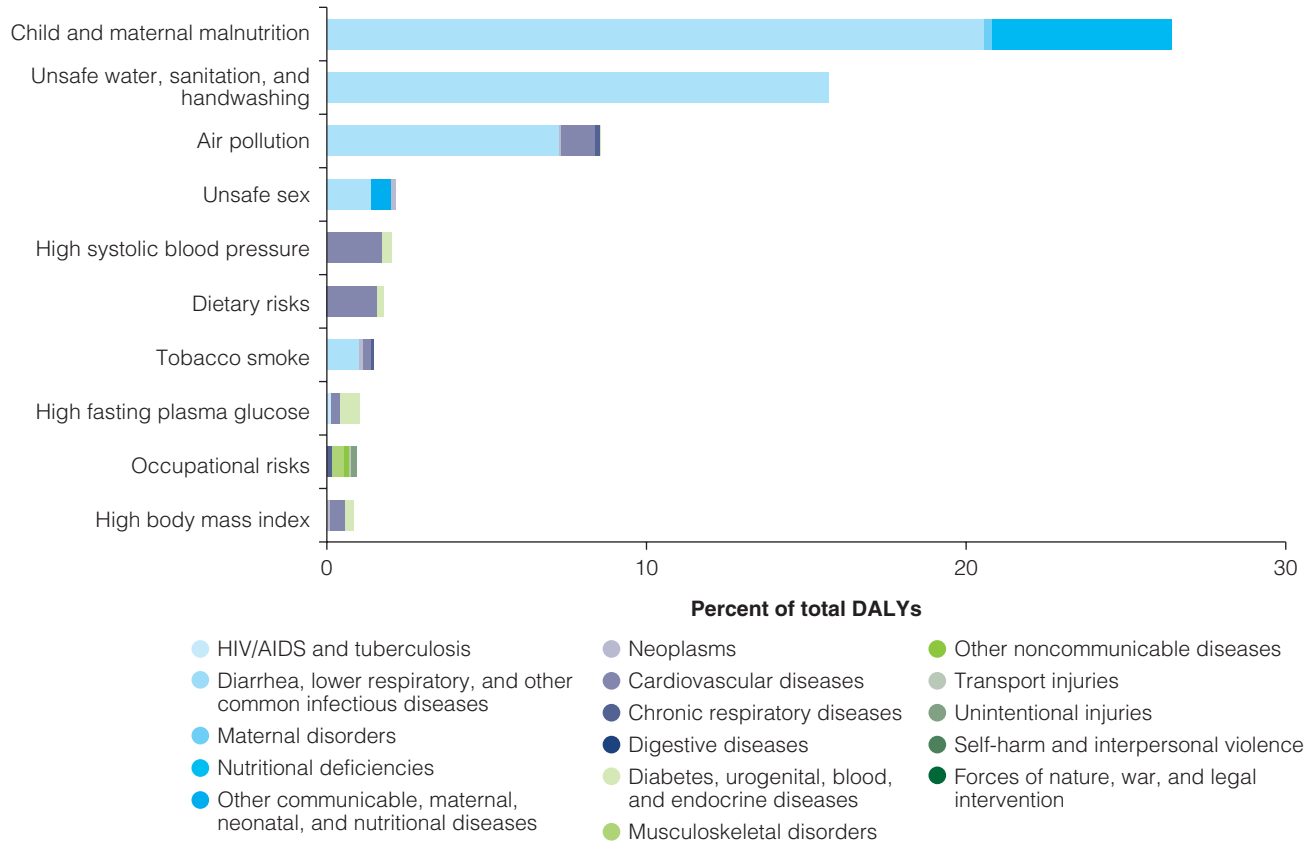
Source: Chase et al. (2016).

There is a multiform link between WASH and malnutrition. Figure 4.4 reprises the conceptual pathways between water, sanitation, and nutrition. Three main biological pathways linking unsafe WASH to malnutrition and its negative health effects are worth highlighting (Cumming and Cairncross 2016):

> "(1) via repeated bouts of diarrhea (Briend 1990; Checkley et al. 2008; Petri et al. 2008; Richard et al. 2013);
>
> (2) soil-transmitted helminth infections… (O'Lorcain and Holland 2000; Prüss-Üstün and Corvalán 2006; Hall et al. 2008; Ziegelbauer et al. 2012); and
>
> (3) a subclinical condition of the gut, referred to variously as tropical enteropathy (Baker and Mathan 1972; Humphrey 2009a), environmental enteropathy (Fagundes-Neto et al. 1984; Korpe and Petri 2012) or, most recently, … environmental enteric dysfunction (EED) (Haghighi et al. 1997; Humphrey 2009b; Keusch et al. 2014; Crane et al. 2015)."

In each of these biological pathways, enteric pathogens and associated infections that inhibit nutritional uptake are transmitted through contaminated water and unsafe sanitation. Danaei et al. (2016) highlight unimproved sanitation as one of the leading risk factors for stunting in LICs in a cross-country study of 137 LICs. Empirical research has demonstrated the link between WASH and health outcomes in the field both at village and cross-country level. Duflo et al. (2015) show that the provision of integrated water supply and sanitation improvement programs at the village level has a substantial impact on reducing the incidence of diarrhea in that village. Those results echo those of Alzua et al. (2015) who find that fully eliminating open defecation from a village in which that is the sole option would increase child height by 0.44 standard deviations (looking at Mali, Indonesia, India, and Tanzania).

Figure 4.5: Risk Factors in Niger, 2015



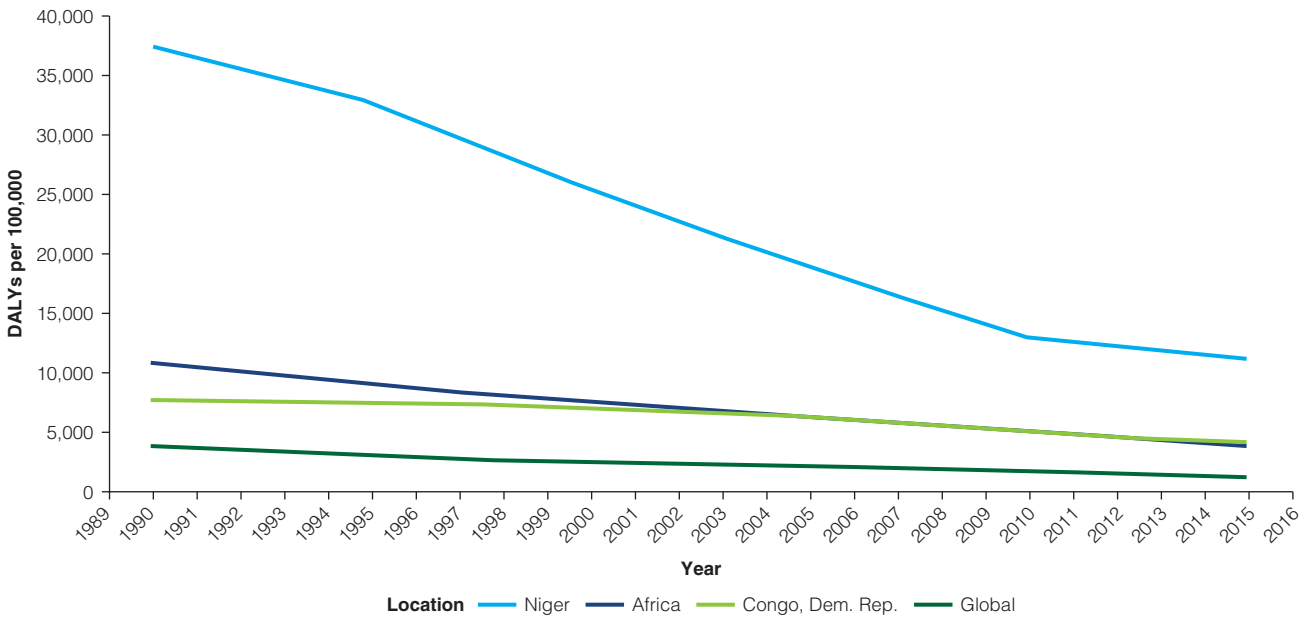
Source: IHME 2015.
Note: As the data show, WASH is second only to malnutrition in the risks factors driving death and disability in Niger. DALYs = disability-adjusted life years.

In Niger, unsafe WASH is closely related to under-five morbidity, mortality, and overall disability. As seen in figure 4.5, inadequate WASH is the second-highest **risk** factor associated with death and disability in Niger (IHME 2015).[3] Niger is the fourth country in Africa in which WASH is the highest contributor to death and disability behind Somalia, South Sudan, and Chad. Diarrheal diseases, which are closely associated with poor WASH, are the second **cause** of death and disability in Niger, just behind malaria.

The 2012 Demographic and Health Survey (DHS) indicates that prevalence of diarrhea in children under age three was close to 20 percent in both urban and rural settings (21 percent and 19 percent, respectively), and rates of diarrhea in children under five were closer to 15 percent (16 percent in urban areas and 14 percent in rural ones, respectively).[4] Interestingly, the highest incidence of diarrhea can be found in Niamey for both children under three (32.8 percent) and children under five (24.6 percent), possibly as a result of higher population density in a low sanitation environment. It is slightly higher for the wealthiest quintiles than is it for the lowest quintiles (14.7 percent and 15.2 percent, respectively, for the fifth and fourth quintiles compared to 13.2 percent and 13.6 percent, respectively, for the two lowest quintiles), which further flags the issue of contamination and water quality developed in this chapter.

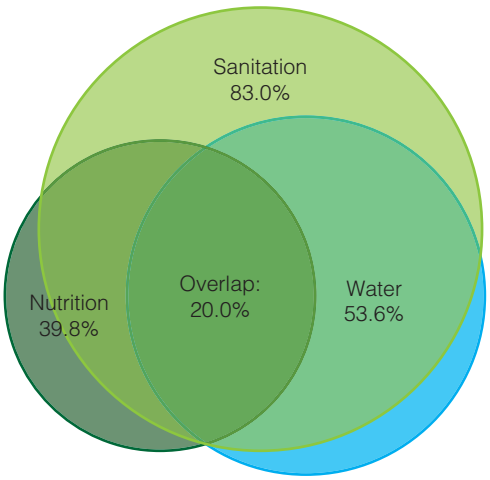
While food insecurity is the leading factor, unsafe WASH access is a contributing risk factor that further weakens nutritional and health outcomes and is thus the foundation of early childhood development, notably, though not exclusively, through diarrheal diseases. As seen in figure 4.6, Niger remains substantially above the average for Africa in terms of disability-adjusted life years (DALYs), attributable to unsafe WASH.[5]

Figure 4.6: Disability-Adjusted Life Years Attributable to Unsafe WASH (All Causes), 1990–2015



Source: World Bank calculation based on IHME 2015.
Note: DALYs = disability-adjusted life years.

Figure 4.7: Percentage of Children Facing Deprivation in Single and Overlapping Dimensions, 2012



Source: UNICEF MODA using 2012 DHS.

There is an important overlap in the WASH and nutrition deprivations children suffer, heightening the effect of malnutrition in Niger. Using United Nations Children's Fund's (UNICEF's) Multiple Overlapping Deprivation Analysis (MODA) to look at the interrelations of children's deprivations shows an important overlap of 20 percent between three key deprivations in nutrition, water, and sanitation (figure 4.7).[6] This result confirms the findings of the UNICEF synergy framework on malnutrition undertaken for the Niger WASH Poverty Diagnostic (WPD), which considers four key dimensions: food security, childcare practice, health, and WASH (i.e., adequate environment),

and shows that few children have access to an adequate environment.[7] This analysis finds that less than 15 percent of the children in the sample are adequate in each of the four nutrition dimensions, resulting in 66 percent of the children lack access to even one of the four nutrition dimensions. That is, the lack of food is persistent across the nation and the subpopulations considered. Yet, access to adequate food by itself (as defined in this study) is not associated with better nutritional outcomes. Also reflected in synergy analysis, the threat of low care practices and food to nutritional outcomes, further weakened by poor WASH access.[8]

Open defecation and poor sanitation are associated with worse nutritional outcomes. Open defecation significantly increases the probability of children to be stunted or experience anthropometric failures (appendix V, table V.1). Decomposition analysis of nutritional outcomes between children with access to improved sanitation and those without shows that those with better sanitation access have a greater height-for-age z-scores (HAZ) than those with poorer access (appendix T, table T.1, and appendix U, table U.1). Low access to sanitation in Niger renders difficult the analysis of the relation between nutritional status and better sanitation access. However, looking at neighboring Mali, which presents a number of similarities with Niger, can help shed light on this dimension. Mali has slightly lower malnutrition and access to improved water but better improved sanitation and lower open defecation rates than Niger. Regression analysis focused on Mali for the same survey dates (2006 and 2012) does confirm that an improved access to sanitation is associated with lower probability of stunting and anthropometric failures.

In Niger, a reduction in the probability of anemia and diarrhea is consistently and significantly associated with an improvement in the type of access to water. This result, seen in appendix V and based on national survey data (DHS 2006 and 2012), shows that improving water in Niger has a significant effect on anemia and its negative impact on child mortality and early childhood development, which aggravate similar effects stemming from malnutrition. While the results indicate a correlation rather than a causal pathway, it could also be read as indicating that improved water facilities likely reduce helminth infection by limiting water contamination by worms and mosquito larvae.

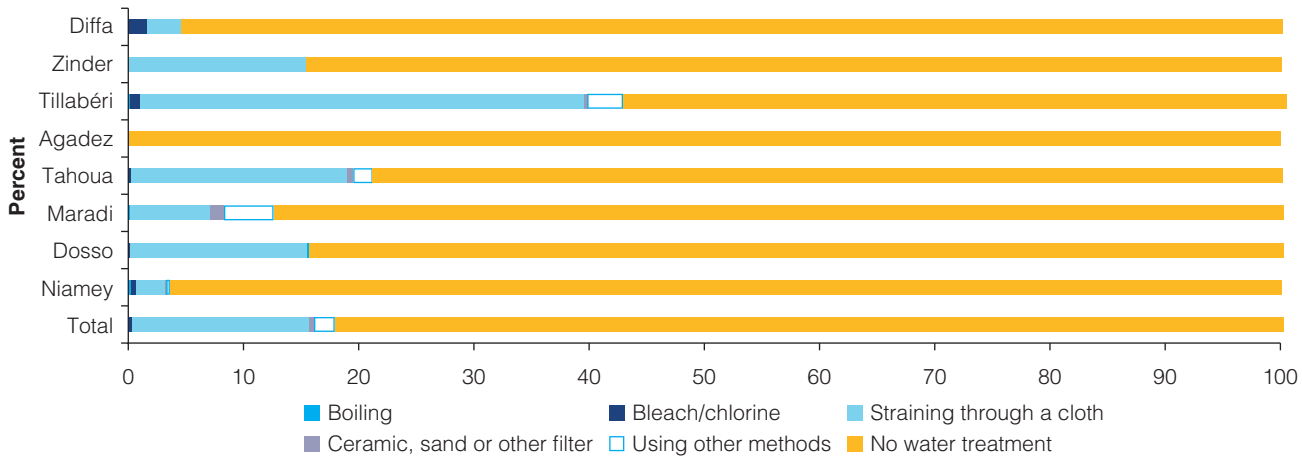
While improved WASH facilities significantly reduce the risk of anemia and diarrhea, association between *improved* water and malnutrition is not consistently significant. Regression analysis using the 2006 and 2012 DHS data shows the expected negative direction of the effect of improved water on the risk of stunting and other anthropometric failures (Composite Index of Anthropometric Failures [CIAF] with a higher level of access such as piped improved water and piped on premise. However, this result is only statistically significant in 2006, not 2012. One reason could be the higher prevalence of stunting observed in 2006 (55 percent) compared to the more typical level of stunting around 40 percent in 2012. Other contributing factors include the gender of the child (boys would appear to be more exposed), the education of the mother, breastfeeding, location (region and rural), and wealth[9] (appendixes V and X). It appears that access to standard improved sources significantly reduces anemia, possibly by limiting helminth and diarrheal infections, but does not protect significantly against malnutrition related to fecal contamination. Better improved access (piped and piped on premise) would appear to help (appendix Y, table Y.1). However, in a context of low sanitation, this does not seem sufficient. The results for Mali (appendix W, table W.1) suggest that this might indeed be the case: Mali has lower access to improved water but better access to sanitation and nutritional outcomes. The effect observed in Niger in 2006 but not in 2012 may also indicate that improved water access reduces only the probability of malnutrition when stunting increases beyond its chronic level around 40 percent in Niger (i.e., the level outside of nutrition emergency in the country.

High rate of fecal contamination of "improved" water sources and very low access to safely managed sanitation are likely to explain the limited impact of improved access alone. It is unlikely that "improved water" would significantly impact malnutrition if it were not, in fact, free of fecal contaminates in many cases. While data on point-of-use water quality are not available in Niger, evidence from other countries in Africa presenting similarities in terms of WASH

access show high E. coli contamination even with piped access in the capital and near complete contamination in peri-urban and rural areas (World Bank 2017). First, an assessment of the water quality in 19 water supply schemes in Niger indicated that 18 out of 19 centers do not have a chlorination system and that water quality is poor in four centers (Maiga 2016). Second, a high share of improved water access is not on premise (especially in other urban areas and, of course, in rural ones) further raising the risk of contamination risk between point-of-collection and point-of-use. Third, and of particular concern for rural areas, previous studies in Niger have shown a high contamination of groundwater, with high levels of oxidizable nitrogen and bacteriological pollution (coliform and fecal streptococcus), which makes the water unfit for human consumption (Chippaux et al. 2002; Vassolo et al. 2015). Poor sanitation and poor management of fecal sludge represent a threat to the quality of underground water (Graham and Polizzotto 2013). Similarly, even "improved sanitation" is unlikely to lead to strong positive effects on malnutrition or properly protect "improved" water sources from contamination if (a) even households with improved facilities do not have access to safe disposal of the temporarily contained sludge (less than 3 percent of household are connected to sewage in urban setting according to the latest DHS); (b) overall access levels are so low that cross-contamination from other households is likely; and (c) handwashing with soap after toilet use is low. Even assuming that water at point-of-collection provides quality water, the pathways to recontamination at point-of-use are further heightened in a low sanitation environment such as Niger.

The insufficient protection "improved" water sources provides against malnutrition is aggravated by the extremely low level of point-of-use water treatment in the Niger, which has known protective effects. According to the 2012 DHS less than 1 percent of household adequately treat their water, regardless of the type of treatment used (figure 4.8). Only three regions have treatment rates over 1 percent (Maradi, Diffa, and Tillabéri). Treatment by straining through a cloth is the preferred method in Niger (around 15 percent nationally and as high as 38.5 percent in Tillabéri), though not qualifying as adequate. As seen in appendix Z, table Z.1, even this imperfect water treatment yields a reduction in anthropometric failure. This confirms that renewed attention to water quality, water treatment, the delivery mechanism, and behaviors required for sustained and systematic use is warranted to address malnutrition in Niger, particularly as long as the available infrastructure does not reliably deliver safe water supply and sanitation. Niger's high exposure to climate variability further raises the question of how to best protect nutritional outcomes in a context of low WASH.

Figure 4.8: Types of Water Treatment per Share of Population Living in Household in Niger



Source: World Bank calculation based on 2012 DHS.

Links between WASH Access, Nutrition, and Climate Vulnerability

Exposure to climatic variability and shocks worsens nutritional outcomes in Niger. Looking at both Niger and Mali using the two latest rounds of DHS (2006 and 2012) shows that an increased climate variability either in the year prior to birth (in utero) and the year prior to the survey results in a higher probability of anthropometric failures for children under five years of age. Climate variability is measured through the Standard Precipitation Index (SPI), which expresses the standard deviations of the observed precipitation from the long-term mean.[10] This choice of indicator is preferred to others due to the high dependence of agriculture on rainfall in the Sahel region and the historic development of the measure to monitor droughts.[11] Appendix AA, table AA.1, shows this climatic variability looking across three time periods: three, six, and 12 months, capturing, respectively, interseasonal and interyear climatic variations. All three show the expected positive and significant sign.[12]

In Niger, exposure to climatic variability worsens open defecation. Building on the climatic variability variables defined using the standard precipitation index (SPI), the variables are computed to define more specifically droughts and floods (appendixes BB and CC) using panel data of the 2011–14 LSMS survey to investigate the determinants of WASH at the cluster (primary sampling unit [PSU]) level show that the occurrence of drought between survey rounds is positively and significantly correlated with open defecation practices throughout the specifications (appendix BB, table BB.1, columns 1–4).[13] A strong path dependence with the 2011 behavior is also observed (columns 2–4). On average, an additional month of drought is associated with and additional percentage point in the share of households defecating in the open at the community (cluster) level. This increase in open defecation in 2014 appears to be driven by a reduction in the use of other unimproved sanitation (columns 5–6).

In turn, the interaction of open defecation and climatic shocks negatively affects child health and nutrition. As seen in appendix DD, table DD.1, the interaction between household open defecation and climatic shocks occurrence decreases HAZ on younger children. Controlling for other factors, shocks of both floods and droughts are shown as heightening the negative impact of open defecation. While open defecation is negatively associated with health and nutrition of children under two years of age, the results are not significant. However, the results become significant in the case of floods and droughts. An additional month of drought reduces the HAZ of children by 0.873 points, accounting for 58 percent of the standard deviation in HAZ of younger children. Similarly focusing on floods, the results show that child health is negatively associated with household open defecation, but the detrimental effect of open defecation is significant only in combination with floods. An additional month of flood reduces child HAZ by 0.544 points, accounting for 36 percent of the standard deviation in HAZ of younger children.

Better household access to WASH can reduce the effect of climatic shocks on anthropometric failures—particularly wasting. Regression analysis using the 2006 and 2012 [**DHS**] shows that access to piped water and improved sanitation is associated with a reduction of the negative effect of shocks experienced on anthropometric outcomes (measured by the CIAF). This is particularly the case for shocks suffered in utero, on which the analysis for this chapter is focused, and to a lesser extent for those experienced during the year prior to the survey. This is notably the case in the event of floods, which are particularly associated with negative anthropometric outcomes resulting from a compromised environmental context (i.e., increased risk of contamination). Access to improved water either reverses the sign or reduces the coefficient associated with a higher probability of anthropometric failures, i.e., mitigating anthropometric failures (appendix EE, tables EE.1–EE.4). The effect is most consistent in the case of wasting. Here again, children in Mali benefit from a higher access to improved sanitation in the case of shocks (particularly droughts) where their counterparts in Niger do not see such effect, possibly due to a lower sewerage coverage. Disaggregating the analysis between urban and rural areas confirms that improved access is associated with a reduction in the probability

of wasting in Niger (particularly in 2006) while the effect on other types of anthropometric failures is less consistent (appendix L, map L.1, panels a–b). Since wasting is a less chronic form of undernutrition (compared, for instance, with stunting), these results could signal a reduction in the incidence of infectious diseases, a result confirmed when looking at the incidence of diarrhea per se (appendix GG, table GG.1).[14] Even if the results are not consistently significant, they are indicative of dynamics at play between WASH and climate shocks.

Community-level access of at least 50 percent to improved piped water is especially important to reduce the negative impact of floods. The importance of WASH access at the community level is well documented (Duflo et al. 2015; Alzua et al. 2015; Lawson and Spears 2014). While household access matters to children's health, community coverage could be even more important in the case of climatic shocks, pointing toward an important dimension of building a household's resilience. While full community–cluster coverage would be ideal, (a) the question of where the threshold of access begins to be positively associated with children's anthropometric growth and (b) "protecting" their nutritional outcomes from climatic shocks are especially important to inform policies and prioritize interventions in a situation of competition needs. Looking at the HAZ of children under five confirms a strong and significant association between access to improved piped water by 50 percent of the cluster in the event of floods (appendix HH). Whereas access to piped water by the household is associated with a higher HAZ, in the event of floods, such access is associated with a smaller increase in HAZ, possibly due to a higher incidence of contamination. On the other hand, a community-level access to piped water of at least 50 percent does produce a strong and significant protective effect in the event of floods. Raising coverage to 75 percent does not yield an additional benefit, but the negative effects are observed solely with household access (i.e., the result at community level is no longer significant). The data do not allow for a testing of a total community coverage.

The effect of community-level access to improved sanitation in case of floods is less clear, likely owing to the missing link of sludge management and treatment. The effect of improved sanitation on HAZ is mixed. At the household level, improved sanitation access is positively associated with child growth for both Mali and Niger. At the community level, due to the low sanitation coverage, just 2 percent of households live in clusters with a community-level access to sanitation equal or superior to 50 percent. Looking at Mali shows that coverage needs to be raised to 75 percent to observe a large and significant positive effect on HAZ in 2006 (appendix HH). Combined with the results discussed earlier in chapter (and the higher prevalence of diarrhea in urban and wealthier children), this lack of systematic translation of the gains from improved access in the absence of shocks to protection in case of shocks is likely associated with the concentration of fecal sludge—itself the result of a higher concentration of those toilets and the absence of proper disposal and system to manage the resulting waste. This issue is particularly salient in urban areas due to a higher density of population.

WASH: Where to Start? From Bricks and Pipes to Behaviors

What Would it Take? A Lot More than Now

Direct undernutrition interventions (e.g. nutrient supplementation, promotion of exclusive breastfeeding), even when scaled up to 90 percent coverage rates, have been estimated to address only 20 percent of the stunting burden (Bhutta et al. 2013).[15] As one of the key complementary determinants of better nutrition outcomes, the WASH sector can help address the other 80 percent. The latest Global Nutrition Report (IFPRI 2016) estimated the thresholds of a set of key determinants—water supply and sanitation along with calories, education, and female empowerment—needed to reduce stunting to 15 percent.[16] These thresholds can serve as a starting point for countries to inform their targets and policies as well as to mobilize partners toward common goals across sectors.[17] Table 4.1 presents the thresholds identified

Table 4.1: Thresholds for Underlying Drivers to a Predicted Stunting Rate Less Than 15 Percent in Niger

Six underlying drivers	Threshold corresponding to a prediction of stunting prevalence of <15%	Present value for Niger
Total per capita calories in food supply	2,850 cal.	2,546 cal. (2011)
Calories from nonstaples (%)	51	n.a
Access to improved water (%)	69	**66.5** (2012)
Access to improved sanitation (%)	76	**13.8** (2012)
Female secondary school enrollment rate (%)	81	13.9[a]
Ratio of female to male life expectancy (proxy for the empowerment of women)	1.072	1.023 (2014)

Sources: IFPRI 2016; World Bank WDI, DHS, and UNESCO UIS.Stat (latest years available).
Note: Robust standard errors in parentheses. n.a. = not applicable.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

and gaps between thresholds needed to reach a predicted stunting rate of only 15 percent, and actual values in Niger.

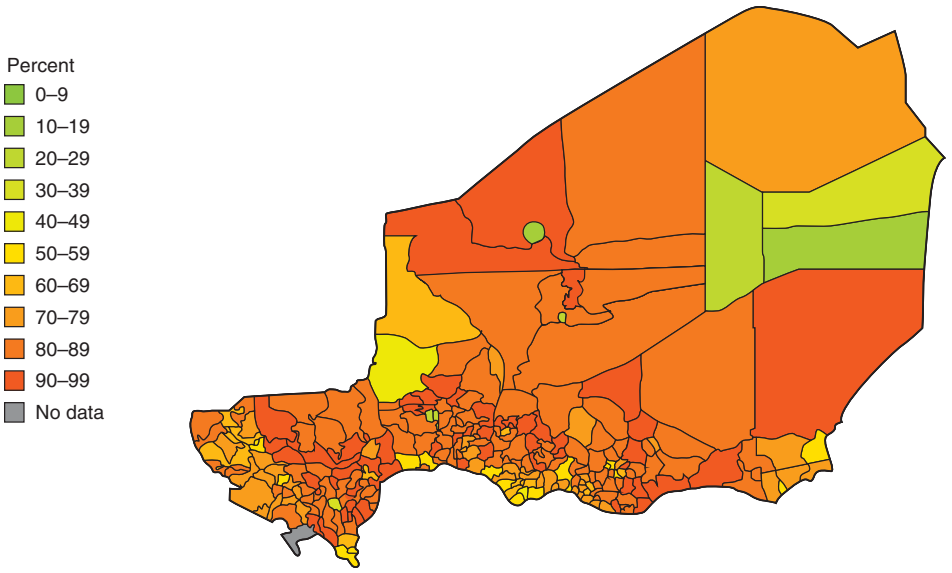
While Niger has vulnerabilities across the six drivers of malnutrition, the gaps in access to improved sanitation is particularly wide. If food security remains an issue—with a gap of 10 percentage points with respect to the per capita calories in food supply—the gaps in the area of water supply and sanitation are also wide. Countrywide, sanitation presents a gap of over 62 percentage points, while in *rural* areas the gap is important for both water supply and sanitation: a gap of about 10 percentage points and 70 percentage points, respectively, to reach a predicated stunting threshold of 15 percent.[18] Access to truly safe water is significantly lower than data on improved WASH access suggest. The thresholds' gaps also flag the low level of female education, in this case referring to secondary education, though female basic literacy is equally preoccupying: just 15 percent of women aged 15 years and above are considered literate as of 2015. This low level of education also has implications with respect to change in social norms directly affecting WASH-related practices and nutritional outcomes.

Community-level coverage, systematic use, and high compliance are needed to gain "protective" dimensions of WASH. The analysis on the gains associated with community-level access to improved WASH in case of shocks echoes the findings of recent literature on both water supply and sanitation on the needs for community-level coverage to see anthropometric and health impacts (Boisson et al. 2013; Duflo et al. 2015; Alzua et al. 2015; Spears 2013). This high level of coverage and compliance (notably with respect to point-of-use water treatment) also highlights the role of norms and behavioral nudges to reach the needed threshold to positively impact health and nutritional outcomes. In infrastructure and policy, such coverage requires prioritization of at-risk areas and the inclusion from the start of sludge treatment and management as part of the strategy of expansion of access. In Niger, this means areas with a large number of households relying on open defecation.

Spatial Lens on Poverty

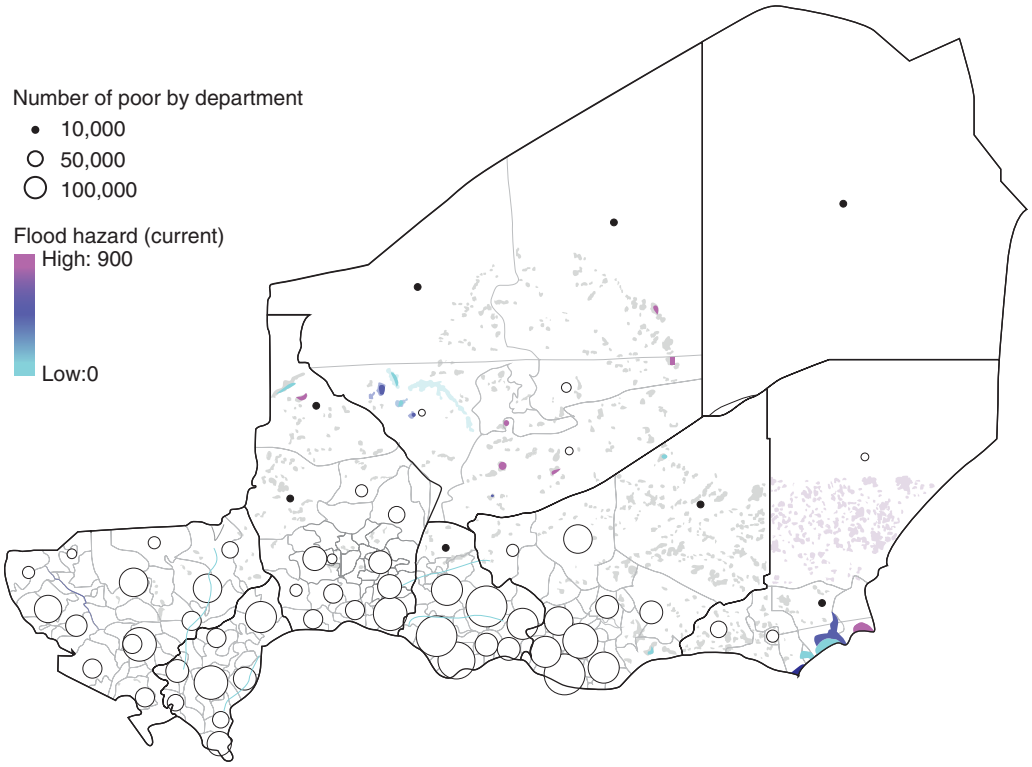
The latest poverty map shows that the regions of Maradi, Zinder, and Tillabéri have the largest number of communes that concentrate a high number of poor and households relying on open defecation and with a high exposure to floods (See maps in Appendix). In a context of competing needs and priorities, the new poverty map can help guide the prioritization of interventions toward communes in which the public health consequences of open defecation can be expected to be the greatest (i.e., those most exposed to the risk of flooding (map 4.1); and those with a high number of households relying on the practice [map 4.2]. An important overlap with poverty can be seen in those three regions which account for the largest number of poor in Niger. As seen in

Map 4.1: Open Defecation by Communes (Percent), Niger



Source: World Bank calculation using Flood Hazard data (World Bank GFDRR 2016); Niger poverty maps (RNPG, LSMS); 2012 RNPG (census).

Map 4.2: Poverty (Number of Poor) and Exposure to Floods, Niger



Source: World Bank calculation using Flood Hazard data (World Bank GFDRR 2016); Niger poverty maps (RNPG, LSMS); 2012 RNPG (census).

figure 4.3, panel b, the regions of Maradi and Zinder present stunting rates over 50 percent. Diffa, at the southern end of the region, also presents a high exposure to flooding and an important concentration of open defecation, poverty, and stunting (also over 50 percent).[19]

Beyond household access, a focus on key infrastructure in health and education also matters, especially for inclusion. In a country with very low schooling attainment (1.4 years on average) additional obstacles to school attendance can have amplified consequences. This is especially true for girls, with important intergenerational effect given the importance of the mother's educational attainment among the factors determining the nutritional status of her children. In a country with strong gender norms such as Niger, the absence of adequate WASH facilities for children in general, and for girls in particular, can make the difference between children being allowed to attend school or not. Issues such as privacy, safety, and dignity are especially important for girls, and particularly pubescent girls. Recent evidence from India shows that if the installation of any latrine substantially benefits younger girls and boys, possibly more exposed to sickness from uncontained waste, only gender specific latrines reduce gender disparities (Adukia 2017).

Public health and education infrastructure are a priority. Results from the recent sustainable delivery indictors show that public health and education facilities are poorly equipped with functioning WASH infrastructures, particularly in rural areas (appendix KK, tables KK.1–KK.4). While clean water is available to all public health facilities in urban areas, less than 50 percent of rural ones enjoy such access. Toilets for outpatients are unsurprisingly low in public infrastructure (23 percent). Access to functioning toilets is less than 30 percent in both urban and rural public schools (table 4.2). The majority of the roads in Niger are nonpaved (90 percent) and walking long distances in rural areas to seek to attend school of treatment is common.

Table 4.2: Availability of Water, Sanitation, and Infrastructure in Health and Education Infrastructure in Niger (percent)

HEALTH	All	Public	Private	Difference (%)	Rural public	Urban public	Difference (%)
Clean water	**54.4**	52.5	92.5***	(76.2)	49.3	100.0***	(102.7)
	(7.6)	(7.8)	(4.5)	(9.4)	(8.2)	0	(8.2)
Toilet for outpatients	**25.5**	23.3	69.8***	(200.1)	20.6	63.7***	(209.4)
	(5.6)	(5.4)	(11.3)	(13.5)	(5.5)	(12.6)	(13.7)
Electricity	26.4	22.7	98.0***	(330.9)	18.4	88.2***	(378.1)
	(4.4)	(4.2)	(1.9)	(4.9)	(4.0)	(6.5)	(7.6)
Electricity with no regular outages	21.3	18.4***	79.4	(332.2)	14.3	80.3***	(462)
	(3.7)	(3.4)	(5.9)	(7.2)	(3.2)	(6.5)	(7.2)
EDUCATION							
Indicator (% unless otherwise noted)	Niger	Public	Private	Difference (%)	Urban public	Rural public	Difference (%)
Toilet functioning and available	24.3	22.6	83.5	–60.9***	28.3	21.4	–6.9
Toilet clean	42.7	41.1	100	–58.9***	70.4	34.9	–35.5***
Toilet private	27.7	26.2	83.5	–57.3***	35.2	24.3	–10.9
Toilet available	42.2	40.8	94.5	–53.7***	74.1	33.7	–40.3***

Source: SDI Niger 2017.
Note: Robust standard errors in parentheses.
Significance level: *** = 1 percent.

During the rainy season, flooding makes facilities even less accessible. That those facilities could be failing to provide adequate WASH infrastructure to students and patients is all the more problematic and compromising to a wide range of key human development objectives, such as vaccination.[20]

Integrated 'Social Compact' for Climate Resilient Nutrition and WASH Across Sectors

In Niger, the importance of nutrition as a national priority is reflected through projects and programs such as the 3N, the SUN initiative, or the REACH partnership. Started in 2011, the 3N (Nigeriens Feed Nigeriens [les Nigériens Nourrissent les Nigériens]) program aims to build national capacities with regard to food production, supply, and resilience to food crises and disasters. Niger has earmarked 25 percent of its budget to this flagship program. The initiative includes five priorities and 12 key programs that seek to diversify agricultural, livestock, and forestry production to increase yields, irrigate more land, enhance market supplies, improve crises and disaster responses, and fight malnutrition. Other programs, such as the Scaling up Nutrition (SUN) initiative (joined in 2011) or the REACH partnership[21] (established in 2008), also attest to the recognition of international partners to make undernutrition a priority and adopt a multisectoral approach, initially heavily focused on agriculture and food security. In spite of this focus, malnutrition has remained stubbornly high even over the more recent period of relative calm in terms of shocks.

Since nutrition is a key stepping stone to households' resilience to climate shocks, safety nets may be one of the best approach for a country such as Niger. Reinforcing countries' resilience to shocks is paramount to reduce poverty. Several recent analyses emphasize the role of safety nets toward building households' resilience in countries presenting a high vulnerability to shocks (Cervigni and Morris 2016; Hallegatte et al. 2016). The Cervigni and Morris study on building resilience in Africa's drylands (2016) flags Niger as an outlier in which even assuming all the resilience-enhancing interventions are adopted, the number of drought-affected people will require a significant scale-up of safety net measures, such as the Adaptive Safety Nets project, funded by the International Development Association (IDA).[22]

Cross-sectoral approaches that include WASH in malnutrition interventions are increasingly piloted. One such example is the WASH in Nut (WiN) program, developed in the context of food security emergencies in the Sahel region, which targets nutrition and feeding centers and children suffering from severe malnutrition. Organized around a "minimum WASH package," the WiN strategy is a tool targeting, in a specific and integrated way, mother and severely malnourished children, from health infrastructure to communities.[23] The WiN strategy is now endorsed in the Humanitarian Action Plans of eight countries in the Sahel (including Niger), which is now being extended to the Democratic Republic of Congo.

The strategy is progressively being extended to nonemergency approaches with the objective of enhancing nutrition outcomes in countries with a high malnutrition burden. A further expansion linking this humanitarian approach more systematically to those undertaken in development could help achieve greater and more sustainable outcomes. If WASH is an underlying driver of nutrition, nutrition can also be a vector to improve WASH outcomes through other sectors and delivery mechanisms, notably through safety nets and social protection or community-driven development projects, particularly in hard-to-reach vulnerable populations in which single-sector interventions may not be cost-effective. Review of existing evidence in the key sectors determinants to nutrition (health, social protection, WASH, agriculture, etc.) highlighted how behaviors have been consistently identified across sectors as a key dimension explaining relatively limited results in terms of nutritional outcomes. Behaviors and norms may well be the missing link to connect all those interventions and yield at last sustainable outcomes but also require more systematic coordination.

WASH interventions targeting nutrition and health must place particular emphasis on ensuring high water quality efficiently. Building infrastructure that can deliver truly clean water and a fully safe sanitation chain is a long-term project. In the short run, "fail-safe" stop-gap interventions such as treatment at point-of-use may also be considered as part of nutrition focused projects, especially in vulnerable areas where high quality infrastructure is not cost-effective yet. Evidence suggests that point-of use treatment can achieve take-up rates of up to 70 percent and reduce child diarrhea by 20 percent to 40 percent (e.g., Ahuja, Kremer, and Zwane 2010; Arnold and Colford 2007; Clasen et al. 2006; Clasen et al. 2015; Fewtrell et al. 2005; Sobsey 2002; Waddington et al. 2009). Such interventions may also minimize recontamination in the home, a well-known cause of water quality degradation even in the best-case scenario of access to clean piped water. While not sufficient alone, point-of-use water treatment can be a cost-efficient WASH intervention to protect key nutritional outcomes in children under five, thereby protecting Niger's potential for shared prosperity.[24]

Implications of the WASH-Nutrition Nexus for Policy Makers

The nexus of WASH and nutrition highlights important lessons for policy makers. First, the results presented in this chapter flag the need to factor climate variability in the expansion of WASH, a concern also echoed by the UNICEF–GWP Climate Resilient Framework (2015), in both the planning and building of WASH infrastructure but by accounting for the long-term implications on nutrition.

Second, the new SDG focus on quality of WASH services is of critical importance to address the major health problem of WASH-related diarrhea and malnutrition. Contaminated "improved" facilities are part of the problem, contributing to acute and long-term negative health effects in Niger. The urgency of addressing Niger's sanitation gap is rendered acute by the country's high exposure to climate variability. Reducing open defecation through the expansion of improved

Box 4.1: Enhancing Household Resilience to Climate Vulnerability through WASH- and Social Protection-Integrated Community-Led Interventions

The WASH/ CFS is a collaboration between the World Bank's Water Global Practice, the Social Protection and Labor Global Practice, and the Behavioral Initiatives team (Poverty Global Practices). Key motivation for this pilot intervention is the role of behaviors identified across sectors (health, social protection, WASH, agriculture, etc.) as a key dimension explaining relatively limited results in terms of nutritional outcomes. In a context of high stunting (44 percent), high open defecation (over 80 percent), and vulnerability to climatic shocks (floods and droughts), the cross-sectoral pilot intervention will place a primary focus on the issue of promoting systematic water treatment at a high level of compliance and a secondary focus on changes sanitation behaviors.

The pilot builds on the expansion of the Niger Adaptive Social Safety Nets project, its delivery mechanism through community agents and accompanying measures to identify complementary WASH interventions and nudges that can yield greater results in terms of nutritional and health outcomes of vulnerable children in Niger. The pilot is to be implemented in FY18/19 in 155 villages in the departments of Dosso, Maradi, Zinder, Tillaberi, and Tahoua. The pilot includes an impact evaluation with anthropometric measurement of children under five and water quality testing.

sanitation owes to take into account public health in that larger climate vulnerability context and factor in sludge management and treatment to limit contamination.

Second, fail-safe interventions directly targeting water quality—e.g., point-of-use treatment—may help alleviate health impacts among the most vulnerable and reduce the negative consequences associated with climatic shocks until adequate infrastructure is in place. Safety net programs and other interventions with a strong community-based focus may be best positioned to promote the behaviors most likely to result in systematic use of water treatment (i.e., not just in case of outbreaks such as cholera) at a high level of community compliance to yield the expected nutritional and health benefits (see box 4.1). Third, cross-sectoral interventions incorporating high-quality WASH along with factors such as food security, maternal education, and childcare, with an emphasis on the role of norms and behaviors at household and community levels, are likely to have most impact on health.

Notes

1. The GHI scores are based on a 100-point scale in which zero is the best score (no hunger) and 100 the worst. In practice, neither of these extremes is reached. A value of 100 would signify that a country's undernourishment, child wasting, child stunting, and child mortality levels each exactly meets the thresholds set slightly above the highest levels observed worldwide in recent decades. A value of zero would mean that a country had no undernourished people in the population, no children younger than five who were wasted or stunted, and no children who died before his or her fifth birthday. The GHI Severity Scale is deemed: "Low of the GHI is inferior of equal to 9.9; moderate is the GHI is between 10.0 and 19.9; Serious if the GHI is between 20.0 and 34.9; Alarming is the score is between 35.0 and 49.9; Extremely alarming if the score exceeds 50.0." See IFPRI's website, http://ghi.ifpri.org/methodology/.
2. Stunting and the CIAF are used in this section to capture the overall extent of undernutrition among children. Stunting is a cumulative measure of both acute and chronic undernutrition and tends not to vary instantaneously in response to acute conditions such as diarrhea or measles. This makes it a preferred indicator of aggregated deprivation over time. The CIAF has been proposed (Svedberg 2000) and used (Nandy et al. 2005) to provide an unequivocal statement on the direction and degree of change in undernutrition over time, which would be particularly useful in a context of high vulnerability such as Niger. The CIAF allows the analysis to capture more systematically the different combination of anthropometric failures (i.e., including wasting and underweight in addition to stunting). Still, stunting represents the main contributor to CIAF in Niger and stunting captures more than 80 percent of the children with anthropometric failures.
3. The risks by cause analysis looks at the total burden of deaths by risk factor and how risk factors affect 21 broad cause groups. Data used for the 2013 Global Burden of Disease come from vital registration, verbal autopsy studies, maternal and child death surveillance, and other sources covering 14 to 244 site-years (i.e., years of cause of death data by geography) from 1980 through 2013. The data were used to estimate cause-specific mortality. Data from 35,620 epidemiological sources were used to estimate the prevalence of the diseases. Cause-specific mortality for most causes was estimated using the Cause of Death Ensemble Model Strategy Global Burden of Disease Pediatrics Collaboration (2016).
4. The indicator captures the incidence of diarrhea in the last two weeks prior to the survey in children below 59 months of age.
5. **DALY** is a universal metric that allows researchers and policy makers to compare very different populations and health conditions across time. DALYs equal the sum of years of life lost (YLLs) and years lived with disability (YLDs). One DALY equals one lost year of healthy life. DALYs allow us to estimate the total number of years lost due to specific causes and risk factors at the country, regional, and global levels (IHME, 2015).
6. **MODA** is a tool developed by UNICEF to enhance the equity focus of child poverty and deprivation analyses around the world. MODA adopts a holistic definition of child well-being,

concentrating on the access to various goods and services that are crucial for children's survival and development. It recognizes that a child's experience of deprivations is multifaceted and interrelated, and that such multiple, overlapping deprivations are more likely to occur, and with greater adverse effects, in more socioeconomically disadvantaged groups. MODA builds on UNICEF's Global Study on Child Poverty and Disparities, the Oxford Poverty and Human Development Initiative's (OPHI's) Multidimensional Poverty Index (MPI), and other research carried out in the field of multidimensional poverty. MODA has five main characteristics that may be distinguished from most existing studies: (a) it selects the child as the unit of analysis, rather than the household, since children experience poverty differently from adults especially with regard to developmental needs; (b) it adopts a life cycle approach that reflects the different needs of early childhood, primary childhood, and adolescence; (c) it applies a whole-child-oriented approach by measuring the number of deprivations each child experiences simultaneously, revealing those most deprived; (d) it measures monetary poverty and multidimensional deprivations simultaneously for each child whenever the data used have information on both; and (e) it enriches knowledge from sector-based approaches through overlapping deprivation analyses and generating profiles in terms of the geographical and socioeconomic characteristics of the (multiply) deprived, thereby pointing toward mechanisms for effective policy design. (See UNICEF [2013].)

7. The adequate environment (WASH) measure is based on adjusted definitions adopted by WHO/UNICEF Joint Monitoring Programme (JMP) and as part of monitoring the Sustainable Development Goals (SDGs) and include components on (a) access to improved drinking water; (b) access to improved sanitation; (c) adequate handwashing practices; (d) adequate disposal of child's feces. Given that it is not only the child's immediate environment, i.e., the facilities in the dwelling unit, but also those in the immediate neighborhood that affect the degree of exposure to pathogens, communitywide access to improved sanitation is also explored. Further details on the econometric model and definition used can be found in appendix.
8. In terms of access to adequate food, about 22 percent of the children aged 6–23 months have access to a diverse diet and 45 percent have access to the appropriate number of feedings. However, only 5 percent have access to both simultaneously. Even in the wealthiest wealth quintile, 23 percent of children have access to dietary diversity although about 43 percent receive at least the minimum number of feedings, and 12 percent have simultaneous access.
9. A Wealth Index excluding the WASH variables typically used in the DHS Wealth Index is used.
10. For a normal distribution and fitted probability distribution for the actual recorded precipitation (McKee, Doesken, and Kleist 1993).
11. The SPI is not, however, a drought prediction tool. Many other variables were also tested for this analysis (temperature, the normalized difference vegetation index (NDVI), evapotranspiration, runoff, etc.). Ultimately, for clarity of interpretation, the choice was made to rely on the SPI. No single measure could be expected to fully capture shocks, but the SPI was determined best as a reference to define droughts and floods in a consistent manner. Other measures are used for a robustness check. The source of all the climatic data used in the analysis is the Princeton University's African Flood and Drought Monitor, available at http://stream.princeton.edu/AWCM/WEBPAGE/interface.php?locale=en.
12. The three-month Standard Precipitation Index (SPI3) is the number of standard deviations where three-month cumulative precipitation deviates from the climatological average are observed (McKee, Doesken, and Kleist 1993). SPI6 is the same measure observed over six months, while SPI12 is the same measure observed over 12 months.
13. Primary sampling unit (PSU), enumeration area (EA), and cluster refer to the same sampling concept. Preference is given to the use of cluster to refer to this concept in the Niger WPD for consistency.
14. The incidence of diarrhea, a self-reported measured of diarrhea of under 5 children over the past two weeks preceding the date of the DHS survey interview, is known to be problematic. In the present analysis, it is primarily used in combination with other indicators to flag a potential contamination pathway. Indeed, as noted by GBD (2015) "although considerable formative research was done in the early 1980s to understand local terms

and beliefs about diarrhea, this information is often overlooked in the design of questionnaires and simple mistakes in the translation of survey instruments or the omission of key local terminology can result in missed diarrhea episodes. Moreover, current surveys assume that all diarrhea episodes are in need of the same level of treatment. Older surveys asked caregivers about the duration of the diarrhea episode, but this is no longer common. Currently, caregivers are asked about the presence of blood in the stool, but are not asked questions designed to classify disease severity, because this is thought to be difficult in household surveys with 2-week recall."

15. A recent World Bank report using the Bhutta et al. (2013) program, and factoring in the annual trend decline of 1.5 percent, will leave the stunting rate in 2025 at 36 percent below to its 2010 value: 4 percentage points shy of the 40 percent target reduction adopted by the 65th World Health Assembly, which estimates a rate of return for 34 countries as a whole of 17 percent, with a benefit-cost ratio of 15 to 1. The East Asia and Pacific region has the highest rate of return (24 percent), reflecting the low per capita program cost, the high rate of return to education, the high initial GDP per capita, and the high GDP growth rate. Africa has the lowest rate of return (15 percent), reflecting the high per capita program cost, the relatively low initial GDP per capita, and the relatively low GDP growth rate. Africa's numbers are offset only partly by the relatively high rate of return to education in Africa. There are variations within regions, of course: India, for example, has a rate of return of 23 percent, reflecting in part India's low program cost and its high GDP growth rate (Galasso and Wagstaff 2017).
16. This 15 percent stunting cutoff is arbitrary but does correspond to the approximate stunting prevalence in 2015 for 100 million stunted children: the World Health Assembly (WHA) target for stunting in 2025 (IFPRI 2014).
17. The underlying driver thresholds are calculated by fitting a line to a cross-plot of stunting and each of the underlying drivers using data from all countries that have available data for all six underlying drivers. The threshold for, say, available calories per person per day is determined by the calorie level above which we would estimate a stunting rate—on average—of less than 15 percent (2,850 calories). This is done for all six underlying drivers. In total, 98 countries were included in the definition of those thresholds, including Niger (IFPRI 2016). Several studies provide estimates that link stunting to a range of underlying drivers. Smith and Haddad (2015) analyzed variation across a number of countries over time, while Headey and Hoddinott (2015) and Headey, Hoddinott and Park (2016) analyzed variation within a given country over time.
18. The 2012 DHS estimates a higher access to improved WASH than the 2011 and 2014 LSMSs; we choose to use the 2012 DHS as an upperbound reference here. In the case of rural improved water, the gap from the IFPRI threshold is 8 percentage points with the 2012 DHS, while it is 11 percentage points with the 2014 LSMS. With respect to rural improved sanitation, the gap is 70 percentage points with the 2012 DHS and 74 percentage points with the 2014 LSMS.
19. Due to security reasons, data collection in the region of Diffa has become difficult and the recent LSMS only partially covered the region of Diffa.
20. As noted earlier, only 52 percent of children under two years of age have received a complete set of vaccinations. There is strong evidence that vaccination rates are strongly correlated with distance. Children living within a one-hour distance from a health center are 1.9 times more likely to have a complete set of vaccinations compared to children living further away (Blanford et al. 2012). Access to health care is impeded not only by inadequate infrastructure and personnel but also by cultural attitudes. For example, the most recent DHS shows that getting permission to go for treatment is listed as a barrier to accessing health care by high proportions of women in Agadez (44 percent), Maradi (40 percent), and Niamey (30 percent).
21. The REACH partnership was established in 2008 by the FAO, UNICEF, the World Food Programme, and WHO to assist governments of countries with a high burden of child and maternal undernutrition to accelerate the scale-up of food and nutrition actions.
22. The report identifies Niger as an outlier, primarily driven by its demography. The report warns of the large need to protect poor people in Niger, along with Mali and Senegal, from the consequences of droughts in the drylands and the scope of the challenge even if all

resilience enhancing measures are taken. For those three countries, the fiscal realities are expected to be especially harsh. For those countries, even with those resilience measures taken, the cost of using cash transfers to bring all drought-affected people up to the poverty line is likely to far exceed 1 percent of GDP, the consensus value in the social protection literature on the resources governments should be willing to spend on social safety nets.

23. The strategy is centered on mainstreaming a WASH "minimum package" in humanitarian programs. This strategy recommends three main groups of activities: (a) improving WASH conditions in nutrition centers and reducing the risks of nosocomial infection among children who receive treatment; (b) providing a hygiene kit and giving advice to families in order to improve treatment and reduce risks of relapse; (c) Improving the WASH environment in communities at risk of undernutrition to prevent new cases (WASH in Nut in the Sahel 2012). The WiN strategy was developed over several years after the 2005 food crisis, but received a "push" by the crisis in 2011–12 and was then formalized.
24. While no recent study on the cost-effectiveness of water treatment exists, a WHO–UNICEF study postulates that household water treatment can pay back US$60 for every US$1 invested (WHO/UNICEF 2005).

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Chapter 5
WASH Service Delivery—Providers, Performance, and Bottlenecks

Key Points

- Urban water has been managed through a public-private partnership (PPP) since 2001, successfully improving access and continuity of supply, and attracting the lion's share of water supply, sanitation, and hygiene (WASH) funding in Niger.
- Even in urban water, however, key challenges remain, in particular water quality at point-of-use and the expansion of urban services to poor neighborhoods for which the PPP arrangement gives few incentives.
- Rural water access has improved considerably over the past decade, but underfunded, low-capacity communal authorities have struggled to close the remaining access gap and enforce service quality.
- Urban sanitation suffers from a lack of institutional ownership and funding, resulting in low improved access and a near absence of public interventions, even in key health and education facilities.
- In rural sanitation, the government has adopted community-led total sanitation (CLTS) as its preferred approach, but an underfunded, fragmented effort has only reached 3 percent of villages and improved access remains below 5 percent.
- The uneven subsector performance creates cross-sectoral challenges since the lack of safe fecal sludge management can affect water quality, undermining health outcomes.

Successful PPP in Urban WASH Settings, Despite Key Service Gaps

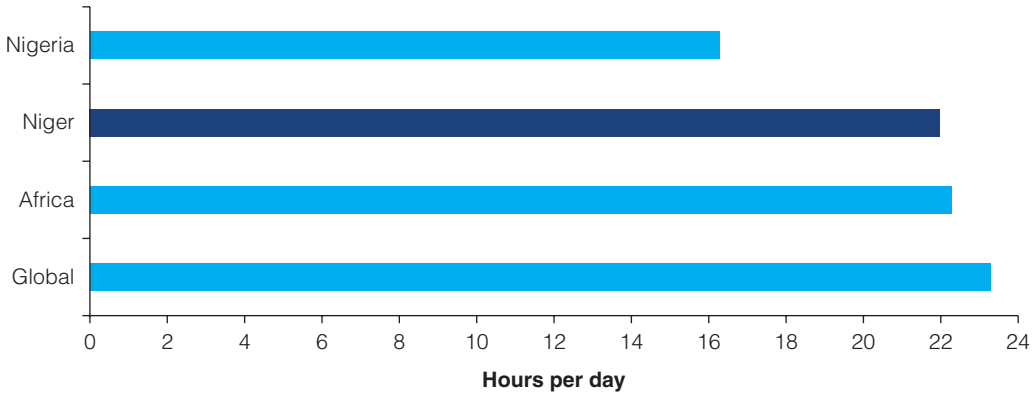
The 2001 PPP reform is credited for the achievement of the Millennium Development Goal (MDG) target in 2013 for urban areas. The 2001 reform established a system based on two distinct entities: SPEN (Société de Patrimoine des Eaux du *Niger)* and SEEN (Société d'Exploitation des Eaux du Niger), through a PPP. SPEN, a public corporation, is the asset-holding company in charge of sector development under a 10-year concession contract. SEEN, a private company, was selected to operate and maintain the facilities and commercial activities (billing and collection) under a 10-year *affermage* (lease) contract. These two companies are in charge of water supply in 54 centers in the country (all big cities and some secondary centers). The concession contract with SPEN was renewed in 2014 for 10 years. The contract of the private operator was renewed for 10 additional years in 2012 based on its good performance.

The financial equilibrium of the urban water sector has been restored but remains fragile. SPEN has become financially autonomous and able to recover its capital and operational expenditures without government subsidies. However, since 2015, nonpayment of the government water bills, which represents 20 percent of the company's turnover, is putting pressure on SPEN's finances. This situation is compounded by an absence of adjustment of water tariff.

Niger urban water supply is a success story in terms of access, but access is eroding as demand continues to grow. As seen in chapter 2, access to improved water in urban areas is high. It is high across areas (Niamey, regional capitals, and smaller towns) and improved access expanded by 14 percentage points between 2005 and 2015 (JMP). This high access is combined with an improvement in the continuity of service. Whereas a situation of rationing existed prior to 2001 (about 12 hours of service a day) in all urban cities, including Niamey, water supply is now close to continuous (24 hours a day, 7 days a week) through the entire service area. This performance ranks the service continuity through SPEN and SEEN above that in its neighbor Nigeria and above the average for that in Africa (figure 5.1). However, looking at the type of piped access hints at the challenges faced by urban water. While piped access expanded, access to piped water on premise deteriorated over the same period in smaller towns.

Water quality is a pressing issue. Although there are no countrywide data on water quality at either point-of-collection or point-of-use, low sanitation and sewerage, climatic variability (floods and droughts), as well as increased population density in urban areas are worrying signs.[1] Existing data for Niamey confirm a high contamination by nitrates and nitrites above acceptable limits of nearly all aquifers around Niamey, as well as a contamination by E. coli of all underground water as a result of fecal contamination and fertilizers (Vassolo et al. 2015). Furthermore, an assessment of the water quality in 19 water supply schemes in Niger indicated that 18 out of 19 centers do not have a chlorination system and that water quality is poor in four centers (Maiga 2016). In addition, for those without access to water on premise (the majority), a reliance on daily delivery of water by ambulatory vendors—called *ga'ruwa* in Niamey (from Hausa, meaning "there is water"—increases the contamination pathways, even if the water at point-of-collection was not polluted (photograph 5.1).[2] The higher incidence of diarrhea of children under five in urban areas (16 percent) both compared to rural areas in Niger as well as to urban ones in neighboring Mali, highlights the urgency.[3]

Figure 5.1: Service Continuity—Hours per Day of Water Supply, 2015



Source: IB-Net 2015.
Note: As the data show, SPEN and SEEN continuity of service in Niger is high. SEEN = Société d'Exploitation des Eaux du Niger (operating company for water utilities); SPEN = Société de Patrimoine des Eaux du *Niger* (asset-holding company for water utilities).

Photograph 5.1: *Ga'ruwa* (Water Vendor) in Niamey, 2017

Source: World Bank.

While the level of access is high at the city level, there is important within city variation. In newly settled peri-urban areas where most poor people live, access is problematic in terms of coverage and cost. As seen in chapter 2, the poor have much lower access to improved water than the nonpoor in Niamey (55 percent compared to 85 percent as of 2014). This situation is in part the consequence of a lack of planning for newly urbanized and peri-urban areas combined with low rates of expansion of the network. Furthermore, not only is network access of the poor lower in these areas but also water tends to be much more expensive. For instance, in Niamey, households connected to the water supply network are paying an average of 304 XOF (corresponding to US$0.60 USD) per cubic meter while those out of the network in the peri-urban areas pay up to XOF 2,500 (US$5) per cubic meter. This makes the cost of water much higher precisely in neighborhoods in which the majority of poor people live (temporary or permanent migrants from rural areas).

Regulation of water supply is weak, and no pro-poor measure is in place to expand the urban network. In 2014, a regulatory body was created within the Ministry of Water and Sanitation (MHA). Yet, it is far from being operational. To date, the regulation bureau staff is seconded from MHA but also reports directly to the MHA, making it difficult for the institution to behave as a true regulatory body. With minimum resource requirements lacking, no expansion targets for the network in the SPEN and SEEN contracts, nor pro-poor measures to facilitate connections and prioritize poorer neighborhoods, closing the access gap for the urban poor in a context of rapid demographic growth is undoubtedly a challenge for urban water.

Challenges of Rural Communes to Close Service Gap

In line with Niger's political decentralization, the 2010 Water Law assigned responsibility for rural water supply to local governments. The communes are responsible for public water supply services within the confines of their territories and are the owners of water supply assets. The Public Water Supply Services Guide of the same year further introduced a delegated management model and private sector participation, allowing communes to enter into a formal agreement with an operator. The private operators manage the water supply systems under a lease (*affermage*) management contract with the commune. This model has since become more prevalent than direct community management. At the end of 2014, out of 1,154 rural water supply systems, 860 (75 percent) were under delegated private management compared to 25 percent under community management. Finally, the MHA was identified as regulatory institution. As per the new Sectorial Program for Water, Sanitation and Hygiene (Programme sectoriel Eau Hygiène et Assainissement [PROSEHA]), the MHA makes decisions based on municipal local water supply and sanitation plans (Plan Local pour l'Eau et l'Assainissement – PLEA) for priority infrastructure and negotiates with the Ministry of Finance to secure resources that should then be transferred to the communes.

Weak capacity of the different parties involved and confusion over their roles is an issue, despite the clarity of the guidelines. Without an operational regulatory body, quality is an issue. Communes need to be supported in planning and delegated management (Maîtrise d'Ouvrage Déléguée) to fulfill their role, and be endowed with sufficient resources to finance needed investments, since large sections of the rural population still rely on wells for their water supply. Mobilizing the private sector is challenging in rural and small towns due to the lack of a business case and unclear rules of engagement. Various donors provide resources but in an uncoordinated way.

Communes and private operators struggle to respond to the needs of growing rural municipalities. Management of water supply systems in growing rural municipalities is becoming a problem as population continues to grow. An increasing demand for water quantity and quality, as well as for household connection, faces a limited prospect for the extension of existing infrastructures. Communes and private operators are unable to respond to this challenge in small municipalities. Through PROSEHA, the government is planning to transfer the management of 75 rural water supply and sanitation (RWSS) centers to SPEN. This transfer requires that SPEN and MHA revisit the existing concession contract and agree whether these centers will be managed by SEEN or by another private operator after a bidding process.

Closing the rural water service gap has remained elusive, particularly considering Niger's institutional challenges, climatic vulnerability, and high population growth (but low rural population density). While rural populations have seen an increase in their access to improved water by 7 percentage points between 2005 and 2015 to reach close to 49 percent of the rural population, the quality of this access is lagging (only 20 percent is piped as of 2012 and close to no connection is available on premise). Low levels of infrastructure (not just in WASH—for instance, only 21 percent of roads in Niger are paved), low density of population, and high climate vulnerability are just some of the challenges current rural water systems face. A growing population is putting pressure on existing systems to close the gap and respond to an increased demand. A large share of the 30 million people need access to improved water by 2030, and indeed many the poor in Niger today reside in rural areas (and will in the future).

Water quality is a pressing issue given the current and projected growth of the gap in access to improved water infrastructure, the multiplicity of contamination pathways, and vulnerability to climate shocks. As seen in chapters 2 and 3, households' treatment of water is very low across Niger. This is especially problematic in rural areas due to (a) the continued reliance of

Photograph 5.2: Dan Toulou (Dosso). Water from Village Well (Left) and Household Storage (Right), September 2016

a large share of the rural population on unimproved water sources, and (b) the multiple contamination pathways of water (even improved water) before consumption in a low sanitary environment exposed to climatic variability (floods and droughts). Building infrastructure that can deliver truly clean water and a fully safe sanitation chain is a long-term project. In the short run, "fail-safe" stopgap interventions, such as treatment at point-of-use, may be considered as part of nutrition-focused projects, especially in vulnerable areas in which high-quality infrastructure is not yet cost-effective (photograph 5.2).

Reasons for Inadequate Household Solutions with Urban Sanitation

Urban sanitation lacks leadership and is devoid of systematic, at-scale service provision, be it public or private. Urban dwellers rely on household-level solutions, which are often of low quality. While access has increased to a still low level of 38 percent, the MDG target was missed in urban areas (chapter 2). Moreover, in the absence of professional collection and treatment services to manage and safely dispose of fecal sludge, even urban households with improved on-site facilities ultimately contribute to environmental pollution and urban hygiene risks. Completing this dire service delivery picture is the absence of a regulator for sanitation and low demand for sanitation in spite of the high risk to public health.

At the policy level, urban sanitation is similarly orphaned. The National Program for Drinking Water and Sanitation (2011–15), adopted in December 2011 (PN-AEPA; Programme Nationale d'Alimentation en Eau Potable et d'Assainissement), includes a sanitation component but does not distinguish challenges in urban and rural areas. Municipalities and the Ministry for Urban Planning have not yet engaged in more integrated and complex urban planning to respond to urbanization. As a consequence, densely populated informal settlements have emerged. The lack of space and formality in these settlements poses technical problems for

constructing sanitation facilities and collecting waste. While some alternatives do exist, such as nonconventional sewage collection systems (small-bore sewers), there is currently limited capacity in the public sector to develop and manage them.

The modest rise of on-site sanitation in urban areas has not been matched by an expansion of sewerage and emptying services. Little evolution has occurred with respect to the construction of on-site sanitation, which continues to be basic (lined pits, improved latrines, cesspools) and driven by the demand of households (WSP 2011). Pit emptiers, masons, and public toilet managers are often low-status and untrained. There is no sewer system as such, but there are a few small piped sewer systems in areas of Niamey, constructed as part of a pilot scheme by a nongovernmental organization (NGO), a private operator, and a property developer. To date, sewerage remains limited to rainfall drainage, which modestly expanded from only 630 kilometers nationally in 2007 to 750 kilometers in 2012.

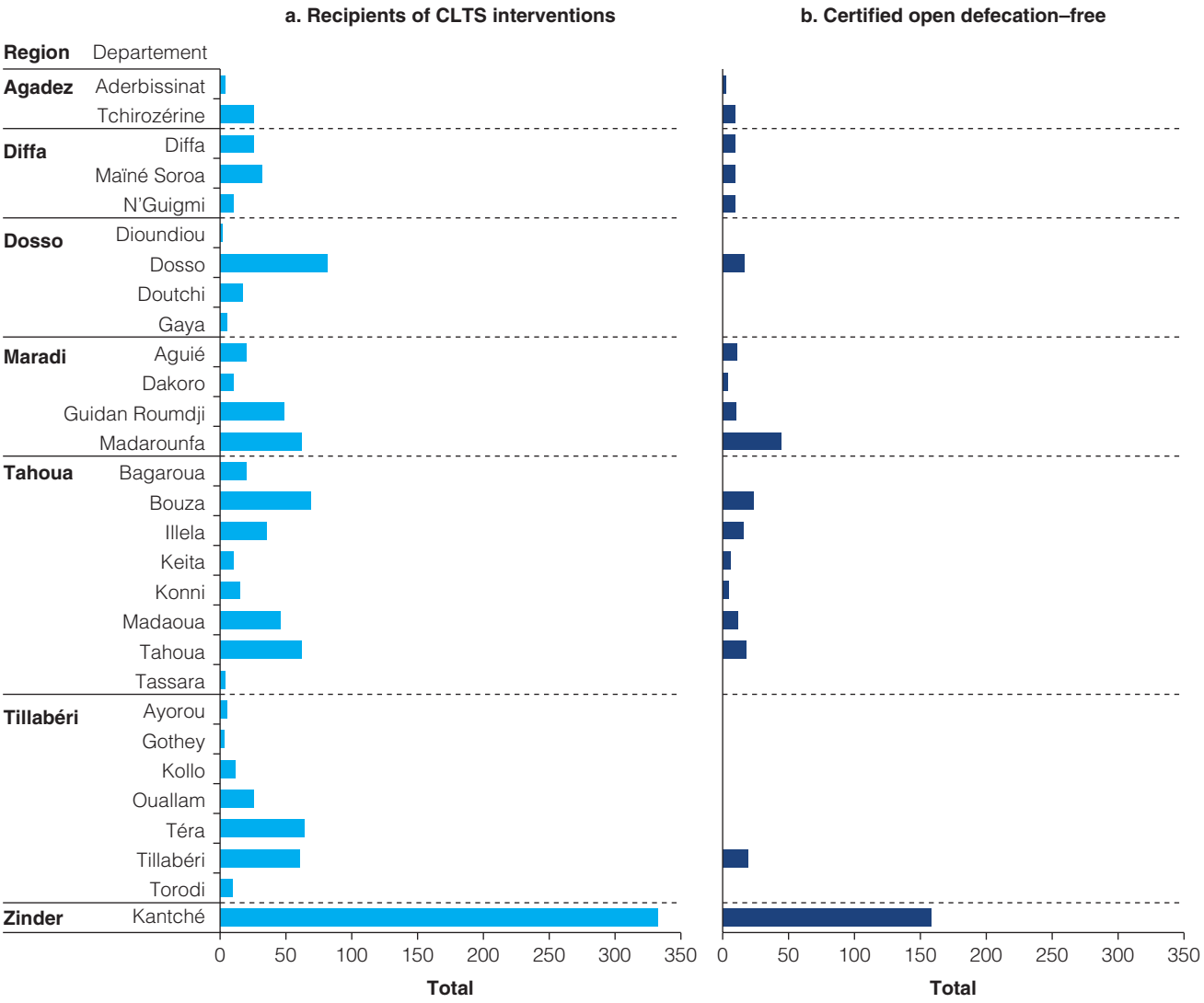
A lack of adequate wastewater collection and treatment presents a challenge to public health in urban areas. No specialized company exists to manage fecal sludge. Vacuum trucks for the evacuation of excreta operate but mostly serve richer areas of the Niamey area. Even the vacuum truck of the Urban Community of Niamey (CUN; Communauté Urbaine de Niamey) is used as part of the private service offerings. CUN has little control over pit emptying operators, which has two direct implications. First, a lack of monitoring and regulation by the public sector means inappropriate practices, such as the disposal of sludge illegally in the streets and in the Niger River. Second, although prices remain subject to competition, there is no subsidy mechanism available to reduce the amount poorer households have to pay, making the cost of managing latrines (in addition to their construction) out-of-reach for those households. This lack of wastewater collection and treatment presents an important public health danger in urban Niger in which increased population density combined with climatic shocks (particularly floods) lead to higher contamination, poorer nutritional outcomes (chapter 3), and heightened risks of epidemics such as cholera or Ebola.

CLTS Strategy Falling Short in Rural Sanitation

CLTS has become the dominant approach to rural sanitation since its initiation in Niger in 2009, but due to underfunding and fragmentation, results have been very limited. As of 2016, 1,118 villages in 116 communes across Niger have been the focus of CLTS interventions implemented by different actors, primarily NGO-based. This means less than 3 percent of villages received an intervention (figure 5.2). The implementation has not been uniform across Niger, with some departments such as Kantché in the region of Zinder receiving over a third of the total number of village interventions, while other regions have been nearly untouched by the CLTS approach. Only about a third of the targeted villages have been certified open defecation–free. While some villages are still undergoing this process, experiences from other countries (e.g., Mali, the Democratic Republic of Congo) show that sustaining "healthy" WASH norms is difficult, even in the short term. A new focus on "open defecation–free" post-certification is progressively emerging but has yet to translate into actions at scale. Those modest results raise the question of the reasonable expectations one should place on this approach alone, and whether the combination with other cross-sectoral interventions could yield better outcomes.

CLTS is the main vehicle for intervention in rural sanitation, but this approach alone will not bridge the existing and growing sanitation access gap. CLTS is the main vehicle for intervention in rural sanitation and recognized as such by the government through PROSEHA and the Operational Strategy for the Promotion of Hygiene and Basic Sanitation (SOPHAB; *Stratégie Opérationnelle de promotion Hygiène et Assainissement de Base*), which promotes a consistent, no-subsidies approach to prevent distortions created by a multiplicity of donor-driven schemes that create disincentives to implementation. At this stage, and in light of limited institutional capacity, CLTS remains NGO-driven and implemented. This official endorsement of CLTS reflects what can be done with limited resources.

Figure 5.2: Villages in Niger that Are Recipients of CLTS Interventions Since 2009 and Certified Open Defecation–Free



Sources: World Bank calculation based CRS, MHA, and UNICEF data as of November 2016.
Note: CLTS = community-led total sanitation.

Besides the relatively low sustainability of all the norms promoted by CLTS, the impact on other key outcomes such as children's health and nutrition has also been muted. The approach has shown some results on improving anthropometrics, such as in Mali (Pickering et al. 2015) but is overall insufficient (Ahuja, Kremer, and Zwane 2010). This is not surprising since failure to build latrines can be the result of several factors, such as lack of supply chains, that could easily impede the translation of community willingness to change into action. Additionally, high level of community compliance is required to see anthropometric impact. Alzua et al. (2015) find that fully eliminating open defecation from a village in which everyone defecates in the open would increase child's height by 0.44 standard deviations (looking at Mali, Indonesia, India, and Tanzania). This high level of compliance also highlights the role of norms and behavioral nudges to reach the needed threshold to positively impact health and nutritional outcomes.

None of these potential impacts of CLTS are realized at scale in rural Niger, where open defecation still dominates. High rates of open defecation are primarily driven by lack of access,

not by preference. A 2014 report on attitudes toward sanitation (WSP 2014) finds that most respondents (82 percent) did not mention any advantage of open defecation, with no difference between male and female respondents. In addition, 73 percent of the respondents are not satisfied with the available place for defecation; 86 percent of respondents would stop the practice if they had a latrine; and 95 percent, if they had a latrine in their compound. Respondents identified key motivations for the construction of the latrines by rank: (a) the desire for more privacy (61.4 percent); (b) hope for better health at home (57.6 percent); (c) the reception of external support by an NGO (28.3 percent); (d) Aspiration for better health for the community (22.5 percent); and (e) more comfort (20 percent).

Cost is the main impediment to latrine building, but the high rate of open defecation contributes to the perpetuation of a de facto prevalent and accepted practice. In a context of pervasive poverty and high climate variability affecting fragile infrastructures, the construction of latrines is not prioritized by households and the community where they reside, perpetuating the practice. Still, as discussed in chapter 2, the high rate of open defecation in Niger contrasts with its neighbor Mali, where poverty and building costs are overall comparable, yet open defecation is much lower (only 15 percent based on the 2015 JMP estimate). This indicates that other factors are at play, notably in terms of norms, with social and cultural taboos interfering with the construction of even the most basic type of sanitation infrastructure (even unimproved ones, which have limited cost implications, if any). For instance, in some cases, open defecation is elected over using a shared latrine because it offers more privacy to the user (WSP 2014). The de facto social acceptance of practice calls for interventions at the community level.

Across the country, norms exist for "institutional" latrines but are not enforced. The derelict condition of institutional latrines, i.e., latrines in public buildings providing health and education services, is testament that the issue of sanitation does not receive the required attention from authorities, threatening the very existence of the few existing infrastructures.[4] When latrines are built, their usefulness is short-lived: without a mechanism (management contract, community management) to clean and empty them, they rapidly become unusable. As shown by the data of the recent Service Delivery Indicator (SDI) survey, just 23 percent of public health facilities have toilets for outpatients (20 percent in rural areas, 64 percent in rural ones). A similar situation is found in terms of education, with only one school in four (24.3 percent) having functional, private, and accessible latrines (World Bank 2017). This is very serious especially given the importance of public and institutional latrines for gender and inclusion, notably with respect to menstrual hygiene (UNICEF 2013). The lack of adequate access threatens the already low health and educational outcomes of women and girls in Niger.

Despite real progress at the policy level, both urban and rural sanitation are still negatively impacted by institutional uncertainties. Urban sanitation does not exist as a subsector. The PN-AEPA[5] includes a sanitation component, but does not distinguish challenges in urban and rural areas. Rural sanitation lies in the shadows of rural water (*hydraulique rurale*). Furthermore, both urban and rural sanitation are affected by cleavages between actors favoring approaches prioritizing changes in hygiene, behaviors, and norms compared to those prioritizing sanitation infrastructures or environmental protection. These issues are further discussed in the next chapter.

Notes

1. Data quality at point-of-collection and point-of-use are being collected as part of the WASH/Social Protection pilot done in collaboration with the Adaptive Social Safety Nets project in Niger.
2. These vendors purchase water at street-side standpipes where they fill 10–14 twenty-liter plastic containers of water and deliver them for a higher price to regular customers using metal pushcarts with bicycle wheels specifically designed for this purpose by local blacksmiths. Ga'ruwa pay the standpipe managers CFAF 15 (US$.03) per twenty-liter

container of water filled, and collect CFAF 25–50 (US$0.05 to US$0.10) for each twenty-liter container of water delivered, depending on the distance between the customer and the standpipe. Ga'ruwa also make spontaneous sales of water on the street, for example, to commercial truck drivers about to embark on long trips. Thus, a ga'ruwa who pushes a cart that carries 10 containers earns a profit of CFAF 100–350 (US$0.20 to US$0.70) per cartload, after paying the standpipe manager for the water (Youngstedt, Keough, and Idrissa 2016).

3. The additional financing of the urban water supply and sanitation project (P159240) approved in 2016 includes a water quality component. Under this component, five towns in which the quality of groundwater does not comply with standards (excessive fluorine in Tessaoua and Guidanroumdji, iron in Matankari, and nitrates in Gazaoua and Goudoumaria) will be equipped with treatment facilities.
4. Latrines near markets are promoted in some communes, with some successful examples of fee-based use and delegated management.
5. National Program for Drinking Water Supply and Sanitation (2011–15) adopted in December 2011.

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Chapter 6
Governance—At the Root of Weak Service Delivery

Main Points

- Weak and unequal water supply, sanitation, and hygiene (WASH) service delivery is rooted in the deep-seated governance challenges of Niger's fragile, rent-seeking political economy that does not prioritize public service delivery.
- While Niger has seen important advances in its formal WASH policy and legal framework, in practice the sector has remained constrained by three major governance challenges:
  - Institutional fragmentation and lack of coordination in the sector
  - Unequal distribution of finance across subsectors, low absorption capacity, and lack of long-term prioritization of poverty reduction
  - Recent effective decentralization of responsibilities for water to local governments, which lack the financial and human capacity to meet these service delivery challenges
- Costs to expand access and close the gap dwarf what has been spent in the sector, and likely its capacity to absorb it, making prioritization essential.

Lack of Prioritization of WASH Services in Challenging Political Economy

Niger's complex political settlement and institutions constrain the capacity of the country to deliver services. The relatively small elite competes over access to rents from the country's natural and environmental resources and illegal trafficking, and profits from skimming public procurement (World Bank 2016). The elite coalition is fluid and fragile. Its survival depends on its capacity to distribute privileges among members and to weaken opponents through cooptation. The fragility of the ruling coalition and its reliance on privileges to sustain the coalition is not conducive to developmental policies, and leads to distortionary regulation, a fragmented and weak public administration, and neglect of public services.

- ***A poor regulatory and institutional environment*** constrains the most profitable economic opportunities to elite members, thus thwarting the development of the private sector, encouraging informality, and lowering domestic resource mobilization opportunities.
- ***A fragmented administration***, with many ministries and overlapping responsibilities, makes policy setting and implementation difficult; and this is compounded by high mobility of staff at all levels (staff mobility, ministerial turnover). The institutionalized fragmentation may well be intended since it enables power sharing between competing elites under the arbitrage of the presidency. Fragmentation also means that every unit can hope to attract dedicated project funding.

- ***A weak civil service***. Civil service has not recovered from the structural adjustment period's recruitment freeze in the 1980s (there is an experienced top layer of staff in the administration, but very little experienced middle-level management). It is based on patronage for appointment and promotions or demotions. Incentives to deliver are scarce since staff members see more benefits in courting development partners, which contributes to distortions in policy choices and implementation.

- ***In such a context, limited attention to the quality of public service provision reflects political calculations***. Traditional, religious, and ethnic leaders have the power to tell the population who to vote for, which can explain why the incumbent prefers to spend on private goods as opposed to public goods (or on a good preferred by donors, such as "education for all"). To the degree that public resources are spent, government officials tend to favor capital-intensive investments in large-scale, highly visible projects (roads, dams), and prioritize visible, short-term fixes. Public expenditures are biased toward established neighborhoods in the capital city: the priority is not on the front line, with most staff and resources remaining in the capital. This has a dire impact on services—and even more for rural services—and for sanitation.

Niger is a highly aid-dependent country with direct implications on governance. Between 2007 and 2016, donors contributed 8 percent to the gross domestic product (GDP) (11 percent in 2015) and financed about a third of the budget. This has three types of impact on governance. First, challenges of coordinating a diverse range of donors and external partners can create distortions in policies and policy implementation, and in a country with low capacity such as Niger, the distortions lead to an agenda neither firmly led by the government nor consistent among interventions. Second, donor support at times places more emphasis on establishing a best-practice legal and regulatory framework, without enough attention paid to local realities or the challenges of implementation.[1] This is compounded by an administrative culture in which creating structures per decree often is equated with having achieved something—even if such structures are not operational.[2] Third, a heavily aided administration creates duplicative structures in low capacity environments. Donors are pushing for "one structure per activity" to create a modicum of focus and control and more autonomy from limiting rules and practices, de facto bypassing existing government's structures in the worst cases (Operational Strategy for the Promotion of Hygiene and Basic Sanitation [SOPHAB]). This also has a negative impact on strategic planning and can create distortions on prioritization of activities (preference for activities most likely to provide per diem, such as ad hoc training).

A fragile regional context puts pressure of the government's spending priority toward security. Recent shocks are not likely to shift priorities toward public services since the security situation and commodities prices create pressure on public expenditures. Niger is at the heart of a turbulent region marked by political and religious violence. Spillovers from crises in northeast Nigeria, Libya, Chad, and northern Mali affect the country. Niger is battling an insurgency by the Islamic militant group Boko Haram and has declared a state of emergency in the Diffa region (about a third of Diffa's population was forcibly displaced) (World Bank and UNHRC 2016).[3] Supported by the international community, Niger is increasing its support to its security sector.

WASH's Improved Legal and Policy Framework and its Daunting Implications

Over the past decade, Niger has overhauled its policy framework for WASH and have defined guiding principles. The 2010 Water Law has laid the ground for a new policy basis for the sector and opened a phase of consolidation of the programmatic framework toward the achievement of the Millennium Development Goals (MDGs) and, more recently, the Sustainable Development Goals (SDGs). This process has led to the setting up of dedicated central agencies, particularly in the area of water and to a lesser extent—and more recently—

in the area of sanitation. Discussions between public officials and the donor community around these policies have moved the agenda forward and created the beginning of a shared understanding on key principles: the importance of the role of the private sector, of delegated management, and of a consistent approach (e.g., for implementing community-led total sanitation [CLTS]—i.e., no household subsidies for latrine construction).

The Water Law outlines the distribution of responsibilities in the WASH sector including a principle of subsidiarity aligned with the country's decentralization process. Article 63 of the Water Law clarifies the distribution of the roles and responsibilities between the state and local governments. A greater delegated role is given to local governments based on the principle of subsidiarity. The law also details the institutional setup for the management of water (Title IV). Sanitation is included in national and regional commissions' mandates (National Commission for Water and Sanitation [CNEA; Commission Nationale de l'Eau et de l'Assainissement]); Regional Commissions for Water and Sanitation [CREA; Commission Régionale de l'Eau et de l'Assainissement]) as well as in relation with the protection of points-of-water withdrawal for human consumption (title VIII).

The new Sectorial Program for Water, Sanitation and Hygiene (PROSEHA; Programme sectoriel Eau Hygiène et Assainissement) sets the objectives of universal access and sustainable management of both water supply and sanitation and will shape policy and operational dialogues moving forward. A product of important consultation, the PROSEHA (2016–30) is an ambitious sectoral program setting the targets for the WASH sector to reach universal coverage by 2030. The program also includes objectives more specifically geared toward pastoral water (*hydraulique pastorale*), a key issue in a country with a sizeable nomad and pastoral population. Although an entire component has been dedicated to hygiene and sanitation, it lacks details, which will make its operationalization a challenge.

PROSEHA builds on the SOPHAB, Niger's first sanitation strategy, attesting to the progress sanitation made on the policy front. The PROSEHA acknowledges the existence of the Operational Strategy for the Promotion of Hygiene and Basic Sanitation (SOPHAB, Stratégie Opérationnelle de promotion Hygiène et Assainissement de Base) as the main strength of the sector, which illustrates that sanitation, a neglected sector until recently, is beginning to get attention. The SOPHAB (2014–18) was elaborated and adopted in July 2014 to tackle the issue of hygiene and sanitation since this component was not well developed in the National Program for Drinking Water and Sanitation Programme (PN-AEPA; Nationale d'Alimentation en Eau Potable et d'Assainissement). The SOPHAB was a breakthrough following a long process to bring sanitation higher up in the public policy priorities. The launch of the "decade of drinkable water and sanitation" in the 1980s (with a goal of systematically twinning water supply projects with sanitation) was a first step, which led, 30 years later, in 2010, to the creation of a dedicated department within Ministry of Water.

The principles guiding the PROSEHA are ambitious, inclusive, and wide-ranging. The main principles include (a) equity of access and affordability; (b) specific attention to women, girls, and vulnerable populations; and (c) increased citizen participation. For water in urban areas, the program supports improving network and water quality, the formalization of the strategy for peri-urban areas, and continued public private partnerships. For water in rural areas, the program supports increasing coverage and access to improved sources based on a public-private partnership (PPP) approach and sectoral programming, and strengthening the implementation capacity of local governments and the private operators.

The feasibility of the objectives of the PROSEPHA for the next 15 years—much like that toward the SDGs—is questionable and will have to confront the institutional realities and bottlenecks of the subsectors. The PROSEHA epitomizes the progresses made on the policy front of the WASH sectors over the past decades. They constitute a remarkable achievement in perseverance and pave the way for substantial changes in the sector to reduce the gaps, address the needs (discussed in chapter 2), and tackle linkages (highlighted in chapter 3). Still, they will need to confront the sizeable institutional bottlenecks and challenges.

Challenges will be particularly daunting at the local level with communes now responsible for building and managing most basic services, including WASH. A recent decree (January 2016) confirmed the transfer of the health, education, environment, and water to local governments. This represents a very important shift in a centralized environment. For WASH, communes are responsible for the construction and management of public equipment including (a) building and maintaining water supply infrastructure; (b) collecting and disposing of waste water and household trash; (c) building and maintaining drainage systems and sewers; (d) building and maintaining treatment stations for waste water and household trash. They are also responsible to build and maintain "institutional latrines," i.e., latrines in education and health facilities.

The renewal of the National Plan for Economic and Social Development (PDES; Plan de Développement Économique et Social) and the Integrated Plan for the Management of Water Resources (PANGIRE) could have presented an opportunity to further connect the dots. The PDES initially defined in 2012 was extended by one year. Both the new PANGIRE and new PDES were approved in 2017. While the opportunity to better connect the PDES, the PANGIRE and the new National Food Security Policy (PNSN) did not fully materialize, there is still room for strengthening cross-sectoral collaboration in the targeting of financing and interventions.

Table 6.1: National Institutional Structure of Niger Water and Sanitation Sector, February 2017

	Water		Sanitation	
Aspect	Urban	Rural	Urban	Rural
Legal framework	**Constitution of Niger (2010):** Article 12 of the new Constitution of Niger adopted in October 2010 establishes that every citizen has the right to potable water.			
	Water Law (Code de l'Eau) adopted in 2010			
	The Water Law has the following **key** provisions in the water sector: • Guarantees to citizens the provision of water services for personal and domestic use (Art. 4) • An obligation by the state to make available to every citizen enough water supply of good quality at acceptable cost at all times and at all places, where there is a need (Art. 5) • Management of water resources is guided by principles of equity and sustainability; a global integrated approach through the GIRE; it notably recognized the role of women and the economic value of water (Art. 9) • All local governments are charged, within their sphere of jurisdiction, the functioning and provision of public provision of water (Art. 61) • The distribution of roles between the state and local governments is based on the principle of subsidiarity, with a greater role delegated to the local governments (Art. 63) • Public provision of water is managed and regulated by the local governments; within a contract framework for public service delegation; or a management agreement passed with the target population (Art. 67)		• Definition of the attribution of the National Commission for Water and Sanitation (CNEA) (Art. 25) and of the National Fund for Water and Sanitation (Art. 37) • Establishes protection measures related to the protection points of water withdrawal for human consumption, also referring to wastewater (Title VIII) • New ordinances related to the PROSEHA will further clarify the legal framework for the sector.	

table continues next page

Table 6.1: Continued

Aspect	Water		Sanitation	
	Urban	Rural	Urban	Rural
	• The public benefitting from water provision by the state, where the state or local authorities initiated or installed infrastructure will financially contribute to the installation of this service (Art. 69–70).			
Policy framework	**PDES (2012–16[a])**: serves as a reference document as well as a unifying framework for social and economic development for the government of Niger at all levels. Water supply and sanitation are captured under pillar 5, which promotes improved access social services including access to water supply and sanitation. Equally, it suggests improvement of supply of services for drinking water supply, hygiene, and sanitation at the commune level; the promotion of behavior change at the individual and collective levels; as well as the elaboration of plans for management of basic services in urban areas (transport, drainage, and solid waste management) and collection of household trash in rural areas.			
	PN-AEPA (2011–15); replaced by the PROSEHA (2016–30): adopted in 2011, this document guided the main activities of the water supply and sanitation sector for the period 2011–15 in line with the MDG goals. The new PROSEHA is closely aligned with the SDGs, with equally ambitious goals. Although an entire component has been dedicated to hygiene and sanitation, its level of precision is weak, making its translation into action difficult.			
	SOPHAB: Adopted in 2014, this strategy document aimed to tackle the issues of hygiene and sanitation, which was not well developed in the PN-AEPA. It is the only comprehensive document on hygiene and sanitation with an earmarked budget, accompanied by an action plan and an inter-departmental coordination framework.			
State institutions	**MHA**: formed in 2015 as part of a restructure of the management of water supply and sanitation in Niger, is responsible for the design, development and formulation, implementation, and evaluation of the national water supply and sanitation policy.			
	DGA, under the MHA, manages sanitation services through three technical directorates: DIHA/MU, DIHA/MR, and DDVSA.			
	MSP: leads hygiene interventions, which have to be implemented in coordination with the MHA. It focuses mostly on hygiene (rather than infrastructure) and is heavily involved in the development of CLTS programming.			
	Le Ministère de l'Environnement et de la Salubrité Urbaine et du Développement Durable: along with other concerned ministries, is in charge of the conception and implementation as well as follow up of policies on solid waste collection and removal.			
	CNEA works to convene and coordinate cross-government water supply and sanitation interventions. The commission comprises representatives of the ministries for water supply and sanitation, agriculture, urbanization, environment, livestock, regional and commune-level governments, NGOs, the private sector, and other specialist organizations.			

table continues next page

Table 6.1: Continued

Aspect	Water		Sanitation	
	Urban	Rural	Urban	Rural
Service providers	SPEN: a public corporation (an asset holding company) in charge of sector development under a 10-year concession contract. It is one of two companies created under a PPP model when the government of Niger conducted urban water subsector reforms in 2001. SEEN: a private operating company contracted by SPEN for the operating and maintenance of facilities as well as managing commercial activities (billing and collection) under a 10-year lease *affermage* contract.		Private operators operate in several regions managing RWSSs (e.g., Dosso: ELHYFORS; Maradi: Elhyfros and Sonexoh; Tahoua: Elhyfros and Sepa; Tillaberi: Pallsolaire and Ent. MB; Zinder: Ethem).	

Note: CLTS = community-led total sanitation; CNEA = Nationale de l'Eau et de l'Assainissement Commission; DDVSA = Direction du Développement et de la Vulgarisation des Services d'Assainissement; DGA = Direction Générale de l'Assainissement; DIHA/MR = Direction des infrastructures d'Hygiène et d'Assainissement en Milieu Rural; DIHA/MU = Direction des Infrastructures d'Hygiène et d'Assainissement en Milieu Urbain; GIRE = Gestion Intégrée des Ressources en Eau; MDG = Millennium Development Goal; MHA = Ministère de l'Hydraulique et de l'Assainissement; MSP = Ministère de la Santé Publique; NGO = nongovernmental organization; PDES = Plan de Développement Economique et Social; PN-AEPA = Programme Nationale d'Alimentation en Eau Potable et d'Assainissement; PPP = public-private partnership; PROSEHA = Programme sectoriel Eau Hygiène et Assainissement; RWSS = rural water supply and sanitation; SEEN = Société d'Exploitation des Eaux du Niger; SOPHAB = Stratégie Opérationnelle de promotion Hygiène et Assainissement de Base; SPEN = Société de Patrimoine des Eaux du Niger.
a. Extended by one year to 2016.

Constraints of Fragmentation, Financing, and Lack of Capacity

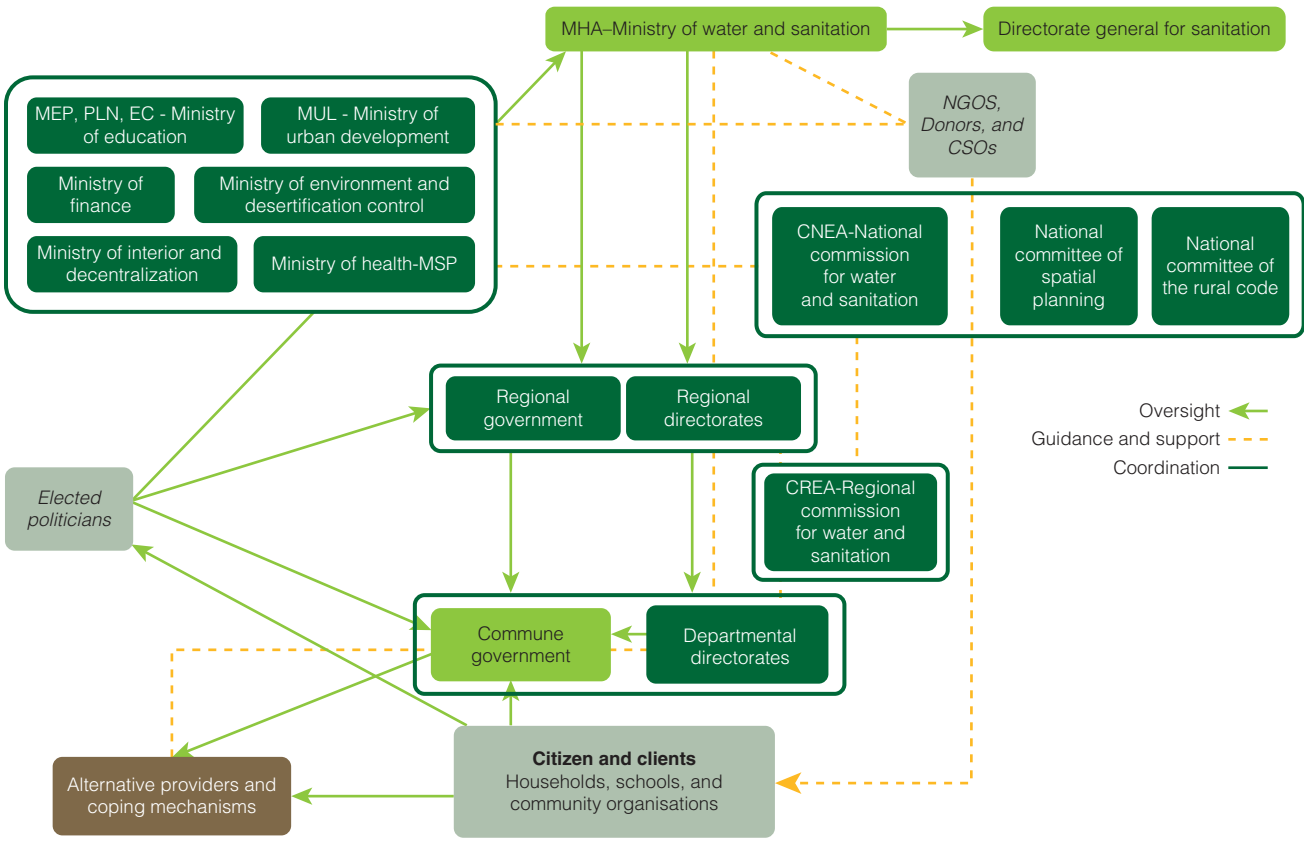
Multilevel Fragmentation

The WASH sector involves a plethora of actors at all levels. The Ministry for Water and Sanitation (MHA) is the main state actor, but needs to coordinate with at least six other central ministries. Each of them has regional and departmental structures that liaise with the communal level. At both central and regional levels, coordination structures have been created (CNEA and CREA).

The deliberate fragmentation of the public administration, rapid changes of ministerial structures, and key staff affect even more than usual a sector that is intrinsically cross-cutting. The MHA, formed in 2015, has direct responsibility for the WASH sector and is responsible for the design, implementation, and evaluation of national water supply and sanitation policy. Several other central ministries have mandates related to water supply and sanitation, including urban, environment, health and education, creating coordination challenges and unnecessary competition between structures (see figure 6.1). For instance, there is now competition for the behavior change agenda on sanitation between the Ministry of Health (traditionally active in this realm) and the MHA (a newcomer in sanitation).

Dedicated coordination structures have been established but lack clout. To assist the coordination of cross-ministry and directorate interventions, the CNEA works to convene and coordinate cross-government water supply and sanitation interventions. The commission comprises representatives of the ministries for water supply and sanitation, agriculture, urbanization, environment, and livestock; regional and commune governments; NGOs; the private sector; and other specialist organizations (GoN 2016). However, the PROSEHA found that neither the MHA nor the CNEA are able to fulfill their coordinating roles despite a reportedly strong consensus on the need for a coordinated cross-sector approach (Thapa 2016).[4]

Figure 6.1: Main Actors of the WASH Sector (Sanitation) in Niger



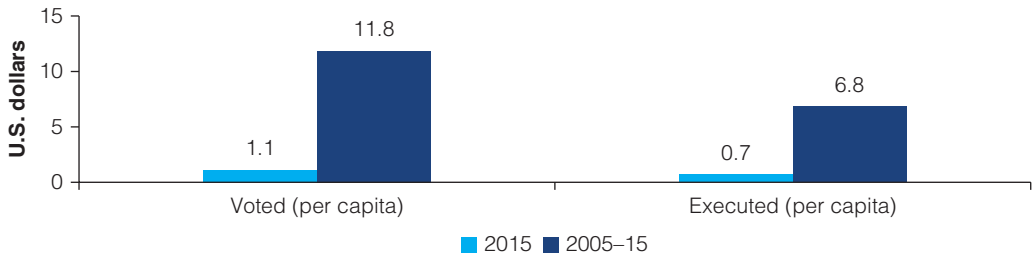
Source: ODI/OPM background note for the Niger WPD 2016.

Large Financing Gap and Poor Public Financial Management

The resources allocated to the four subsectors are not commensurate with current or projected needs. Since 2005, investment in the WASH sector represents on average 1 percent of the total voted budget (0.8 percent of the executed budget). Over the same period, WASH investment per capita reached CFAF 3,468 that is about U.S.070 (executed in comparison to CFAF 5,949 voted, the equivalent of about US$1) (figure 6.2). While voted budgets have expanded, executed budgets have continued to be substantially lower. With few investments ever allocated to sanitation, the bulk of the WASH budget is water-related investments. Still, this budget allocation falls very short as it is from the estimated requirement to reach to the SDGs. Even looking at the most basic and unimproved type of access, capital costs per capita far exceeds what has been spent in the sector so far (table 6.2). In a context of high demographic growth, this financing gap further emphasizes the need for an informed prioritization of investments.

A large influx of resources toward urban water projects, notably through the International Development Association (IDA), has tipped financing toward that subsector. Urban water fares much better than other subsectors, an illustration of the bias of public expenditures toward the more affluent population in the capital city, and toward large investments over maintenance. IDA is the dominant source of funding of the sector (figures 6.4 and 6.5).[5] This reflects a preference for visible, rent-compatible large investment projects, and the large share of donor support in the total budget. As discussed in chapters 3 and 5, the sector has performed well

Figure 6.2: Total Investment in WASH per Capita in Niger, Voted and Executed, 2005–15



Source: BOOST Niger; World Bank calculation.

Table 6.2: Capital Costs Per Person in Niger, Urban and Rural, Including Hardware and Software, Served in 2015 *(US$ per capita)*

	Water			Handwashing station, soap, water	Total WASH investment	
	Basic		Advanced			
	Tube well/ borehole	Dug well	Piped on plot	Handwashing	**Voted**	**Executed**
Total					**1.1**	**0.7**
Urban	37.8	3.8	188.6	6.3		
Rural	91.8	2.6	172.2	0.3		

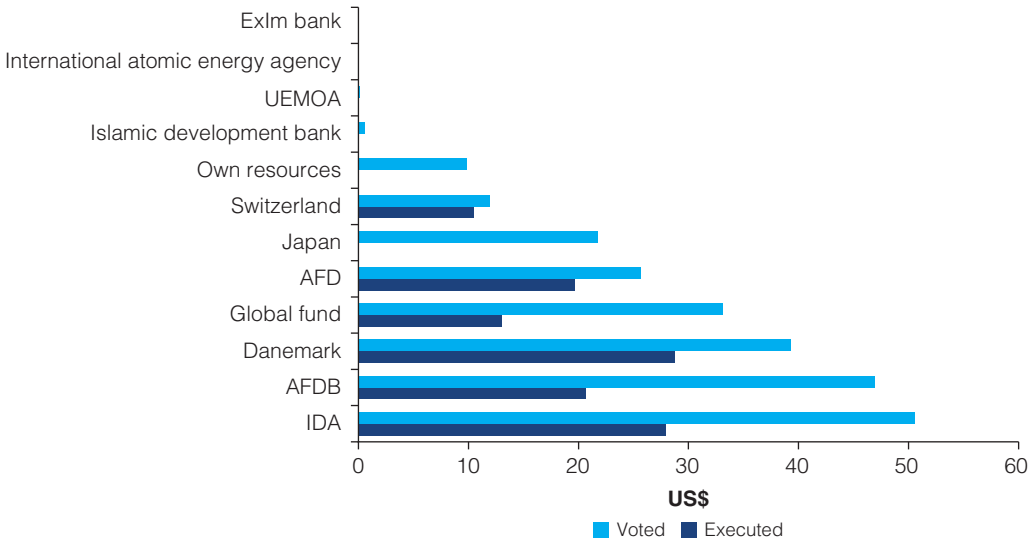
	Sanitation							**Total WASH Investment**	
	Unimproved	Basic improved			Advanced: Full excreta management (incremental off-site)				
	Unimproved pit latrine	Latrine with septic tank	Wet pit latrine	Dry pit latrine	Sewerage with treatment	Septic tank with FSM	Pit latrine with sewerage and treatment	Pit latrine with FSM	**Voted**	**Executed**
Total									**1.1**	**0.7**
Urban		25.8	57.4		77.1	28.9	158	22.7		
Rural	5.1		57.4	28.7						

Source: Hutton and Varughese 2016.
Note: FSM = fecal sludge management; WASH = water supply, sanitation, and hygiene.

over the past decade, in large part thanks to this substantive support. In a country still overwhelmingly rural, and that will remain so for the foreseeable future, such a strong focus on urban water raises the question as to whether future investment should be reconsidered in light of the geography of poverty in Niger. United Nations and NGO funding appear to have been more balanced between urban and rural areas in the sector. However, this reflects the emergency and humanitarian focus of a number of their interventions targeting areas of high vulnerability, and not as much development projects.

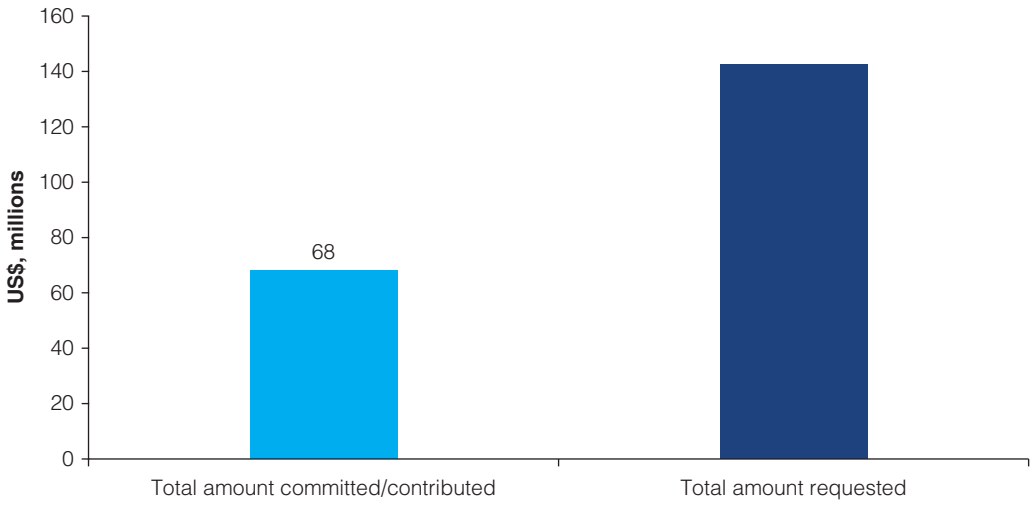
Resources are inadequate and not pro-poor, and public financial management weaknesses prevent their full utilization. Budget execution is an issue extending beyond the WASH sector in Niger. According to the 2016 PEFA, public financial management (PFM) is too weak to be satisfactory.[6]

Figure 6.3: WASH Investment in Niger Voted and Executed, by Source of Funding, 2005–15



Sources: World Bank calculation based on UNOCHA and BOOST, Niger.

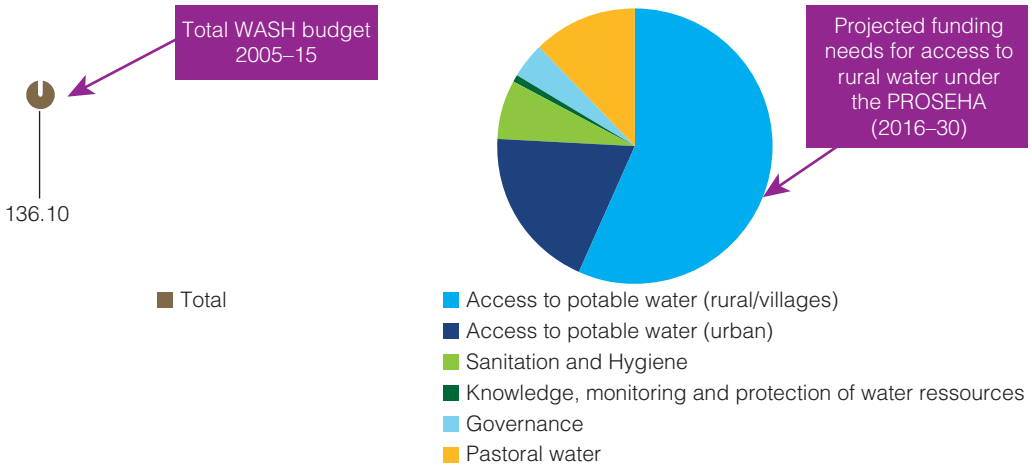
Figure 6.4: WASH Investment by United Nations and NGOs in Niger, 2005–15



Sources: FTS data, United Nations.

The level of execution of the voted investment budget in the WASH sector was less than 60 percent on average for the past 10 years. Over the period 2005–15, total investment in the WASH sector amounted to US$235.76 million voted, but only US$136.1 million was executed (World Bank calculation based on the Niger BOOST). This reflects both the weakness of the system, but might also reflect the share of donor financing (and their erratic disbursement). Yet the level of execution of the voted investment budget overall is 73 percent, meaning that WASH sector performs significantly below the average. This underexecution of the budget means that funding is just one of the constraints of the sector, and that the realism of the projected funding requirement of the PROSEHA is questionable not just in terms of resources mobilization but also in terms of budget execution (figure 6.5). This underexecution of the budget also reflects capacity constraints at all levels, particularly the local level, which undermine program implementation.

Figure 6.5: Total Investment in Water Supply and Sanitation in Niger, 2005–15; Projected Funding Requirement for PROSEHA, 2016–30 (US$, millions)



Source: BOOST, Niger, and PROSEHA 2016.
Note: PROSEHA = Sectorial Program for Water, Sanitation and Hygiene; WASH = water supply, sanitation, and hygiene.

Decentralization to Local Governments with Low Capacity and Few Incentives to Perform

An unfinished decentralization process shapes Niger's institutional infrastructure. In line with the approved "2000 decentralization scheme," Niger has several levels of administration: central, regional, departmental, and municipal. There are two deconcentrated levels (regional and departmental) and two decentralized levels (regional and municipal). Communes cover the entire territory and are divided into three categories: 213 rural communes, 54 urban, and four "urban communities" (the largest cities). Elections at the local level took place in 2004 and 2011 for the communes, with the first regional elections in 2011. The adoption of the 2010 General Decentralization Code and the organization of local elections are important milestones toward implementing decentralization. Still, the delegation of power does not imply that the elected bodies are independent from the central government, which retains control over these institutions and must approve and authorize key decisions and budgets.[7] In reality, this process has not yet fully materialized on the ground.

Decentralization reforms are far-reaching and take time to be implemented. The process is Niger is nonetheless suffering from additional challenges: (a) the organizational architecture is complex with risks of overlaps and competition for scarce resources; (b) the transfer of resources is not commensurate with the transfers of responsibilities; (c) there is low capacity at local level (fiscal and human); and (d) at the commune level, the multiplicity of actors (local governments, traditional leaders, projects, communities) creates confusion with consequences on accountability (figure 6.6).

Communes face vast challenges to implement the WASH agenda, especially insufficient financial and human resources to manage those new responsibilities. In line with the Decentralization Law, a January 2016 decree transfers the responsibilities for the health, education, environment, and water sector to local governments (municipalities and regional councils).[8] Specific decrees laying out the detailed transfers of assets and financial and human resources are being prepared. In the meantime, the transfer of responsibilities for WASH to poorly resourced (financially and humanly) communes, with little state and deconcentrated administration capacity to guide and supervise, is de facto tantamount to the state disengaging from the sector.

Figure 6.6: Institutional Levels in Niger

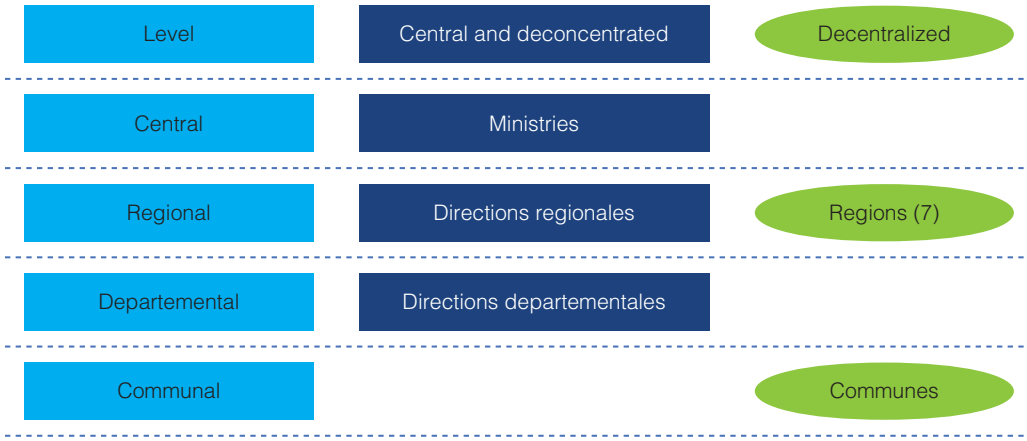


Table 6.3: Presence and status of Regional Directorate Offices for Ministry of Water and Sanitation (DRHA) and Departmental Directorates for Ministry of Water and Sanitation (DDHA), Niger

	Agadez	Diffa	Dosso	Maradi	Niamey	Tahoua	Tillabéri	Zinder
DRHA	Collapsed and evacuated	1	1	1	Missing	Degraded and insufficient offices	1	1
DDHA (office buildings/ districts)	0/6	0/6	4/8	5/8 (one of which is subject to a titling dispute)	0/5	0/12	1/13	5/10

Source: MHA 2014.
Note: DRH/A = Regional Direction for Water and Sanitation; DDVSA = Direction du Développement et de la Vulgarisation des Services d'Assainissement; DGA = Direction Générale de l'Assainissement; DIHA/MR = Direction des infrastructures d'Hygiène et d'Assainissement en Milieu Rural; DIHA/MU = Direction des Infrastructures d'Hygiène et d'Assainissement en Milieu Urbain; GIRE = Gestion Intégrée des Ressources en Eau; MDG = Millennium Development Goal; MHA = Ministère de l'Hydraulique et de l'Assainissement.

A complex organizational architecture increases risks of overlaps and competition for scarce resources. The principal role of the deconcentrated administration should be to supervise and control, yet in a transition period some "doing" is also expected. The problem is that current deconcentrated structures' capacity does not match either role—neither in numbers or skills nor in resources. As of 2014, Water and Sanitation Ministry staff totaled 563: 240 in the central structure and 323 in regional ones.[9] The situation is even worse for the Department of Hygiene and Sanitation in the Ministry of Health with 31 staff and limited means.[10] Similarly, the number of offices are thoroughly inadequate in all departments (table 6.3). The deconcentrated administration struggles to fulfill its essential role of oversight and supervision due to lack of resources (operational resources, staff). Yet these structures also are supposed to provide, on-demand, "support and advice" to the communes, which is both unrealistic and the source of tensions and confusions as to whether such services are free or paid for. The decentralization of the legal framework calls for a concomitant transfer of resources and responsibilities, yet the reality is very different, and the transfer of resources is far from being commensurate with the transfers of responsibilities.

Specific planning tools have been developed and tested for WASH services, the PLEAs (local plans for water supply and sanitation), which can be used as a basis for investment prioritization. The PLEAs will be the basis for the financing of new infrastructure by the PROSEHA. **However, there are several bottlenecks for this to happen.** First, capacity to produce or update these plans is low; in most cases, they will need to be financed by donors. Second, their approval

process is complex and overly hierarchical. PLEAs prepared by communes with help from departmental deconcentrated structures of the MHA (when they exist) are approved at the regional level (by decentralized authority "in coordination" with deconcentrated authority). Finally, the central level, in coordination with the Ministry of Finances, decides on priorities. Yet at the local level Communes have a holistic development plan, called the local development plan (Plan Local de Développement -PDL). The PLEAs need to be integrated with the broader PDLs, which cover all sectors and are approved by communes. Experience to date shows that, in a context of scarce resources, Communal Development Plans (PDCs; Plans de Développement Communaux) tend to prioritize social services and water over sanitation.

Human capacity at local level is very low. According to the law, communes should be staffed with at least a secretary general, a *receveur-comptable* (in charge of accounting and taxes), a person in charge of public individual registries, and an assistant. This is the bare bone of a functioning unit and is mostly in place. Yet this leaves aside technical capacity to manage services and infrastructure. **To be able to fulfill their responsibilities for WASH, communes need the following capacity:**

- *Planning*: communes are in charge of preparing and updating the PLEAs (with some support from the DRHA (Regional Direction for Water and Sanitation; Direction Regionale de l'Hydraulique et de l'Assainissement).
- *Delegated management of contract* (*Maitrise d'Ouvrage déléguée*) i.e., planning, procurement, and management of operators for the construction, maintenance, and management of water infrastructure and sanitation infrastructure in education and health facilities, and for CLTS implementation)
- *Fundraising*
- *Regulation*
- *Oversight*

For WASH, the goal is to create technical units (municipal services for water supply and sanitation (SMEA; *Services municipaux pour l'Eau et l'Assainissement*]). However, few communes have them (see box 6.1).

Box 6.1: Paucity of Local Government Resources in Niger

Local government resources come from own fiscal revenues, retroceded taxes, subsidies, as well as donor funding. There are two types of fiscal resources. Local government's own fiscal resources have a low base and low rates. The central government retains control over the determination of base and rates, and these have not changed since 1984 (information valid as of 2010) [a] and include a significant number of unproductive taxes. Own revenues depend mostly on economic activity of the communes the main source of revenue are markets). In communes without a market, the main revenue source is the "poll tax," a legacy of the colonial period that is very unpopular among taxpayers and whose collection rate is very low.

Retroceded taxes are fiscal transfers collected on the communes' territory by the state. The number of retroceded taxes has been reduced since the 2000s, and the rate at which they are transferred was significantly reduced (real estate tax, for instance, is only retroceded at a

box continues next page

Box 6.1: Continued

rate of 20 percent).[a] The Mining Law and Petroleum Law (2006) provide for 15 percent of the *redevances minieres* to be retroceded to communes with mines in their territory; however, this provision has almost never been implemented.[b] Moreover, in 2009, a regulation[c] provided for about a fifth of municipal or taxes on road system (*voirie*) to be retroceded directly to traditional chiefs, thus diminishing further the resources of the communes.

Most of the fiscal resources available to communes depend on the capacity (and willingness) of regional tax authorities to collect taxes and reverse them to the communes. Lack of resources (staff; skills and politicization of the administration leading to low rates of recovery; operating costs)—made worse by the vast distance between communes in many areas—and coordination challenges between communes and the treasury and tax departments at regional levels are detrimental to the process, resulting in low collection rates and delays in payments.

Remarkably little information is available on the amounts and timing of yearly transfers to local governments. The ANFICT (Agence Nationale de Financement des Collectivités Territoriales) was created in 2008 to manage several resources for the communes: state subsidies (general support to decentralization and equalization fund) as well as budget support and dedicated financing for communes from the donor community. However, the ANFICT is dysfunctional, and transfers are scarce and late (e.g., in 2016, nothing transferred as of mid-October).

Source: World Bank consultations with stakeholders, October 2016.
a. GoN 2010.
b. Communes in Tillabéri and Agadez regions benefitted from some transfers. With the petroleum code, Zinder and Diffa are now eligible to their share, however they have only received additional resources once, partly because of the security situation.
c. Arrêté n°451/MI/SP/D/DGAPJ/DAC-SC du 16 juillet 2009.

Communes are responsible for financing their own technical staff, an impossible goal for most. Main bottlenecks are the lack of financial resources for recurrent expenditures and the low incentives for qualified personnel to be located in remote areas. The fact that municipal staff is mapped to communes but often part of the centrally managed civil service adds an issue for accountability since they continue to report to the center. This has implications on their loyalties as well as concrete impact on the agility of human resources processes.

In short, communes are confronted with three major difficulties: (a) a very low level of human resources—very few local authorities have the necessary budget to hire technical or specialized staff; (b) the quasi-absence of technical support (in the best case, some technical assistance is provided by the devolved technical departments, which mostly depend on donor projects to do so); and (c) very limited fiscal resources (for WASH or any other matter) (WSP 2013).

Lack of Incentives in Serving the Underserved

Niger has an imbalance of public policies and public funding toward urban areas in general but even more toward established neighborhood in which wealthier population lives rather than newer urban settlements. This situation is commensurate with the institutional analysis discussed earlier in this chapter. Rural areas are particularly underserved, but also more

constrained. The central and deconcentrated state is hardly present outside urban centers, and rural communes have even lower financial and human resources than their urban counterparts; opportunities for private sector role is also less obvious in rural areas without a supporting environment from the state. **A "service characteristics" lens (see appendix NN) offers some explanation** as to (a) why investment is preferred above operations and maintenance (O&M) overall (thus leading to inefficient public expenditures and low rates of use of poorly functional investments); (b) why a combination of low demand, low visibility, low *attributability*, and low collective action particularly affect public interest for sanitation.

Making public policies pro-poor is a challenge, because political accountability is weak across all sectors. Voters tend to support a party on the basis of family, ethnic, or geographic connections rather than party policy, and parties reward supporters though cash or other personal benefits (McCullough et al. 2016). As a result, political elites are more influenced by requests from personal connections rather than demands from their constituencies (Cumming and Cairncross 2016; de Sardan 2010).

Geography further complicates the capacity of the state to connect with its citizen. In a country in which the majority of the population is rural, spread over a large territory with some nomadic groups, developing strong state-citizen relations between rural population groups and government is a real challenge (Thebaud and Batterbury 2001).[11] Remote populations' relationships with the state barely exist so they find their own solutions for services.

Ruling parties are not completely unresponsive to demands of the electorate, but to date, collective action only took shape in times of crisis. There have been instances of the ruling party responding to civil society activism such as in 2005, with protests against the rise of value added tax (VAT) and mobilization to protest chronic food shortage in Zinder and Maradi.[12] These responses were a result of broad coalitions formed in reaction to a crisis situation. Such demands might not spontaneously emerge for issues such as poor sanitation, an ongoing problem which has not deteriorated sharply, and affects the poor more than wealthier, more powerful groups, thus preventing the formation of broad coalitions.

While the security situation makes financing and providing services in rural areas even more challenging, it also makes it more pressing. Delivering services demonstrates the benefits of state presence, and this could contribute to shift the center's attention to its periphery.

Other levers might come from donor community or nonstate actors. The donor community is aligned in its intent to support both rural areas and sanitation, but does not always follow through in its investment choices. Still, if coordination improves, this could have an impact by pushing government to identify realistic targets and support their implementation. Coalition around unifying objectives that already enjoy broad-base support, such as nutrition, could also help integrate and prioritize policies and interventions.

Notes

1. For instance, the Government of Niger (GoN) has recently enacted a policy whereby all schools must be handicap accessible, which does not reflect existing constraints (the goal of enabling handicapped children to attend school should be addressed, but there are more effective strategies than a blanket regulation that will not be implemented).
2. To the question, does the interministerial committee for SOPHAB function; a Ministry of Water (MHA) representative replied, "Yes, it is functioning. Well, there might not be many meetings but it was created." (Interview during World Bank mission, October 2016.)
3. Data provided by UNHCR Niger in May 2015.
4. See GoN (2016).
5. The amount reflected does not account for additional financing of the PEMU project, adding an additional US$70 million to the total amount invested by multilateral donors in urban areas.

6. As noted in the recent Niger Systematic Country Diagnostic (2017) "While budgets increased in size budget execution remains very weak. In fact, according to the 2016 PEFA public financial management is too weak to be satisfactory. It is so weak that budgetary discipline is not assured. These weaknesses show up on low budget execution rates which between 2013 and 2015 varied between 68 and 86 percent, with large differences between years. Weak public financial management is not a new phenomenon. It was already clearly identified in the 2003–4 PEMFAR report and has been reflected in the PEFA scores since. Improvements in certain areas have even been registered but these have largely been undone by deteriorations in other areas. Consequently, there has been very little progress overall."
7. In Niger, as in most countries in francophone Africa, the political decentralization process actually refers to a form of delegation (not to a form of devolution). Decentralization in Niger entails the creation of elected bodies that are far from being independent of the central government. The central government retains control over these entities and must approve or authorize key decisions, notably on budget issues. This power is called the *tutelle*. However, specific responsibilities and resources are transferred to the elected local bodies, which are directly accountable to the people. Parallel to the decentralization process, *deconcentration* is shifting responsibilities and strengthening regional administrative units away of the center, with deconcentrated units reporting to their line ministries.
8. It is interesting to note that sanitation is not mentioned in these texts, although it is understood it is part of the tranfer.
9. This total does not include 45 staff seconded to other structure and 30 in training. See MHA Annual Report 2014.
10. The Department for Hygiene and Sanitation, Ministry of Health, counts 31 staff: –27 of them are at the highest rank level in the administration (cadres A), characterizing an administration whose staff is promoted through seniority and with a history of blocked recruitment during the structural adjustment years. Most of these agents are posted at border posts (including airports). The sanitary police for Niamey has only six staff. Their equipment includes four SUV (one of them broken), six motorbikes DT 125 in poor condition, one motorbike 50, and one Yamaha 50 motorbike in poor condition. Their activity depends on external funding. The budget for 2016 (CFAF 12 million) provided for two field visits in a few regions for the "sanitary police," one radio spot on cholera, and a training session for the entire department (annual activity report, Sanitation Development Plan, Department for Hygiene and Sanitation, Ministry of Health; interview by World Bank team, October 2016).
11. In fact, The Fulani and the Tuareg have a tradition of stateless societies (Thomson 1996). Additionally, a significant share of the population does not live close to the main arteries linking Niamey with Tillabéri, Agadez, and Zinder.
12. In 2005, the Quality Equity Coalition against the High Cost of Living formed to protest a government proposal to raise VAT on basic goods. The government reversed its decision following a series of protests and lack of support from the opposition (Tidjani Alou 2012). The public also mobilized to redefine the government's responsibility with regards to the widespread and chronic food shortages experienced in Zinder and Maradi in 2007.

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Chapter 7
WASH Access—The Way Forward

In this final chapter, the implications of the analysis presented throughout the Niger WPD are discussed. In light of the service delivery gaps and their impact on key development outcomes in Niger, **three pillars** of future engagement in the sector are highlighted:

- Address remaining access gaps (including quality), focusing on the poor
- Plan for increased demand (linked to demographic growth) in a climate vulnerable context
- Protect the basics—particularly where infrastructure expansion is not feasible or realistic through cross-sectoral interventions

As seen in the previous chapter, the needs far exceed the resources currently allocated to the sector, and likely those that could be mobilized over the next 15 years. Given this reality, prioritization of interventions is a necessity. The implications of this prioritization are far-reaching for Niger's future. The process should be guided by objectives reflective of the high poverty of the country, particularly in rural areas; the public health implications of poor access; and the climate vulnerability to which the entire country is exposed. This chapter discusses how those pillars can be tackled by subsectors and cross-sectorally.

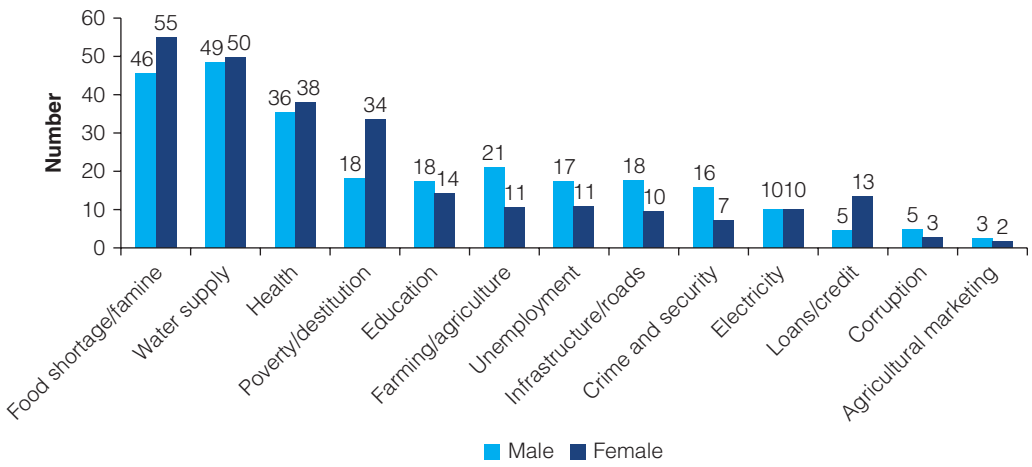
Sanitation Challenge

Ways to Increase Demand and Attention to a Public Health Crisis

Progress (if any) in sanitation lags much behind progress in water access. Sanitation is not an identified priority agenda for the population. Although there has been some signaling by the government on sanitation, and some progress on policies and coordination, implementation is lagging. Water, however, emerges as a top priority for both the government and the population. In a recent survey, respondents rate water as their second highest problem, whereas sanitation does not even make it in the top 13 despite extremely low rates of access (figure 7.1).[1] Analyzed with a service characteristics lens, sanitation suffers from severe challenges, all reflected in the case of Niger:

- Low demand from users, sometimes reflecting social and cultural norms or practices: sanitation does not come into the list of priorities for most households, and there are social taboos to be seen using latrines.
- A lack of political prioritization, particularly where it is not a highly visible issue compared to other infrastructure services: sanitation is institutionally and financially a poor parent.
- Limited structural incentives for collective action: for example, because latrines are a household concern and sanitation is still a taboo topic, limiting discussion of shared concerns and mobilization Mason, Batley and Harris, 2013). There are few examples of collective mobilization around sanitation, even though some recent initiatives in a few cities are interesting (but also reflects the extent of the crisis).

Figure 7.1: Most Important Problems Faced by Citizens in Niger, by Gender 2016



Source: Afro-barometer for Niger 2016.

Political reluctance to adequately fund promotion-based approaches for the sanitation sector could be explained by the lack of visibility and *attributability*. Programs of community sanitation have strong public good qualities but produce personal benefits that are not easily understood or visible except in the long term. They present the dilemma of requiring a public health crisis or a bold political gamble before conditions are created for any visible political payoff.

Sanitation provision is seen as a private issue and a household responsibility rather than a service that the government should be providing. Analysis of behavioral norms around sanitation in rural areas suggests that sanitation provision is commonly seen as a private issue and a household responsibility rather than a service that the government is responsible for. Where users are connected to a common service, such as a shared standpipe or sewerage network, a problem with the quality of the infrastructure means a large number of users are affected at the same time and so demand for improvement is likely to be greater (Mason, Batley and Harris, 2013). However, sewerage networks are virtually absent in Niger; thus, the relationship between a user and provider of sanitation—public or private—is a household, rather than a collective, one, which undermines the potential for collective action and mobilization around poor sanitation provision.

The hidden costs of inadequate sanitation that lead to health risks for all may not be visible or well understood. Wealthier groups may be insulated from negative externalities such as open drains and fecal waste in public areas as well as from moments of more visible service failure (e.g., flooded pit latrines; Mason, Batley and Harris, 2013). There may consequently be less demand for improved state provision sanitation from wealthier people, who are often more politically powerful and who in practice opt out and use private provision (McGranahan 2015).

Finally, the social taboo related to sanitation as opposed to water means that those affected by poor service access are less likely to discuss their common needs, and the lack of visibility of the benefits of sanitation dampens demand. Even where problems arising from the government's poor performance on sanitation are visible (e.g., abandoned public latrines or pit emptying that is not properly regulated by municipal authorities), these potentially negative signals do not appear to provoke demands from citizens.

Moreover, low demand has reinforced weak private sector activity. Pit emptiers, masons, and public toilet managers are often low status and untrained. A lack of monitoring and regulation

by the public sector means inappropriate practices, such as the disposal of sludge in the streets, and absence of protective equipment are common. However, since the electorate does not prioritize sanitation as an issue, there is little public outcry or calls for politicians to resolve these issues. The weak market also implies low margins and little incentive for private providers to invest themselves in more expensive but safer practices. Moreover, the lack of political prioritization of sanitation reinforces an already weak and poorly motivated and monitored civil service. Still, it is possible that demand for sanitation services in urban areas could grow, which might trigger some changes in policies and funding allocation: demand might be easier to articulate on the user side in a more densely populated area where there is little alternative to sanitation services. This would also carry more weight with government officials who may be wary of discontenting urban dwellers who are increasingly aware of their rights.

Collective action in relation to sanitation is beginning to take place in urban areas. In Maradi and Tessaoua, associations built dumps in order to reduce the presence of mosquitos. Such initiatives are more likely to take place in urban areas since close proximity between households, and between households and their waste, creates greater incentives for collective action. Since urban areas have more households with disposable incomes they can use for sanitation (71 percent of the richest 40 percent of the population possesses a pit latrine and 28 percent a toilet flush according to 2012 DHS data), this could generate some demand for a sanitation market (masons, plumbers, pit emptiers), which may help extend provision.

In rural areas, the community-led total sanitation (CLTS) methodology has had some success, yet the challenge is to scale up the approach and to ensure its sustainability. One operational question is whether a CLTS approach will be enough to overcome the dire lack of cash in rural households, and the low priority given to sanitation. As seen in chapter 5, there are indications that this approach will be insufficient by itself and would need to be conceived as part of a larger set of interventions aimed at promoting nutrition, health, and sanitation.

Religious leaders and traditional chiefs are an important constituency that could be brought into the public debate to support water supply, sanitation, and hygiene (WASH) services. Religious leaders could be allies for improved sanitation in public areas—and close to mosques. Issues around the preservation of water purity, privacy, and safety are likely to resonate with traditional authorities who are needed to boost the required collective action.

New Mandates for Communes in Scaling Up WASH Services

Communes are in charge: they need to raise funds to finance works and staff, plan and contract out construction and management of WASH infrastructures, and coordinate with multiple actors. For communes to fulfill their mandate, four key constraints need to be overcome: political commitment to decentralization, financial resources, human resources, and accountability.

Political Commitment to Decentralization

As discussed in chapter 6, political commitment to make decentralization work is dubious. The current crisis makes it even more challenging, since some regions are "off limits" and domestic resource mobilization is suffering from lower commodity prices. Yet the impetus to gain some legitimacy through service provision and to provide employment opportunities for youth might resonate with the government, and provide an opportunity to support more effective and accountable governance at the local level.

Local Resources

Increasing local resources is an imperative. This is a prerequisite to enable communes to recruit qualified staff and support construction and management of local infrastructures and coordinate and monitor behavioral changes campaigns and follow-up. There is a need to

assess overall fiscal revenues of the communes, be they "own" or retroceded resources, and to review the share actually feeding into communes' budgets to correct the imbalance between formal responsibilities and allocated resources.

For communes in mineral-rich regions, mining fees (*redevances minières*) could help. An assessment of the feasibility of complying with the legal framework is needed, considering the fact that communes, which could benefit from this provision, are likely to be under intense security strain—if not in situations of open violence and insecurity.

Local Capacity at Local Level

For now, there is very little capacity at the local level, despite the plethora of institutional actors. In many cases, actors in the field are completely lacking resources and are therefore discouraged and unmotivated. In technical services, at both municipal and departmental levels, there is generally only one individual (sometimes with a backup, usually a civic service worker), who lacks the necessary means to carry out his mission (having neither a vehicle, petrol, nor professional expenses), and who hence has nothing to do except wait for the miraculous arrival of a possible "project" (funded by a development agency) that will come to his aid (World Bank, 2017).

At the deconcentrated level, entities are poorly staffed, and their incentives to support the work of communes are not clear (since it would ultimately lead to their jobs' streamlining or even disappearance). Their role in a transition phase (accompanying newly created Collectivités Territoriales in their development) is important, but carries the risk of entrenching deconcentrated administrations into functions that should be devolved directly to the Collectivités Territoriales.

Assuming there is political will to decentralize, building capacity should be focused on municipal or intermunicipal level for the most part, with the deconcentrated administration equipped to fulfill its oversight and regulatory function. The Sectorial Program for Water, Sanitation and Hygiene (PROSEHA; Programme sectoriel Eau Hygiène et Assainissement) is very clear about this and the need for the Ministry of Water and Sanitation (MHA) to focus on "regalian" missions (yet PROSEHA's detailed action plan seems to focus as much on building capacity of deconcentrated services than building capacity of communes, a sign of a difficult shift toward real decentralization).

Currently, the lack of clarity on whether the deconcentrated administration is providing support and advice free of charge creates tensions and distortions. Although the Ministry of Decentralization claims there is no confusion on whether support and advice by deconcentrated administration are provided free of charge, there seems to be plenty of confusion within the administration. For lack of resources, the deconcentrated administration depends on monetary (through per diem) or in-kind support (use of car) from communes or other partners even to fulfill its regalian functions. Across the board, this leads to a situation of "informal privatization" whereby "service provision by state agents is being financed by users or third parties instead of being paid for by the state itself" (de Sardan 2010). This is creating tensions between levels of administrations and potential conflict of interests, which epitomizes the problems of administrative structures that increase in numbers with very few resources to make them functional.[2]

Local Governance and Local Accountability

Expanding resources and capacity need to go hand-in-hand with stronger local accountability to avoid reproducing corruption and capture at local level. **Building local governance and local accountability will not be simple, since several issues are complicating the accountability relationships at the local level, including the multiplicity of actors.** The decentralized administration includes political representatives (mayors, councilors), who are in theory accountable to their constituents, and technical staff, who might still report on central or deconcentrated administration. These local staff members are supposed to interact and coordinate with

deconcentrated staff members from regional or departmental administration, who report either to their central administration or to the prefecture. However, in rural areas, especially, nonstate actors are sometimes more present than state actors: traditional chiefs are key interlocutors at the village level. Private sector actors are also active where there is a market, and the weak regulatory environment can create opportunities for abuse (water is not for resale outside state structures, yet this does occur) in a context in which state actors or representatives of the communities do not have sufficient capacity or agency to ask them to be accountable.

Accountability is undermined by party politics in local government elections and a socioeconomic environment prone to capture by the elite (public officials and traditional chiefs at the local level). There are frequent challenges to the legitimacy of elected mayors (de Sardan 2011). New councils have been established but have been dominated by existing local leaders and local practices, which continue to be characterized by the diversion of funds, patronage, and *clientelism*, which distort the local distribution of resources (Hahonou 2009). Support to local governance is needed to identify ways to clarify formal and informal relationships between these groups of players, and to enable oversight of their activities.

Need for Funding and Higher Profile in Sanitation

By far sanitation is the most lagging WASH subsector in Niger, and it needs both a higher profile and corresponding funding. While the reasons behind the lack of political traction for sanitation are not so dissimilar from those encountered in other countries, the access gap in Niger is much worse than almost any country in the world. This fact alone makes urgent the mobilization of Nigeriens—both policy makers and citizens—to address this situation. To date, progress at policy level has been mainly donor-driven. Compelling data on the impact of poor sanitation on malnutrition and stunting could be aggressively disseminated into the public realm to generate a public debate. Targeting politicians, government officials, traditional and religious leaders, and the business community will be needed, but also broader groups from within the administration (teachers) and society (*fadas*, community service organizations [CSOs]) that can exact pressure on decision makers. Other entry points include dignity and the preservation of the purity of water threatened by poor sanitation. A less commonly used argument revolves around job creation and the potential of the sector to generate economic activity around the expansion of access, a potentially powerful argument in a fragile country with a large number of underemployed youths.

Households are the key players in the construction of latrines: a clear premise established by the SOPHAB that also clarifies the role of the state. Recommendations for implementing the Operational Strategy for the Promotion of Hygiene and Basic Sanitation (SOPHAB) start with the premise clearly stated in the document: it is unrealistic to expect the state to build latrines at the household level. State financing is needed to build public communal infrastructure in schools or health units (as per official norms), but cannot be expected to provide for financing of latrines at the household level. State objectives for sanitation are thus to encourage latrine construction and use by households, ensure that public communal infrastructure is built to standards and adequately managed, support private sector actors in meeting the demand for sanitation infrastructure, and enforce safe containment and in situ treatment and disposal or reuse.

Coordination and Policy Setting

Bridging the sanitation access gap requires support by and to the state around five key functions: coordination and policy setting, infrastructure, communication, supply chain, and oversight. The state needs to increase its involvement in coordinating and setting the policy for the sanitation sector. Actions of priority importance are (a) clarifying the policy for safe containment; (b) clarifying the role of deconcentrated services (e.g., further clarifying and disseminating policy on payment for services—and which services—distinguishing clearly oversight and advisory

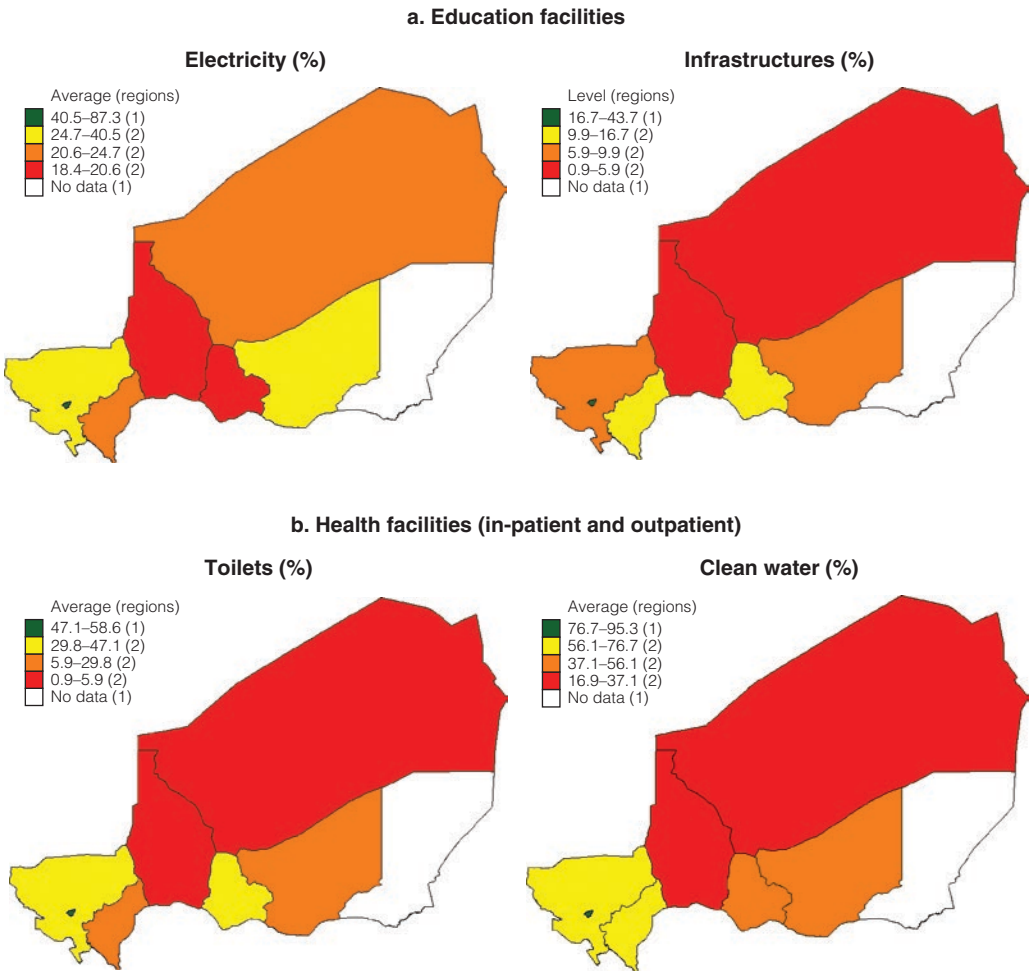
support functions, and streamlining process to request advisory support on a voluntary basis); (c) simplifying the process to incorporate "PLEAs" (local plans for water supply and sanitation) in Communal Development Plans (PDCs; Plans de Développement Communaux).

Focus on Sanitation Access in Basic Public Infrastructure

A renewed effort to ensure the provision of access to adequate sanitation in basic public infrastructure is required. The service delivery indicators (SDI) for Niger show that even for core public infrastructure map 7.1, panels a–b). Communes are now in charge of building and maintaining public infrastructure for sanitation, both for treatment and reuse, and "institutional" latrines (including those attached to schools, health centers, public and rural markets, large bus stations, and *autogare*s), but their capacity to enforce this mandate is so far limited.

Communes need to be supported financially and in terms of human resources to commission and deliver on sanitation. This is especially needed for communes with low resource potential.

Map 7.1: Access to Improved Water Supply and Sanitation in Education and Health Facilities, Niger



Source: SDI Niger 2017.
Note: Data were not collected in Diffa due to security concerns. Data reflect Service Delivery Indicators.

Box 7.1: Considerations in the Implementation of the PROSEHA

- **Push for realism of the targets**: vision can be Sustainable Development Goal (SDG) but needs to have various scenarios aligned to the availability of funding and sequenced implementation (e.g., prioritization per geographical zone and sectors)
- **Provide detailed processes to reach concrete objectives and align existing resources to them** (e.g., training of teachers and health workers on sanitation awareness, and sanitation and roles for CLTS to build sustainable systems)
- **Avoid duplication of structures**: to avoid dilution of responsibilities and *projectization* and "race for per diem," it is important to challenge creation of ad hoc structures (e.g., it is worth looking into the need for a CLTS committee if the SOPHAB has a functional coordination structure)
- **Support common methodology for key priorities** (planning methodology, CLTS) and get donor commitment to follow through: methodological tools to strategically address WASH provision are available and seem to be recognized by key actors within administration and among donor community (in particular PLEAs, and to some extent CLTS); diffusion and implementation are the next frontier
- Some issues on **CLTS** with inconsistency of approach (e.g., use of subsidies) despite PROSEHA being now clear on vision; need to ensure external partners align their projects to government policies
- **External partners** need to focus on sustainability of outcomes, particularly in light of Niger's exposure to climate variability (e.g., support investments and operations and maintenance [O&M], and well as CLTS and post-open-defecation-free activities)

As mentioned in chapter 6, this needs to be done with a clear strategy to both build local capacity, but also local accountability, to avoid reproducing corruption and capture at local level. Necessary steps include the following (see also box 7.1):

- Reassessing fiscal decentralization and local resources holistically (i.e., transfers, taxes, external support) and support fiscal decentralization that is not tokenistic but commensurate with transferred responsibilities.

- Supporting the rollout of PLEA methodology at commune level to prioritize and sequence implementation. In the short term, most communes will need additional support to hire someone with the skills to prepare PLEAs (co-financing, intermunicipal arrangement, etc.). A training module on PLEA methodology is needed for consultants or municipal staff of technical services. Linking closely sanitation with water in planning and execution will be necessary to avoid the neglect of sanitation goals.

- Supporting communes in service delegation (Maitrise d'Ouvrage Déléguée), as already planned for in the PROSEHA. This will enable communes to delegate the management of the institutional latrines to local CSOs or to the private sector with a management contract following simple standards so as to make sure latrines remain operational.

- Assessing how to support communes through pragmatic, possibly asymmetrical, and individualized solutions aligned to their size, capacity, and location, which could include (a) pooling resources with other communes in more densely populated areas

("intercommunality"[3]); and (b) capacity building for the deconcentrated administration should it have staff, for an intercommunal technical pool if there is one, and for the staff of the commune if there is a Municipal Services for Water and Sanitation (SMEA) or a staff with the required profile.

Role of Communication and Behaviors with Demand for Sanitation

Communication around behavior changes requires a multilevel commitment from all institutions. CLTS is now recognized as the main vehicle for the sector in rural settings and recognized as such by the SOPHAB. This clarification helps define three main priorities:

- **Harmonized and sustained messages around key themes, across medium and at all levels**. The issues of dignity, comfort, and security were identified through the formative research conducted in Niger in 2014 (Swiss TPH 2014) and should complement those around nutrition and health. Mass communication (e.g., television and radio at national, regional, and community levels) are key vectors of information in Niger as are interpersonal interventions (e.g., street theater).

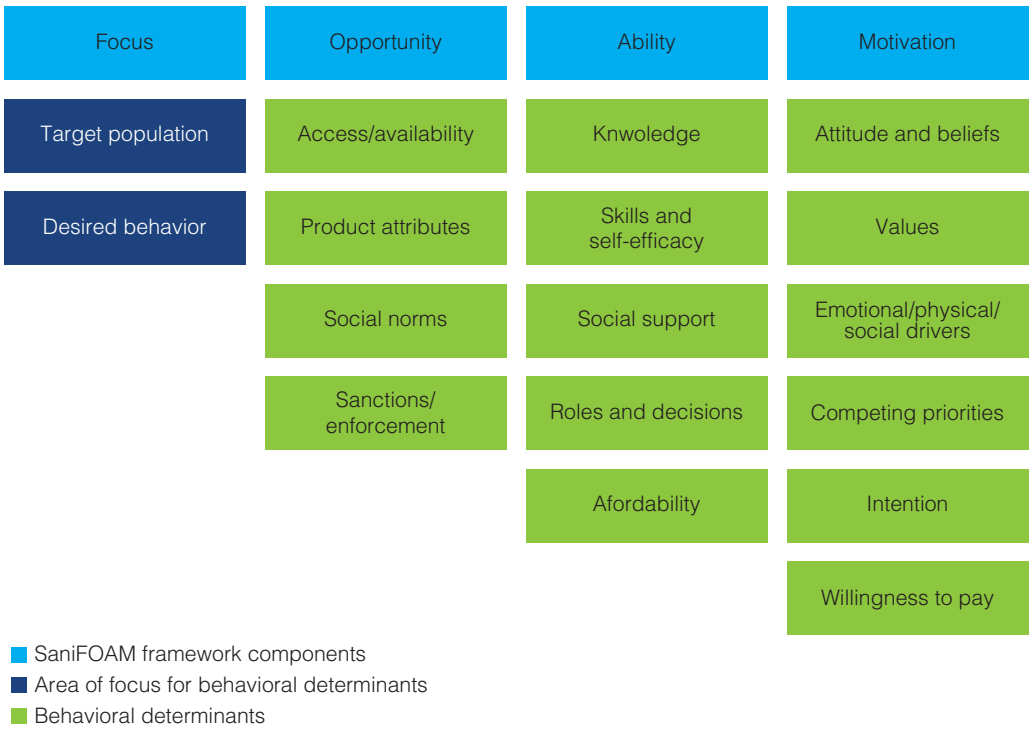
- **A standardized methodology on CLTS** to ensure that standards are respected across actors and in implementation, with a focus on sustainability. To date, post-open-defecation-free interventions have not been prioritized, which could endanger outcomes. One policy question is whether the implementation of CLTS without subsidies will bear fruit in a context in which rural households do not have much disposable income.

- **A message around operation and management of public facilities**: communication around CLTS needs to integrate the issue of the operation and management of public facilities to ensure their sustainability and promote local stewardship and use of those infrastructures.

Communication around behavior change should target the different determinants of open defecation. The persistence of open defecation is complex and multidetermined, comprising a combination of supply-side issues (e.g., access to latrines, affordable building materials) and demand-side, or "user-centered," issues (e.g., cultural and religious beliefs, relative convenience, and affordability; for a recent review see O'Connell [2014]). While behaviors are recognized as important levers to reduce open defecation, their range is much larger than what may be typically used in CLTS campaigns. Frameworks such as the SaniFOAM (figure 7.2) can help design effective sanitation program reflective of the behavioral determinants[4] most effective for the given context.[5] A review of this approach led to the inclusion of socioeconomic and demographic characteristics as another dimension of the SaniFOAM framework—owing to its importance to define the focus of an intervention (O'Connell 2014).

The extent and persistence of open defecation in Niger calls interventions to integrate emerging knowledge on nudges and habits to sustain change over time. A growing body of evidence has emerged over the past decade on the role of habits and nudges to support and sustain behavior change (Marteau, Hollands and Fletcher 2012; Thaler and Sunstein 2008; Neal et al. 2016). This approach calls on relatively automatic and nonconscious factors (system 1 drivers) in contrast to the relatively conscious and motivation factors typically used in CLTS interventions —including the SaniFOAM framework—known as system 2 drivers (see appendix LL, figure LL.1).[6] The association of these two types of drivers in a context such as Niger presents potential to support and sustain behavioral changes and overcome the limited or short-term successes not maintained over time that traditional CLTS programs alone face (Sigler, Mahmoudi, and Graham 2014). This approach also reflects the messages of the 2015 World Development Report (World Bank WDR 2015) which emphasized three core insights from behavioral science, namely that people think (a) automatically, (b) socially, and (c) using mental models that channel their decision making. An ongoing WASH

Figure 7.2: SaniFOAM Behavior Change Framework



Source: Devine 2009.

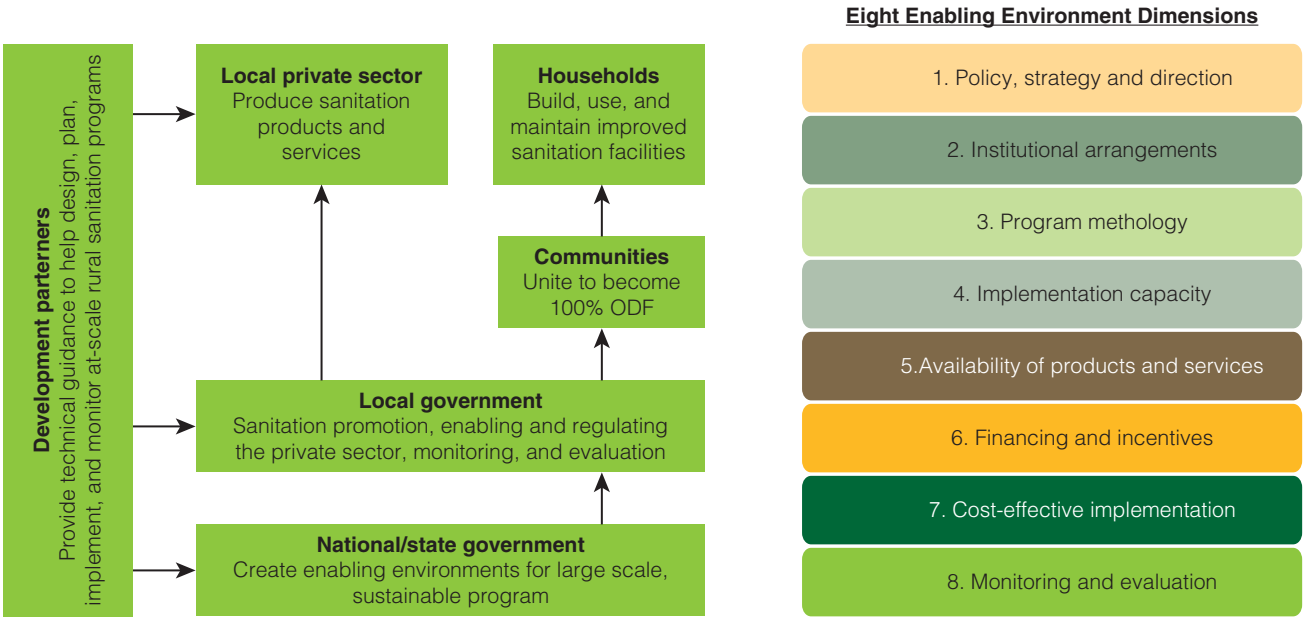
and conditional cash transfer pilot undertaken jointly by the Water, Social Protection, and Poverty Global Practices will pilot such interventions as part of the expansion of the Adaptive Safety Nets project in Niger.

Supply Chains and Job-Creation Potential of the Sector

If households are to be responsible for the construction of latrines, the state has a key role in developing adequate supply chains, particularly toward rural areas. Progress made on the policy reform side (chapter 6) provides a new basis to bring the delivery of sanitation services at scale, provided that an enabling environment exists to respond and sustain the demand. Experience has shown that developing such an environment requires time, does not emerge automatically, and needs the commitment from national and subnational stakeholders to address systemic conditions that would constrain scaling up and replication (Perez et al. 2012).

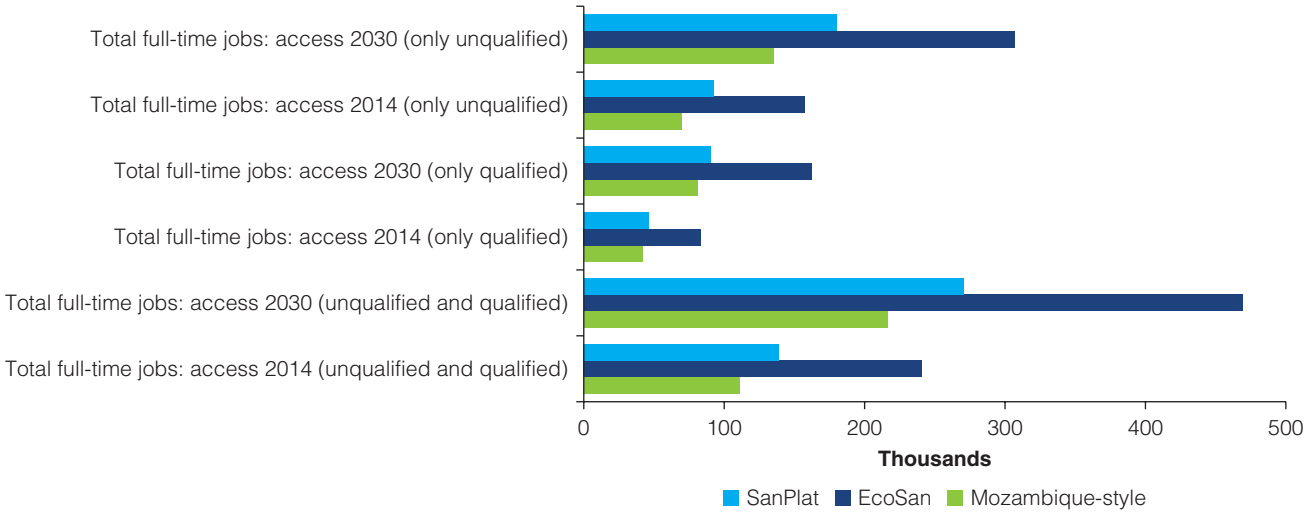
The development of these supply chains presents an important potential for economic activity and job creation in Niger. The need to provide adequate sanitation to Nigeriens should not simply be seen in terms of costs, either in providing or lacking access. While these figures reflect the scale of the needs, they also miss the economic potential the expansion of sanitation access and its economic ecosystem could represent. In a country such a Niger, in which close to 70 percent of the population are under 25 years of age and underemployment is rampant, the job creation potential that the expansion of sanitation represent is evident.[7] A simulation of the number of jobs that could be created to respond to the needs for improved sanitation of the population by 2030 (chapter 3) shows that between 100,000 and up to 300,000 full-time qualified and unqualified jobs could be generated (figure 7.4 and appendix 00, table 00.1, for detail of the simulation). Building on the experience and work requirements

Figure 7.3: At-Scale Sanitation Service Delivery Model



Source: Perez et al. 2012.

Figure 7.4: Potential Full-Time Jobs Created in Constructing Improved Latrines for All Households Needing Access (Upper Bound Scenario) in Niger, in 2014 and by 2030



Sources: World Bank calculation based on qualified and unqualified workday required to build three different types of latrines in Niger (Mozambique-type of latrine, EcoSan, and SanPlat); projected population and access requirement based on LSMS 2014 and UN population prospects 2015.

for three different types of sanitation, their corresponding costs, and labor requirements, the estimates show the enviable potential of the sector to be a vector of employment and economic activities, extending beyond the construction itself to the provision of, for example, the needed materials, maintenance, and training. Here again, the state can play a decisive role in promoting adequate training and making career opportunities in the sector more appealing to youth given their economic potential —and clear social and public health benefits for the community. A first start could include support to the training of masons and

Figure 7.5: Sanitation Service Chain

pit emptiers. It is important to note that major public investment is needed for such massive demand creation to materialize.

Urgent Need for Oversight and Enforcement

Beyond the expansion of sanitation, the need to set up a proper oversight and enforce appropriate practice is critical for the gain of increased access to water supply and sanitation to materialize. A lack of monitoring and regulation by the public sector means inappropriate practices are common, such as the disposal of sludge in the streets and absence of protective equipment. As seen in chapter 3, even households enjoying a high access to improved piped water may still be exposed to the consequences of poor sanitation. Even if household access is expanded, it needs to be accompanied by a proper sanitation system chain to ensure the safe management of fecal sludge. Unless possible on-site, this system requires safe emptying, transport, treatment, and disposal of fecal matter, all of which need to be monitored and enforced (See. Figure 7.5).

Clarification and empowerment of the agency that should be in charge of this oversight are needed. For now, capacity and incentives to oversee this sector are scarce. It is important to assess further which agency should be in charge of such oversight and to discuss timing and options to support its role. Four main agencies could be envisioned with respective advantages and disadvantages: hygiene police; inspections from the Ministries of Health and Education; or the delegated directions of the Water Ministry. Without the proper means to fulfill this mandate, no agency will be able to deliver on the critical dimensions of the WASH agenda in Niger.

Community and citizen monitoring are other complementary entry points. Promoting local, integrated WASH committees could be helpful and address several issues at once. By making the water management committee in charge of sanitation as well, it might overcome some of the taboos associated with sanitation, raise the profile of sanitation and hygiene issues (since water brings more stature), as well as possibly use part of the water fees to support institutional latrines and their management. Mechanisms to collect information related to water quality and sanitation on a regular basis (e.g., through cell phones) could also incentivize these committees to be more active on these issues. A system of small incentives and competitions between committees could also be envisioned, leveraging community pride and citizenship to raise the profile of sanitation as priority area. Citizen monitoring constitutes another area worthy of further consideration.

Sustainable Water Resource Management

Expanding household water access owes to be conceived in the larger context of water resource management (WRM). As a Sahelian country, Niger faces well-known climate challenges heightened by geography and climate change. Expanding household water access in Niger is an issue transcending the strict perimeter of WASH. As seen in chapter 2, the geography of water is closely associated with that of agriculture production, which is itself closely correlated with poverty. While Niger possesses large underground water resources, those resources have been so far largely untapped. Less than 20,000 ha of land are currently irrigated using groundwater (Abric et al. 2011). As noted in the recent Systematic Country Diagnostic (SCD)

for Niger (World Bank, 2017), new mapping of groundwater in Niger have raised the prospect that over 250,000 hectares could be irrigated using this underground water given the water depth (less than 10 meters) and suitability of soils for drilling and cultivation.[8] Yet this access, made easier by technology such as solar pumps, raises the question of the optimal and equitable use of this precious fossil water or slow-to-regenerate resource. While shallow water may be more easily pumped, it also tends to be more dependent on climatic variations and more exposed to contamination. Deeper groundwater, on the other hand, is slower to replenish, and overdraft can have long-term consequences long before the resource runs out.[9] Examples of overexploitation already exist in Niger (box 7.2).

The preparation of the new Integrated Water Resource Management Plan (PANGIRE; Plan d'Action de Gestion Intégrée des Ressources en Eau) offers an opportunity to address the issue of water access and use. The PANGIRE aims to define the national framework for water resource management in Niger and will serve as the operational arm to implement the country's national water policy, coordinating the different actions envisioned by the various sectoral and intersectoral water programs and strategies. The plan specifically identifies the improvement of drinking water supply and sanitation in urban, peri-urban and rural areas, also emphasizing the priority to reduce water-related diseases, thereby raising the importance of water quality.

Expansion and increased resilience of water access for both household and productive uses will heavily depend on access to underground resources that needs to be managed sustainably. Growing demand in areas where access is currently lagging and exposed to climate variability makes access to underground water a necessity particularly in rural areas, all the more so in arid ones (World Bank and CILSS 2015). In Niger, the sectoral policy allows any village of more than 250 inhabitants to have a modern water point (large diameter cemented well; deep well; stand pipe). Low-cost drilling systems appear particularly appropriate for small rural communities of less than 250 inhabitants. Appendix MM, map MM.1, shows areas in Niger most conducive to manual drillings (GoN 2010). Those maps show that the potential is mostly concentrated in areas of low population density. Combined with the maps reflecting simulations of groundwater storage (chapter 2 and appendixes G, H, and I), the message is one of potential for the use of the resource but also one of caution to tap it sustainably in both quantity and quality. In terms of quantity, an increase variability of rainfall could strain the water recharge just as demand increases, while usage of fossil water may constitute a short-term solution with long-term implications that should consider the nonrenewable nature of this precious resource. While it can indeed play a role in improving agricultural productivity and thus reducing poverty, the modalities of its usage (e.g., type of crops, irrigation systems) could make a considerable difference in how sustainably the resource is used. Additionally, preserving the quality of water is intimately related to its exploitation since both increased pumping and drilling could increase the risk of contamination in a context of low sanitation management.[10]

Box 7.2: Ingall Oasis—Example of Overexploitation of Underground Water

In the 1990s, the level of the underground water of the Ingall Oasis (Agadez region) was of about 4–5 meters allowing for the cultivation of date palm. In the early 2000s, the introduction of motor pumps combined with the introduction of onion cultivations destabilized this balance. The number of motor pumps was multiplied by 20 in under five years. This allowed for an increase of cultivation to three yearly harvests. However, the combination of these two factors resulted in the lowering of the water table by 3–4 meters and the decrease in the production of date palms, the capacity of water intake of palm trees being limited to 4 meters.

Source: World Bank and CILSS 2015.

Preserving and improving water quality need to be raised to the top of the water policy agenda. Water quality can't wait for better access to improve. As seen in chapter 4, this is an issue transcending the type of water access and larger question of the type of water infrastructure since improved water doesn't imply safe water; and low access to sanitation and safe management of fecal matter increase risk of contamination. It is also directly connected to water use in agriculture and irrigation, which can have important implications for water quality whether as a result of fertilizer (still relatively low in Niger) or drilling and pumping. Incidentally, the issue of ensuring the quality of the water consumed by households through water treatment (particularly at point-of-use since few households enjoy access on premises) is critical to improve related public health outcomes and increase households' resilience to the consequences of climate variability. The state has an important role to play to promote water treatment behaviors that can ensure a systematic treatment at scale that is sustained over time. This concern over quality also needs to be expanded to the preservation of the underground water from both anthropogenic and geogenic contamination in light of increasing drilling and pumping in a low sanitation context.[11] The risks appear to be particularly elevated in urban areas where, for example, the absence of treatment of fecal sludge has already resulted in heavy E. coli and nitrate contamination of both surface and underground water in the region of Niamey (Chippaux et al. 2002; Spadafora et al. 2015; Vassolo et al. 2015).

Nutrition and Resilience as Potential Platforms for Action

Nutrition can serve as a platform for action to improve WASH access and service quality. The cross-sectoral coordination and financial mobilization required to bridge the access gap and improve service quality can't rely solely on the SDGs as a rallying call that can translate into a prioritization of the sector. Realistically, in a country with numerous and deep deprivations, moving policy makers and partners decisively for action requires focus. As discussed in chapter 4, while malnutrition is problematic in Niger, nutrition is already established as a national priority reflected through projects and programs such as the 3N (Nigeriens Feed Nigeriens [les Nigériens Nourrissent les Nigériens]), the SUN (Scaling up Nutrition) initiative or the REACH partnership. Yet, in spite of this focus, malnutrition has remained stubbornly high even over the more recent period of relative calm in terms of shocks (stunting is greater than 40 percent). With the growing recognition of the role played by WASH, reducing stunting can thus serve as an objective to guide and step up interventions on WASH.

This platform can help guide medium-term planning for the expansion of access but also prioritize fail-safe interventions that can protect the basics in terms of human development. Building infrastructure that can deliver truly clean water and a fully safe sanitation chain is a long-term project. More deliberately associating this expansion to nutrition objectives can help consolidate interventions and achieve better outcomes. However, in the short run, fail-safe, stopgap interventions such as treatment at point-of-use may also be considered as part of health or nutrition focused projects, especially in vulnerable areas where high-quality infrastructure is not cost-effective yet. Evidence suggests point-of-use treatment can be efficient in reducing child diarrhea and other anthropometric failures provided that high take-up and systematic use are secured (Ahuja, Kremer, and Zwane 2010; Arnold and Colford 2007; Clasen et al. 2006; Fewtrell et al. 2005; Waddington et al. 2009; Sobsey, 2002). Such intervention can reduce the risk of contamination or recontamination in the home, a well-known cause of water quality degradation increased by Niger's low sanitation environment. Even in the best scenario of piped access, most of which not on premise, this contamination can occur at transportation, storage, or use. While not sufficient alone, point-of-use water treatment can be a cost-efficient WASH intervention to protect key nutritional outcomes in children under five, thereby protecting Niger's potential for shared prosperity.[12]

A growing focus on building household resilience offers another platform to prioritize WASH cross-sectorally—more so in the larger context of WRM. Reinforcing countries' resilience to shocks is paramount to reducing poverty. Several recent analyses emphasize the role of safety nets toward building household resilience in countries presenting a high vulnerability to shocks (Cervigni and Morris 2016; Hallegatte et al. 2016). The study on building resilience in Africa's Drylands (Cervigni and Morris 2016) flags Niger as an outlier in which even assuming all the resilience-enhancing interventions are adopted, the number of drought-affected people will require a significant scale-up of safety-net measures such as the IDA-funded Adaptive Safety Nets project.[13] In that context, and as discussed in chapter 4, the expansion of WASH needs to be conceived in light of climate variability to resist climate shocks and be implemented in a way that does not threaten the sustainability of water resource management (in both quantity and quality); this expansion can also contribute to increasing households resilience to withstand climate variability.

These common goals can also help make sanitation a priority, and results-based financing that would jointly target water supply and sanitation could help channel efforts toward concrete and incremental goals to enable local institutions to deliver on sanitation. Linking of water supply and sanitation to priority issues such as malnutrition and resilience can help make the case of their importance beyond the WASH sectoral perimeter and overcome some of the political unease and taboos associated with sanitation. However, even this can't replace the need for adequate funding to achieve tangible results. In an aid-dependent country such as Niger, the mobilization of government resources toward sanitation is unrealistic at this point. However, the mobilization of donor resources to aggressively support sanitation through local government projects, with results and linkages defined through disbursement-linked indicators (DLIs), could, and this may not represent as large an investment as the gap could suggest (for instance, the SOPHAB proposes a US$50 million five-year investment plan nationwide). A results-based instrument, such as the Program-for-Results[14] (PforR) could target the three priority pillars: (a) address remaining access and service gaps, focusing on the poor; (b) plan for increased demand in a climate-vulnerable context; (c) protect the basics, particularly where infrastructure expansion is not feasible or realistic through cross-sectoral interventions. By designing an approach that accounts for the institutional challenges identified in the Niger WPD, one could use an intervention focused on water supply and sanitation to support stronger local governance and concrete developmental results.

Table 7.1: Activities Undertaken under the Niger WPD

Activity	Topic	Spatial coverage	Data	Sector coverage	Core question	Delivery date	Status
1	Poverty Review	National	All available household surveys (Enquête 1,2,3; DHS; census)		CQ1	June 2016	Completed
2	Poverty Mapping (new poverty map for Niger)	National	2012 census and Enquête 1,2,3		CQ1-2	November 2016	Completed; validation from INS end of October 2016; inputs included in Niger SCD
3	WASH and poverty linkages	National	All available household surveys (Enquête 1,23; DHS; MICS)	WSS and health	CQ2	November 2016	Completed

table continues next page

Table 7.1: Continued

Activity	Topic	Spatial coverage	Data	Sector coverage	Core question	Delivery date	Status
4	UNICEF Framework analysis (food, care, health, and WASH linkages)	National	DHS 2012	WSS and health	CQ3	June 2016	Completed
5	WASH, nutrition, and shocks	National; DHS analysis expanded to Mali					Analysis completed for WASH Poverty Report; extension of analysis into a research paper
6	Institutional analysis	All 4 subsectors with a focus on sanitation		WSS	CQ4	Nov 2016	Completed; internal QER in December 2016

Note: WASH = water supply, sanitation, and hygiene; WPD = WASH Poverty Diagnostic; WSS = water, supply, and sanitation; INS = Institut National de la Statistique; QER = Quality Evaluation Review; SCD = Systematic Country Diagnostic.

Notes

1. Interestingly, health is rated third which could also guide public health messages on sanitation.
2. To take a concrete example: in the District of Dosso, the Director for Water does not have a vehicle to fulfill its mission. His office is manned by two persons: himself and an assistant. To make field visits, he is picked up by a car from a Swiss cooperation project.
3. The rural commune of Kara Kara is co-financing a full-time staff for SMEA with two other communes (with a ratio commensurate with their revenue) and with support from a project.)
4. Behavioral determinants can be internal (such as beliefs about feces) or external (such as sanctions for open defecations).
5. SaniFOAM is a conceptual framework developed to guide both the formative research and behavior change communications that target the behavioral determinants most relevant for sanitation behavior change. "FOAM" stands for *focus*, *opportunity, ability,* and *motivation.*
6. As noted by Neal et al. (2016), to date, most of the demand-side interventions and frameworks for open defecation have emphasized relatively conscious, "reflective" drivers of behavior change, including people's emotions (e.g., pride, shame), their rational knowledge (e.g., awareness of germ and fecal matter transmission), social norms, and explicit action plans (Sigler, Mahmoudi, and Graham 2014).
7. A GRET study quoting data from the Ministry of Vocational Training estimates that a million and a half of youth aged 13 to 19 are neither in school or employed (the infamous *ni-nis*), and more than 50,000 graduates are unemployed in a country with low educational attainment.
8. That is, the water table is at less than 10 meters below the surface (a depth that allows the use of surface pumps), the porosity of aquifers is high enough, the land above the aquifer is suitable to agriculture (slopes and soil quality), a manually constructed borehole is feasible, and people live in the area.
9. Consequences of groundwater overdraft includes increased pumping cost and cost of drilling new wells; land subsidence; seawater intrusion; water quality degradation (in addition to anthropogenic contamination, challenges to groundwater include salinity, uranium, arsenic, fluoride etc.); surface water depletion; and impact to groundwater dependent ecosystems.

10. After having been considered as possible options to increase households' water access, manual drilling of boreholes is now mainly used for agricultural purpose; the Ministries of Water and Health indicated that those types of drilling were not recommended for drinking since the aquifer is highly sensitive to contamination.
11. Anthropogenic contamination includes sewage effluents (bacteriological, nitrate, salts); agricultural effluents (nitrate, phosphate, organics); landfill leachate (salts, metals, organics); industrial wastewater (salts, metals, organics); energy wastes (coal mining, coal ash disposal, oil spills, oil and gas wastewater [organics, metals, salts, radioactive]); water treatment (disinfection by products). Geogenic contamination includes seawater intrusion (salts); evaporation and salts dissolution in the unsaturated zone (salts, metals); mixing with saline water from external sources (salts, metals, organics); water–rock interactions (salts, metals, organics, radioactivity).
12. While no recent study on the cost-effectiveness of water treatment exist, a WHO/UNICEF study postulates that household water treatment can pay back US$60 for every US$1 invested (WHO/UNICEF 2005).
13. The report identifies Niger as an outlier, primarily driven by its demography. The report warns of the large needs to protect poor people in Niger, along with those in Mali and Senegal, from the consequences of droughts in the drylands and the scope of the challenge even if all resilience-enhancing measures are taken. For those three countries, the fiscal realities are expected to be especially harsh. For those countries, even with those resilience measures taken, the cost of using cash transfers to bring all drought-affected people up to the poverty line is likely to far exceed 1 percent of GDP, the consensus value in the social protection literature on the resources governments should be willing to spend on social safety nets.
14. The PforR is a relatively new instrument complementing the World Bank's two existing lending instruments—investment lending, which supports specific projects and disburses against specific transactions, and development policy financing, which supports policy and institutional reforms. The PforR's unique features include using a country's own institutions and processes, and linking disbursement of funds directly to the achievement of specific program results. It focuses particularly in strengthening capacity, building capacity within the country, and enhancing effectiveness and efficiency toward the achievement of tangible, sustainable program results. The PforR is also unique because it supports government programs and helps leverage World Bank development assistance by fostering partnerships and aligning development partner goals and results that can lead to greater development effectiveness.

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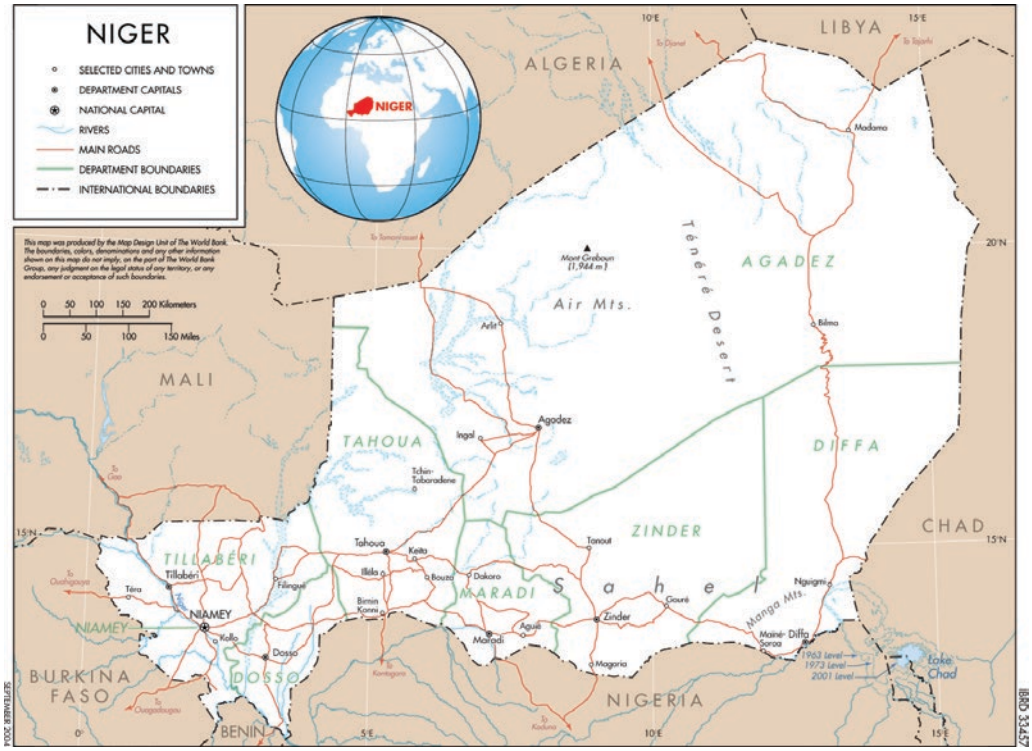
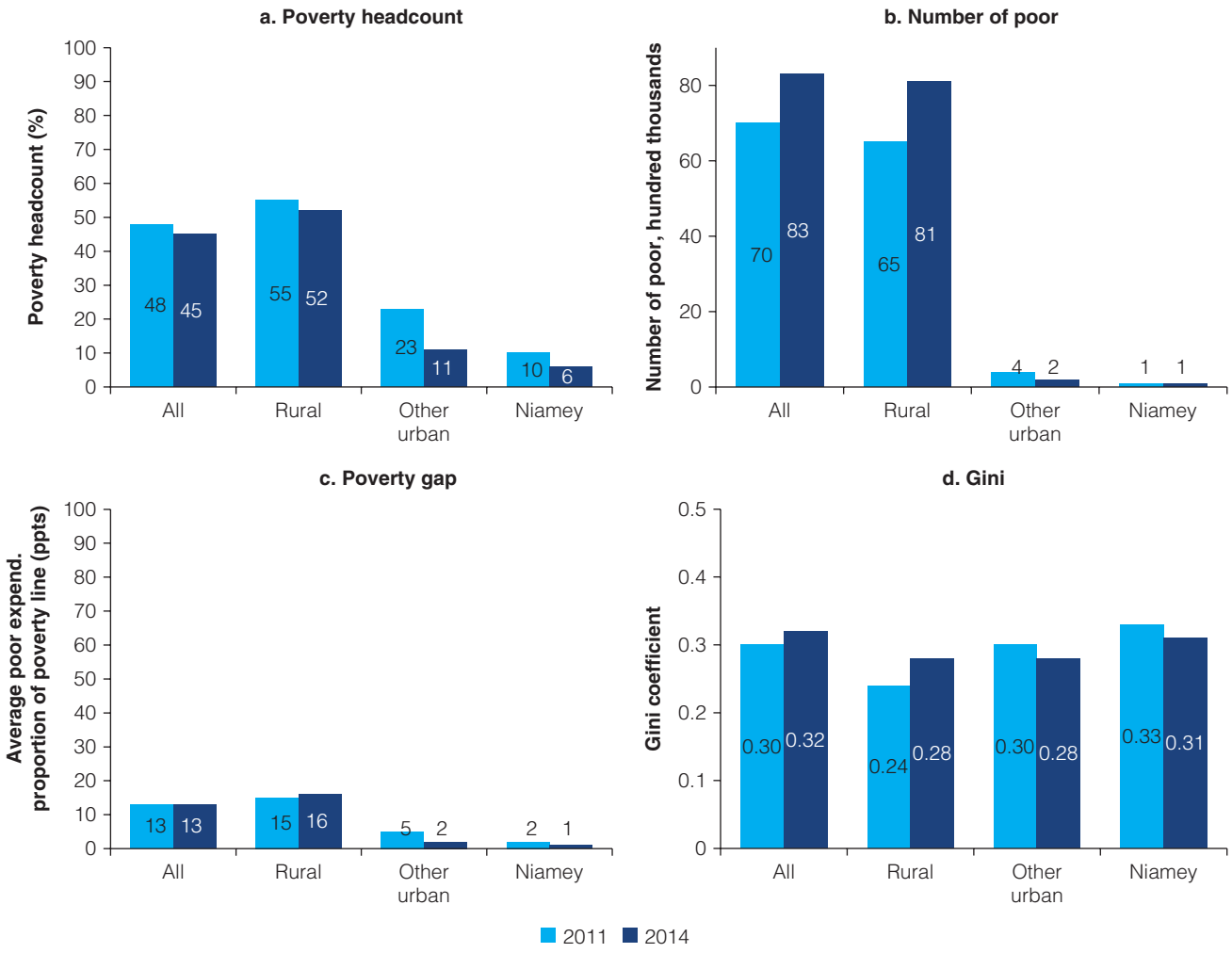
Appendix A
Map of Niger

Map A.1: Administrative Map of Niger



Appendix B
Poverty and Inequality Overview

Figure B.1: Poverty and Inequality Overview in Niger



Source: LSMS 2011, 2014.

Appendix C
Data Sources in Niger

Table C.1: Data Sources for Niger Reports

Variable	Dates	Sample and coverage	Source and format	Comments
LSMS-ISA	2011–14	Sample for the ECVM/A-2011 includes approximately 4,000 households in 270 ZDs Sample is nationally representative, as well as representative of "Niamey," "other urban," and "rural." Within the rural ZDs, the sample is also representative of three ecological zones: agricultural, agropastoral, and pastoral	Survey information for 2011 round; see site	Panel survey, households were reinterviewed in 2014; GPS coordinates
DHS	2000; 2006; 2012	2012 DHS: households; sample size: 10,750; female: (all women); age: 15 to 49; sample size: 11,160; male: (all men); age: 15 to 59; sample size: 3,928	See more at DHS website: http://dhsprogram.com /what-we-do/survey/survey -display-407.cfm#sthash .7UChnBM9.dpuf	GPS coordinate not available
National Census (RGPH)	2001; 2012	National	2012 census used for the construction of the new Niger poverty map	
Niger Safety Nets Project impact evaluation	2012; 2014	Evaluation comprises three groups: one control (52 clusters, 1,469 households, 2,063 children) and two treatments; the first treatment arm (cash transfer only) includes 51 clusters; 1,420 households; 2,126 children; the second arm (cash transfers and parenting training) includes 48 clusters, 1,443 households, and 1,948 children	Niger Safety Nets Project impact evaluation seeks to measure the effectiveness of the cash transfer component. In particular, the impact evaluation seeks to (a) rigorously evaluate the effectiveness of the Niger cash transfer program in improving nutrition and development of children below age five; (b) assess additional impacts when cash transfers are complemented with soft conditionalities in the form of parenting training behavioral accompanying measures	
ENBCM 2007/08	2007/08			
Enquête sur la conjoncture et la vulnérabilité alimentaire des ménages au Niger	2007			

table continues next page

Table C.1: Continued

Variable	Dates	Sample and coverage	Source and format	Comments
QUIBB	2005			Used for the latest poverty mapping done for Niger
CFSVA	2005			
Food insecurity (2013–15) Livelihoods (2011)	2013–15; 2011		FEWS Shapefile	Food insecurity: 5 categories: minimum, stressed, crises, emergency, famine Livelihoods: agricultural products
Croplands WRSI; eMODIS NDVI; Moisture Index; Rangelands WRSI; RFE; Seasonal ETa anomaly			FEWS/USGS GeoTIff	
Water: FAO (AQUASTAT)			http://www.fao.org/nr/water/aquastat/maps/index.stm	
CLISS			Agrhymet http://www.agrhymet.ne/	
Disaster events : DesInventar			DesInventar	Event data are geo-referenced
Disaster events : CRED			EM-DAT	Event data are geo-referenced
Administrative areas (boundaries); inland water; roads; railroads; elevation; land cover; gazetteer			Diva-GIS Mostly Shapefile	Aggregate of other sources by country (includes Niger) Lists sources on main page

table continues next page

Table C.1: Continued

Variable	Dates	Sample and coverage	Source and format	Comments
Rainfall: long-term climate trends for Sub-Saharan Africa	1960–2013	HarvestChoice/IFPRI Lowest geographic unit: level-2 administrative units	Interactive data query http://tools.harvestchoice.org/rainfall/	Version 1.0 Funding Agency: Bill and Melinda Gates Foundation Primary Contact: Melanie Bacou Publication date: December 2014
Average max, min, mean temperatures, precipitation, altitude, and 18 bioclimatic variables (e.g., warmest month, coldest month) by cell for the world			WorldClim Grid	
Spatial Production Allocation Model		Crop modeling platform IFPRI	http://mapspam.info/country-data-2/	MapSPAM shares results from the Spatial Production Allocation Model by HarvestChoice
Cities, airports, hydrography			University of Toronto Shapefile	
Roads, power plants, electricity transmission network			Africa Development Bank; Shapefiles	Does not list dates
DHS variables			DHS_USAID Shapefiles	Subnational but only at the department level
Malian refugees sites in Niger; elevation, health centers, roads, contour lines, rivers, villages/towns, admin WFP: border crossing points, supply routes, obstacles to logistics/transportation			Humanitarian Response Shapefiles	Composite from other sources

Note: CFSVA = Analyse de la Sécurité Alimentaire et de la Vulnérabilité; CLISS = Comité Inter-regional de Lutte contre la Sécheresse au Sahel; CRED = Centre for Research on the Epidemiology of Disasters; DHS = Demographic and Health Survey; ECVM/A = Enquete sur les Conditions de Vie des Ménages; ENBCM = Enquete Nationale sur le Budget et la consommation des Menages; FAO = Food and Agriculture Organization; GPS = Global Positioning System; IFPRI = International Food Policy Research Institute; LSMS = Living Standards Measurement Survey; RGPN = Recensement General des Populations; NDVI = Normalized Difference Vegetation Index; QUIBB = Questionnaire Unifié sur les Indicateurs de Base de Bien-Etre; RFE = rainfall estimate; WFP = World Food Program; WRSI = Water Requirement Satisfaction Index; ZDs = Zones de Dénombrement.

Appendix D
Summary of Indicators on Health and Education in Niger

Table D.1: Summary of Indicators on Health and Education in Niger

Indicator (following lifecycle logic)	Value	Unit	Year	Source
Maternal and reproductive health				
Maternal mortality	630	per 10,000 live births	2012	DHS
Total fertility rate	7.6	per woman ages 15–49	2012	DHS
Women, ages 15–49, who took basic prenatal health tests	83	%	2012	MICS4
Women, ages 15–49, who had qualified assistance during childbirth	29	%	2012	MICS4
Women giving birth in a qualified health facility	30	%	2012	MICS4
Contraceptive prevalence rate (modern methods)	12	%	2012	DHS
Child mortality and child health				
Under-5 mortality	127	Per 1,000 live births	2012	MICS4
Infant mortality	51	Per 1,000 live births	2012	DHS
Under-5 stunting (low height for age): Moderate to severe	43.9	%	2012	DHS
Severe	21.6	%	2012	DHS
Under-5 underweight (low weight for age): Moderate to severe	36.4	%	2012	DHS
Severe	13.3	%	2012	DHS
Under-5 wasting (low weight for height): Moderate to severe	18	%	2012	DHS
Severe	6.2	%	2012	DHS
Under-2 full vaccination coverage	52	%	2012	DHS
Under-5 who slept under an insecticide-infused mosquito net	20	%	2012	MICS4
Under-6 months on exclusive breastfeeding	23	%	2012	DHS
Under-5 diarrhea	19.4	%	2012	DHS

table continues next page

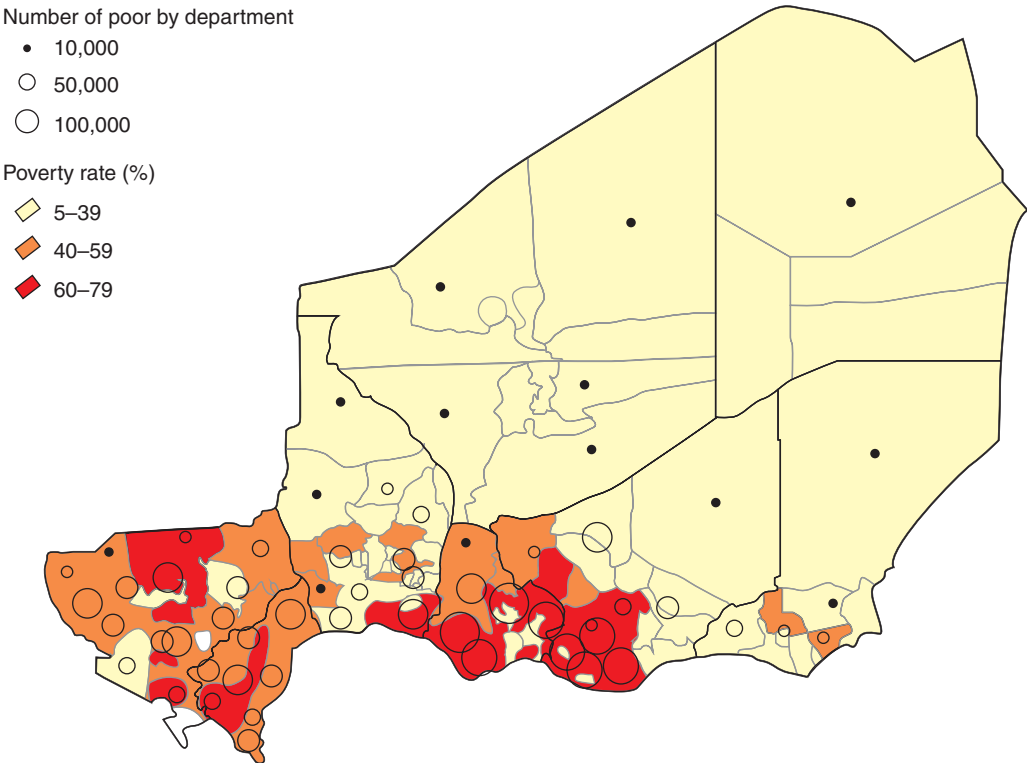
Table D.1: Continued

Indicator (following lifecycle logic)	Value	Unit	Year	Source
Basic education				
Preschool enrollment of 3–5 year olds	7.1	%	2014	WDI
Gross primary school enrollment	70.6	%	2014	WDI
Net primary school enrollment	61	%	2014	WDI
Gross secondary school enrollment	18.8	%	2014	WDI
Net secondary school enrollment	15.7	%	2014	WDI
Gender parity at primary school level	0.84	Girls' net enrollment/ Boys' net enrollment	2012	MICS4
Gender parity at secondary school level	0.69		2012	MICS4
Education and skills of adults				
Years of schooling of women ages 15–49	0.83	Years	2014	HDI
Years of schooling of men ages 15–49	2	Years	2014	HDI
Women, ages 15–49, who can read and write a short simple phrase in French or English	8.90	%	2012	WDI
Men, ages 15–49, who can read and write a short simple phrase in French or English	23.20	%	2012	WDI

Sources: DHS 2012; EDSN-MICS4; WDI 2014.
Note: EDSN-MICS = Niger's Demographic and Health Survey with Multiple Indicators (Enquête. *Démographique et de Santé et à Indicateurs. Multiples du Niger*); MICS = Multiple Indicator Cluster Survey.

Appendix E
Niger Poverty Map

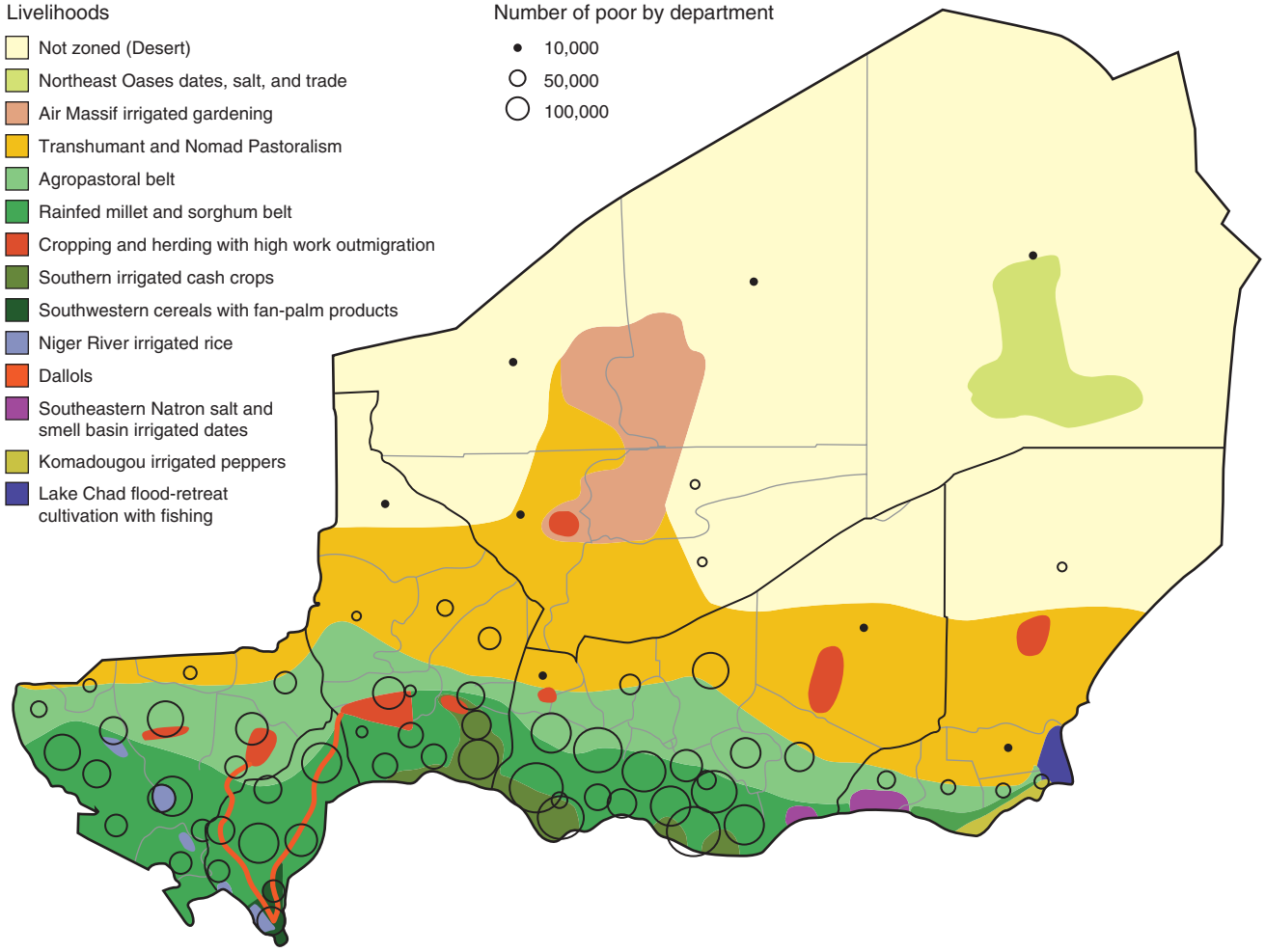
Map E.1: Niger Poverty Map



Source: World Bank calculation using data from the 2016 Niger poverty map (for poverty data based on 2012 census and 2014 LSMS).

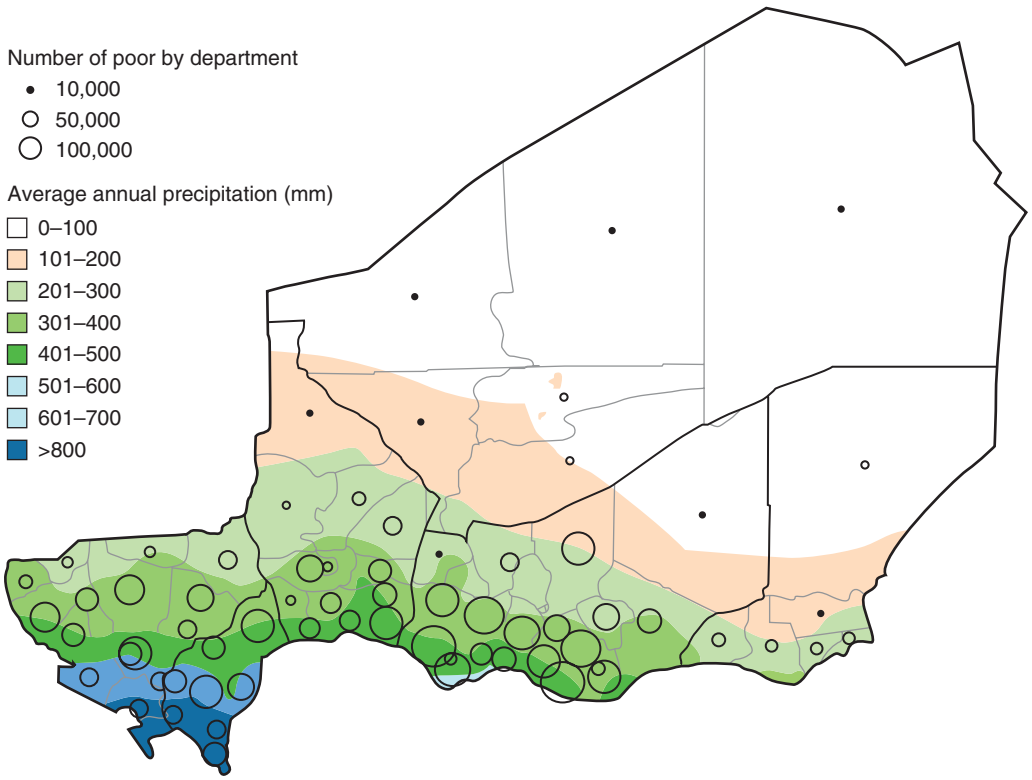
Appendix F
Poverty, Livelihoods, Agriculture, and Precipitation, Niger

Map F.1: Poverty and Livelihoods, Niger



Source: Niger Poverty Map 2016 (based on 2012 Niger census); Livelihoods data from FEWS net.

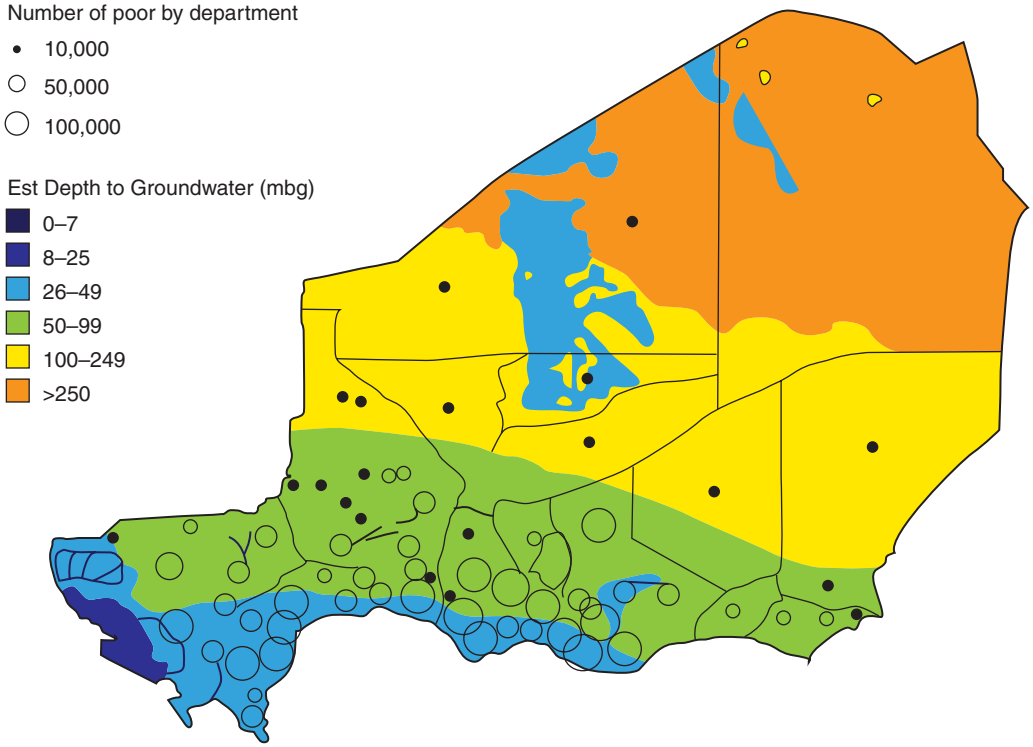
Map F.2: Poverty and Precipitation, Niger



Source: Niger Poverty Map 2016 (based on 2012 Niger census); Rainfall data from the Princeton Floods and Drought Monitor.

Appendix G
Groundwater Depth and Poverty

Map G.1: Groundwater Depth and Poverty, Niger



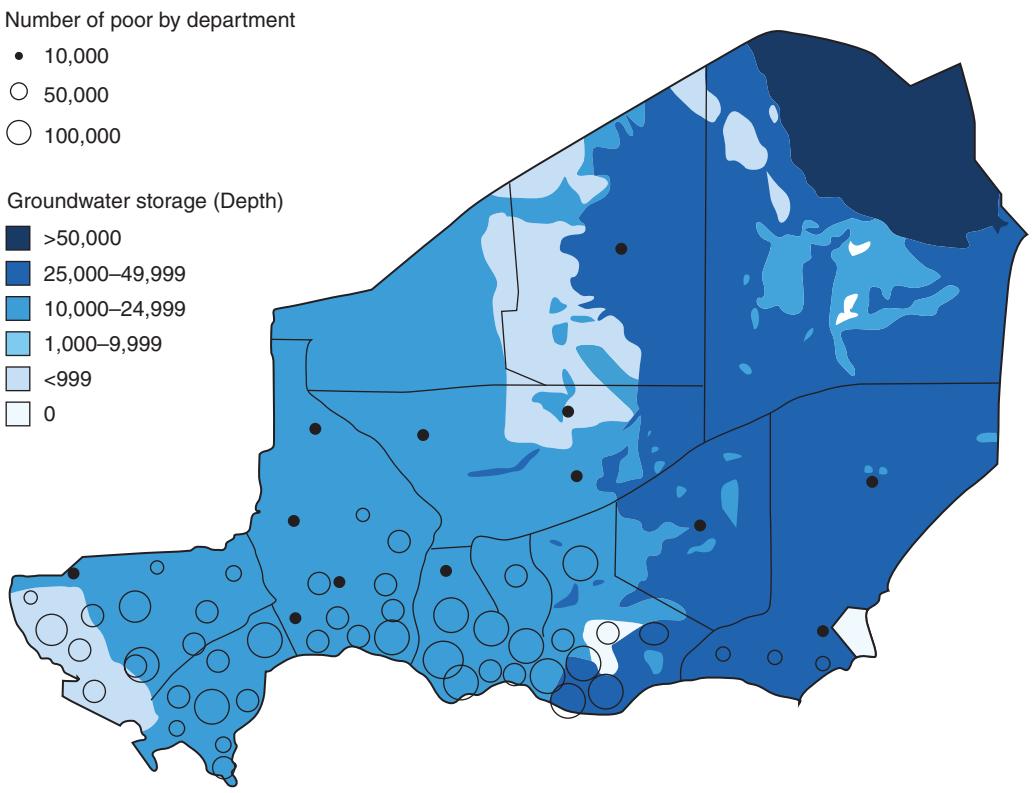
Sources: MacDonald et al. 2012 for water; World Bank calculation using data from the 2016 Niger poverty map (for poverty data based on 2012 census and 2014 LSMS).
Note: mbg = meters below grade.

Reference

MacDonald, A. M., H. C. Bonsor, B. É. Ó. Dochartaigh, and R. G. Taylor. 2012. "Quantitative Maps of Groundwater Resources in Africa." Environmental Research Letters 7(2): 1–7.

Appendix H Groundwater Storage and Poverty

Map H.1: Groundwater Storage and Poverty, Niger



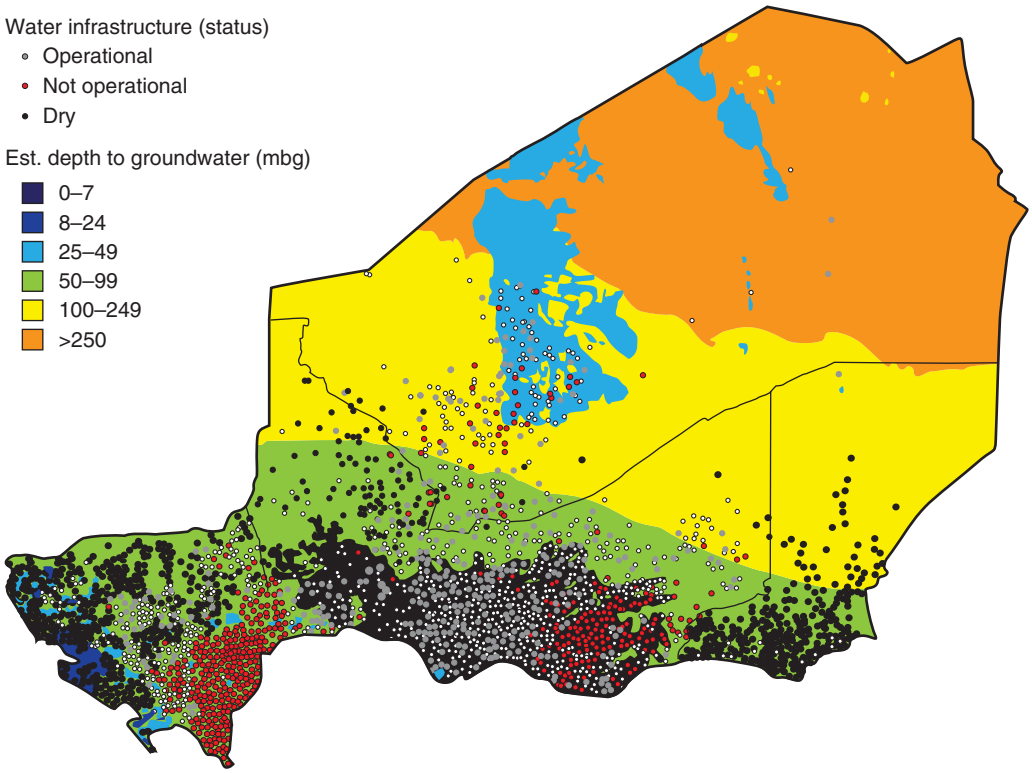
Source: MacDonald et al. 2012 for water; World Bank calculation using data from the 2016 Niger poverty map (for poverty data based on 2012 census and 2014 LSMS).

Reference

MacDonald, A. M., H. C. Bonsor, B. É. Ó. Dochartaigh, and R. G. Taylor. 2012. "Quantitative Maps of Groundwater Resources in Africa." Environmental Research Letters 7(2): 1–7.

Appendix I
Groundwater Depth and Water Points (per 2012 census)

Map I.1: Groundwater Depth and Water Points (per 2012 Census)



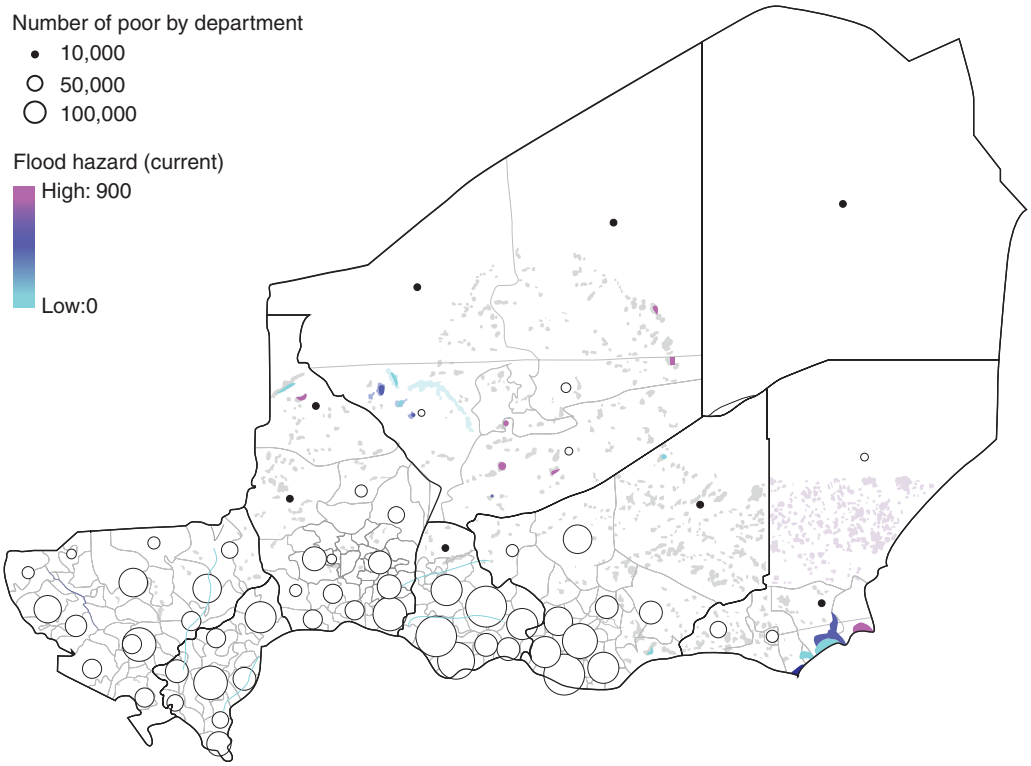
Source: MacDonald et al. 2012 for water; hydro infrastructure (i.e. wells etc.) – MHA GoN.

Reference

MacDonald, A. M., H. C. Bonsor, B. É. Ó. Dochartaigh, and R. G. Taylor. 2012. "Quantitative Maps of Groundwater Resources in Africa." Environmental Research Letters 7(2): 1–7.

Appendix J
Poverty and Vulnerability to Floods

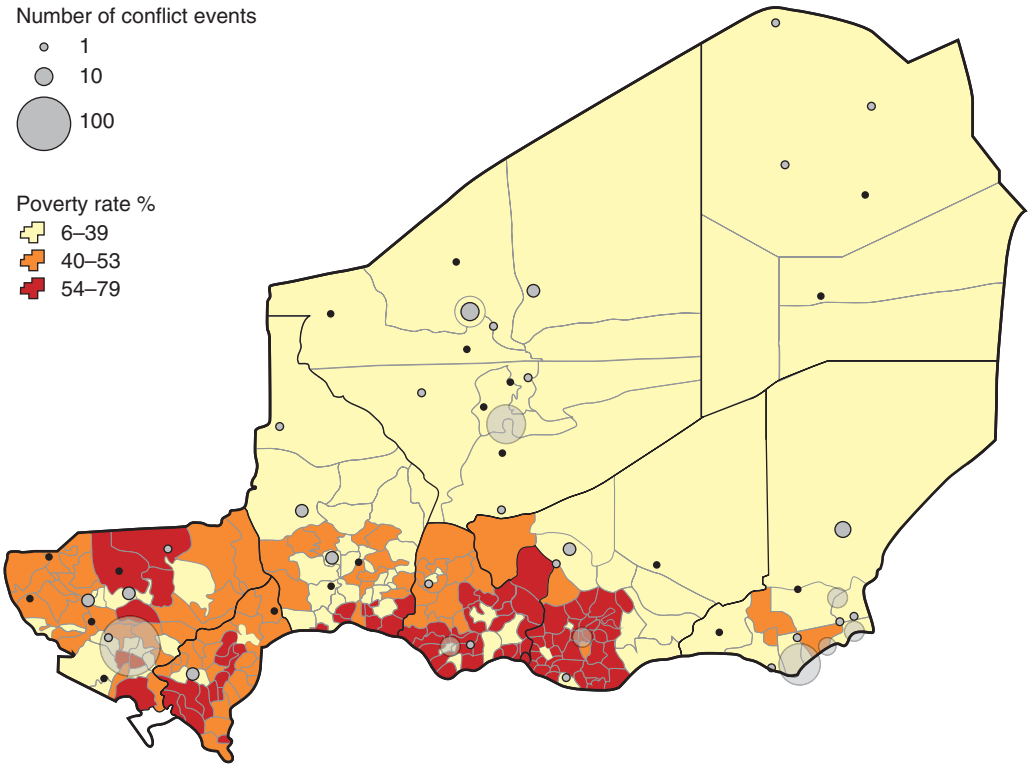
Map J.1: Poverty and Vulnerability to Floods, Niger



Sources: GFDRR risk data for Niger; World Bank calculation using data from the 2016 Niger poverty map (for poverty data based on 2012 census and 2014 LSMS).

Appendix K
Poverty and Conflict

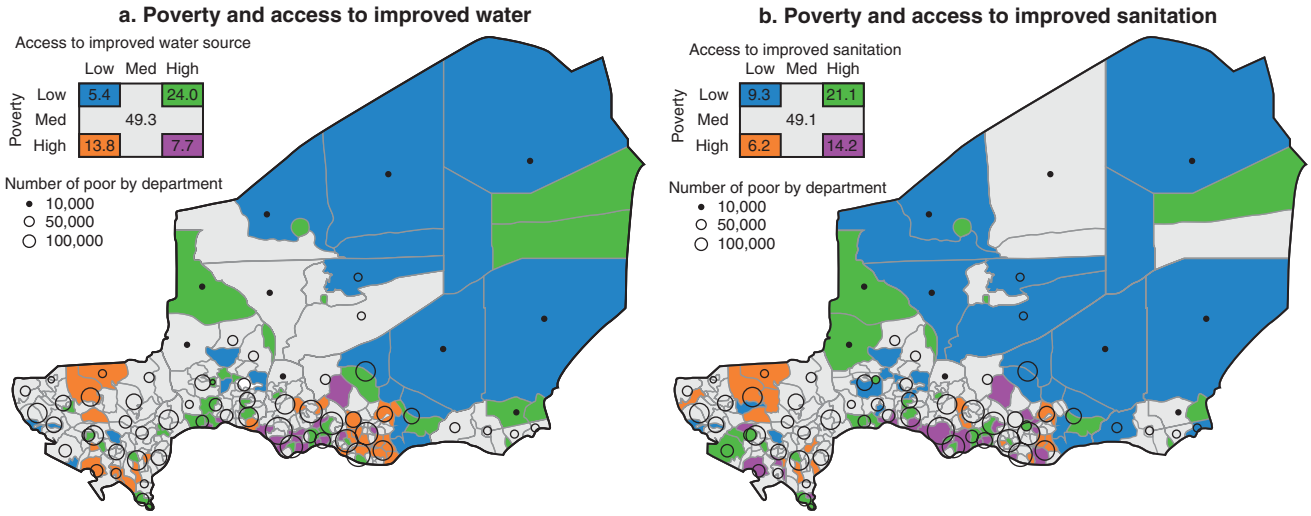
Map K.1: Poverty and Conflict, Niger



Sources: ACLED for conflict events World Bank calculation using data from the 2016 Niger poverty map (for poverty data based on 2012 census and 2014 LSMS).

Appendix L
Spatial Lens on Poverty and WASH Access

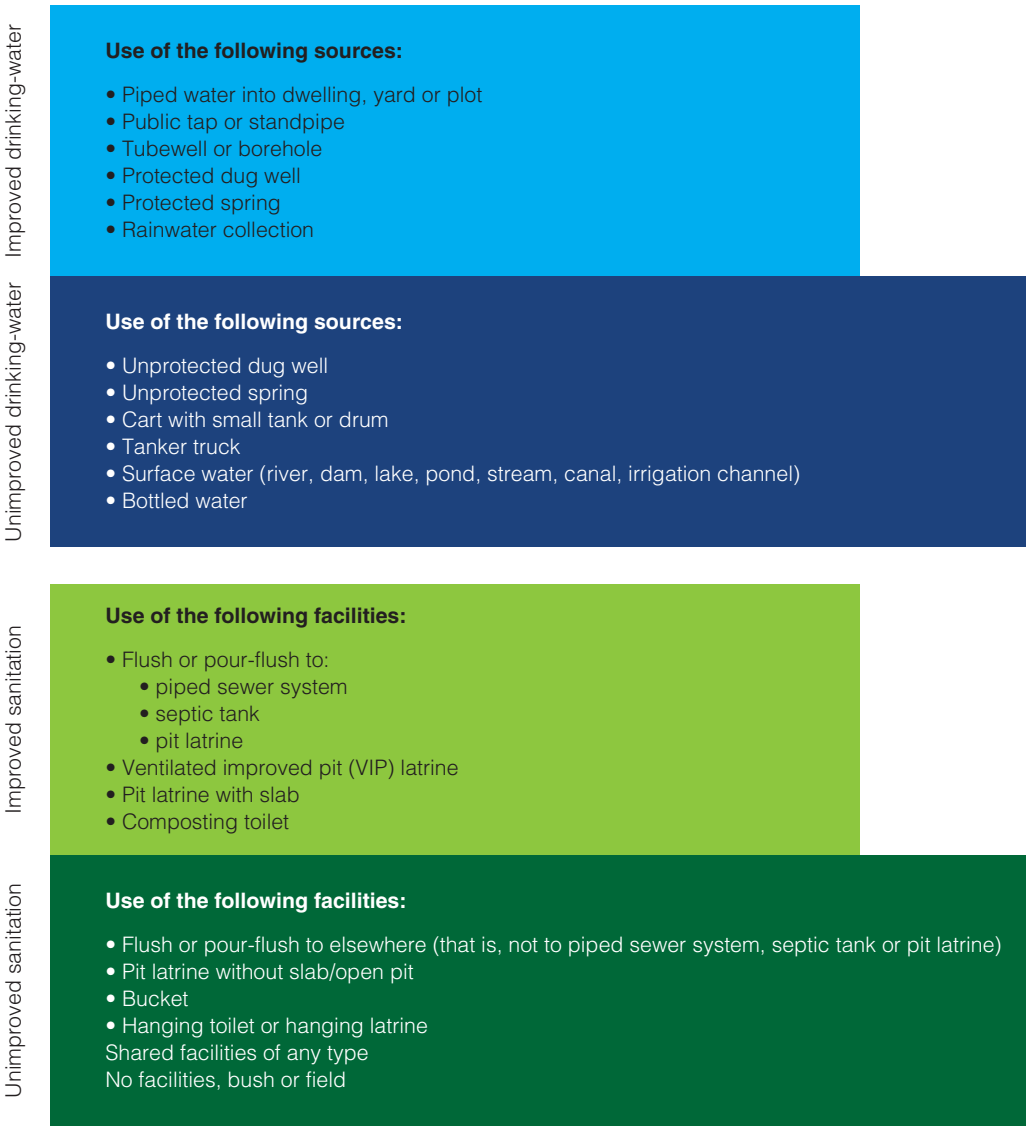
Map L.1: Poverty and Access to Water Supply and Sanitation – Mapping Outliers



Source: World Bank calculation using data from the 2016 Niger poverty map (for poverty data based on 2012 census and 2014 LSMS).

Appendix M
JMP Definitions of 'Improved' and 'Unimproved' Access

Figure M.1: JMP Definitions of 'Improved' and 'Unimproved' Access



Source: WHO/UNICEF.
Note: JMP = Joint Monitoring Programme.

Appendix N
JMP Access Comparison by Survey

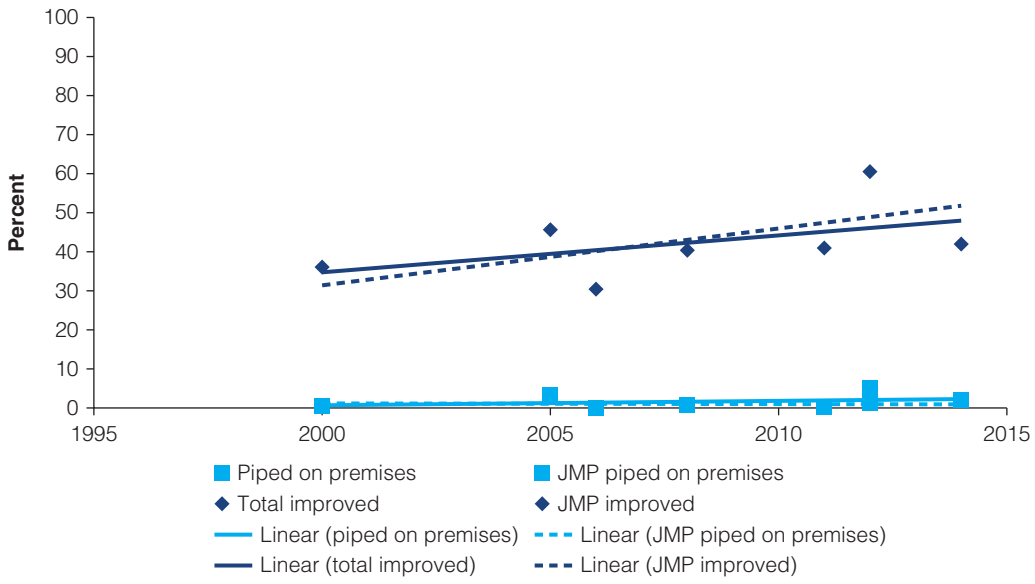
Adjustment to Improved Sanitation

All years (DHS 2006, 2014; LSMS 2011, 2014) are used to calculate the adjustment factor for improved sanitation based on the average percent shared of otherwise improved sanitation in urban and rural across these years. This is how the JMP makes this adjustment: a method followed in the Niger WPD.

This ratio is then applied to the urban and rural households, respectively, with improved sanitation (shared and unshared), to obtain the main variable to measure improved sanitation (the variable SanJMP2_imp). The same ratio is applied across all years.

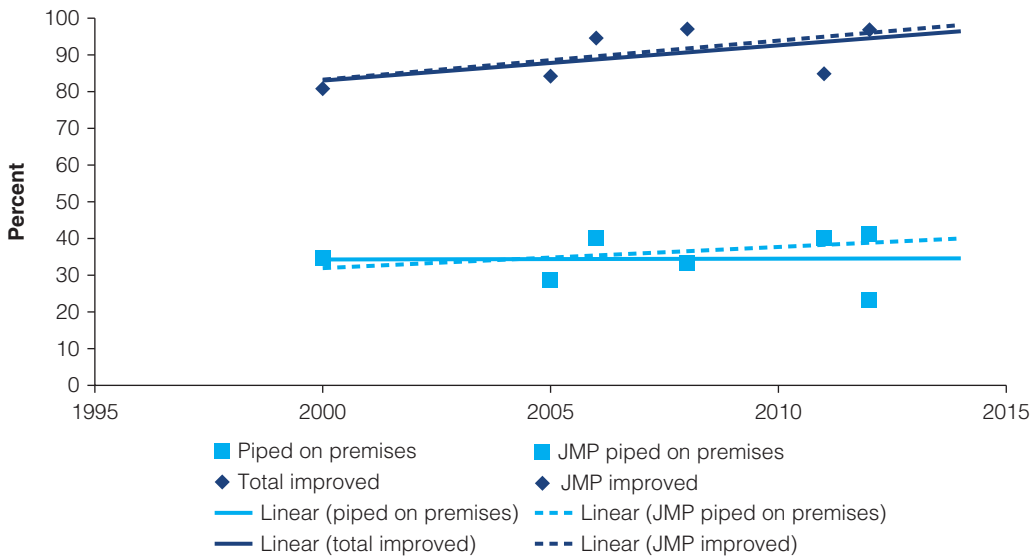
For the purpose of Niger two separate variables are used to show the true (i.e., reported for that year) improved, not shared [SanJMP4_imp]; improved, shared status of the household [SanJMP4_shared].

Figure N.1: JMP Access Comparison, by Survey



Source: World Bank calculation using the respective datasets.
Note: JMP = Joint Monitoring Programme.

Figure N.2: JMP Access Comparison, by Survey



Source: World Bank calculation using the respective datasets.
Note: JMP = Joint Monitoring Programme.

In the main calculations of time series, etc., and poverty by improved, SanJMP2_imp is used (and in the graphs and labels it says "adjusted"). However, the HOI and logit calculations use SanJMP4_imp as the improved variable in order to have a binary improved, not-improved variable (i.e., shared is considered unimproved here). Similarly, the access plus numbers use SanJMP4_imp to show the actual improved/not shared sanitation per year.

Differences from JMP

JMP uses regression to *estimate* the improved shared per year while we calculate it using the numbers for each year, with the only cross-year imputation exception being the adjustment for sanitation. Additionally, there are some ambiguous categories: JMP uses a 50 percent improved/unimproved rule for the ambiguous categories while we consider the ambiguous categories all as unimproved to produce a conservative estimate.

Differences from Global Team

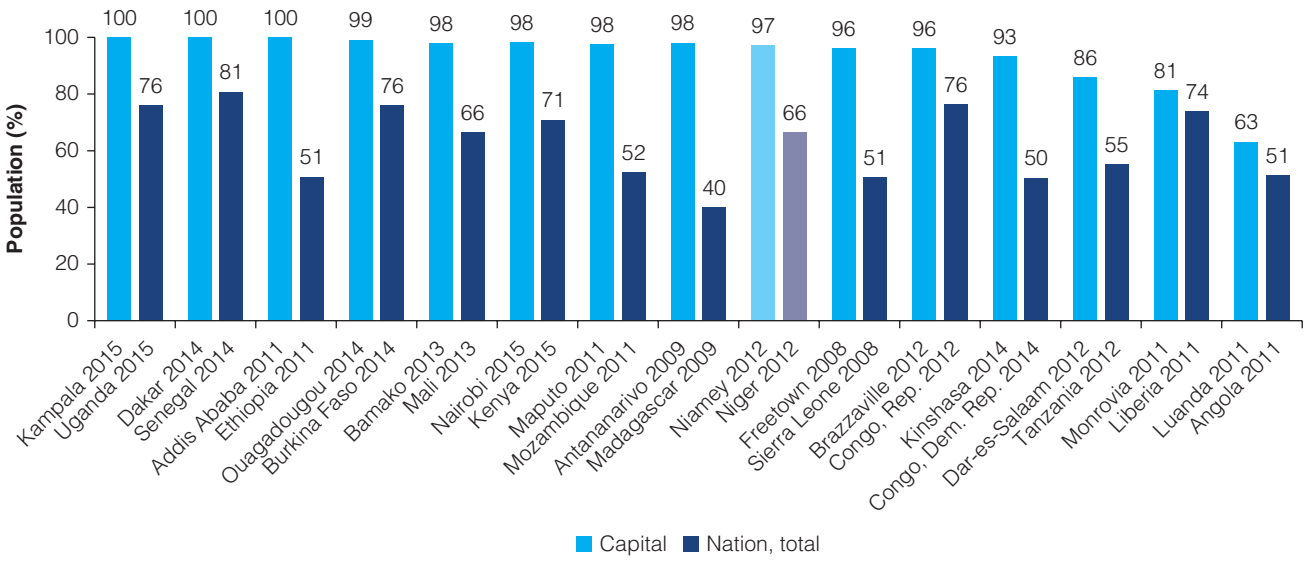
For the purpose of the Niger WPD, the team decided to calculate sanitation figures for all of the surveys included in the analysis even though the file produced by the global team considers some of the sanitation categories ambiguous for DHS 2006 and both LSMS years (2014). These categories are thus considered as unimproved to produce a conservative estimate.

Difference in sanitation between DHS and LSMS

There is a difference in the improved sanitation trends between the years in DHS compared to the years in LSMS. This appears to be data-driven rather than reality-driven so the large “dip” in sanitation between 2012 (DHS) and 2014 (LSMS). It seems sanitation remained steady rather than declined if considering LSMS and improved quite a bit if considering DHS.

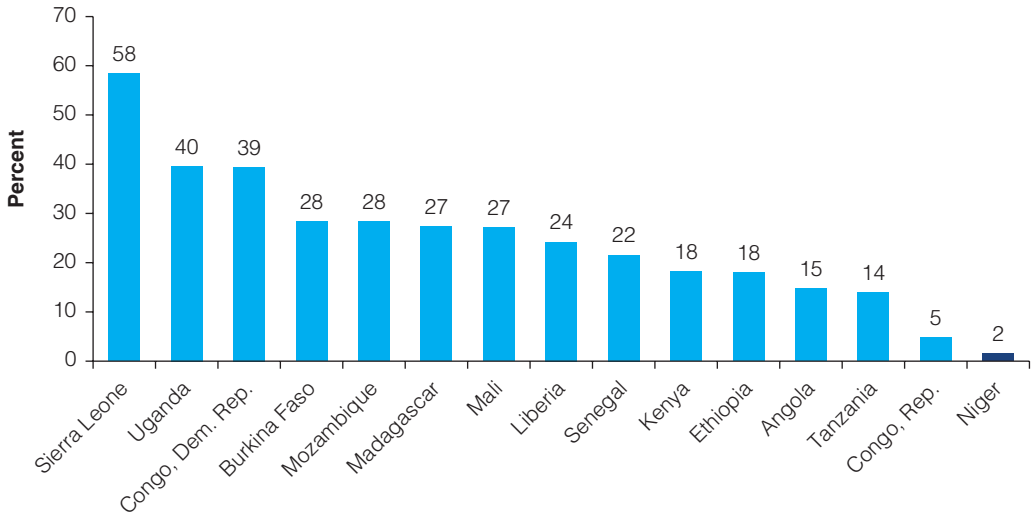
Appendix O
Regional Perspective on Metropolitan, Urban, and Country WASH Access Gaps

Figure O.1: Access to Improved Water in the Nation Overall Compared to Capital in Select African Countries



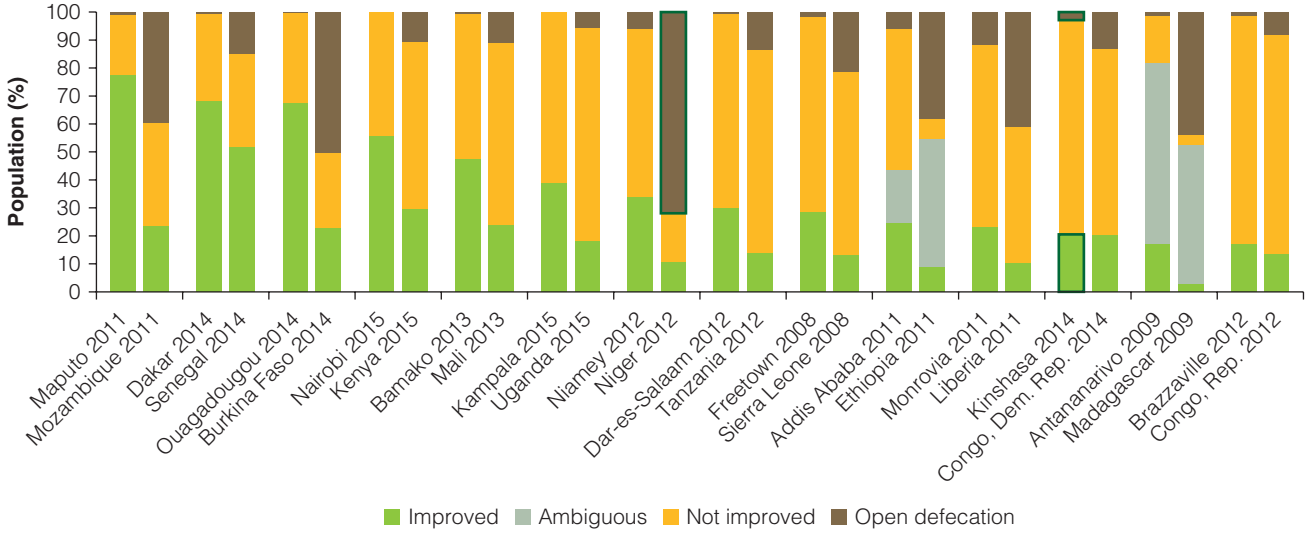
Sources: Lasted DHS available for respective countries.

Figure O.2: Ranking of Selected African Countries by Gap between Capital and Other Urban Areas in Access to Piped Water



Sources: Latest DHS available for the respective countries.

Figure O.3: Access to Sanitation in the Nation Overall Compared to Capital in Select African Countries



Sources: Latest DHS available for the respective countries.

Appendix P
Evolution of WASH Indicators

Figure P.1: Evolution of Water Access Types, by Location

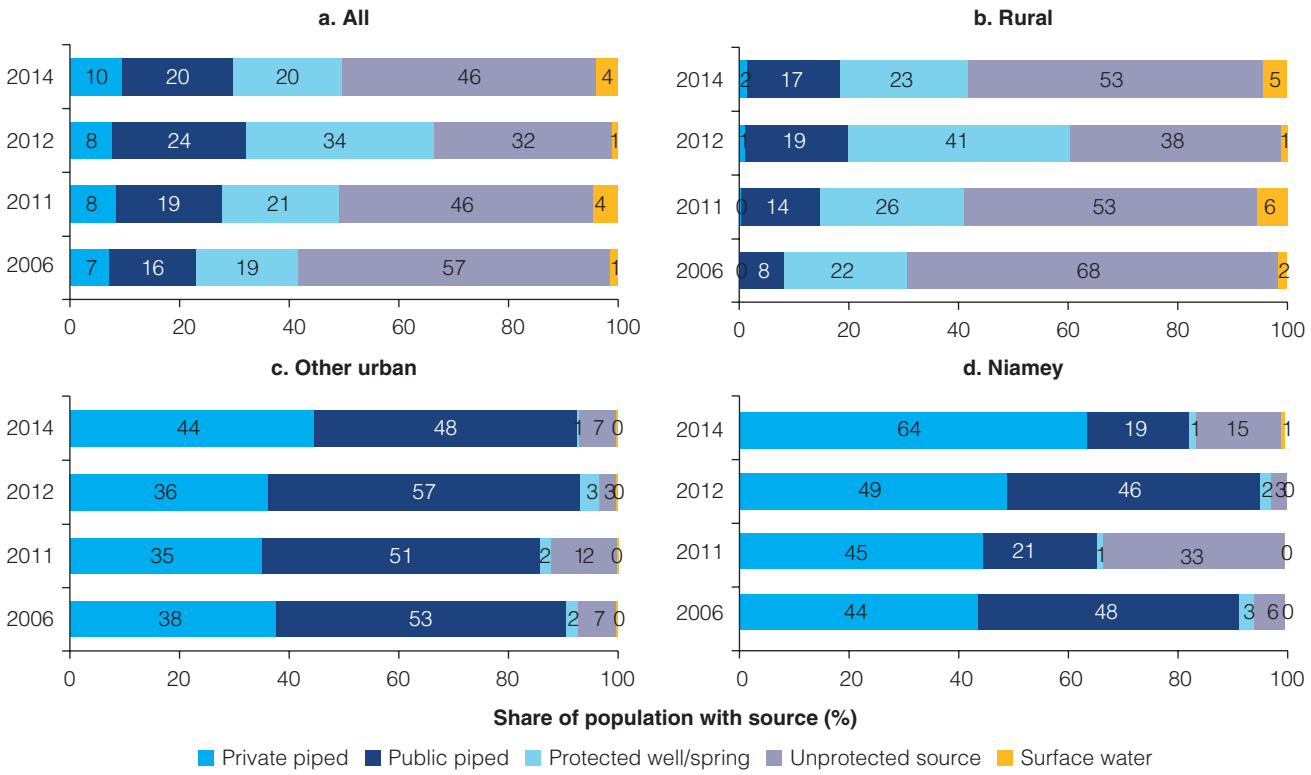
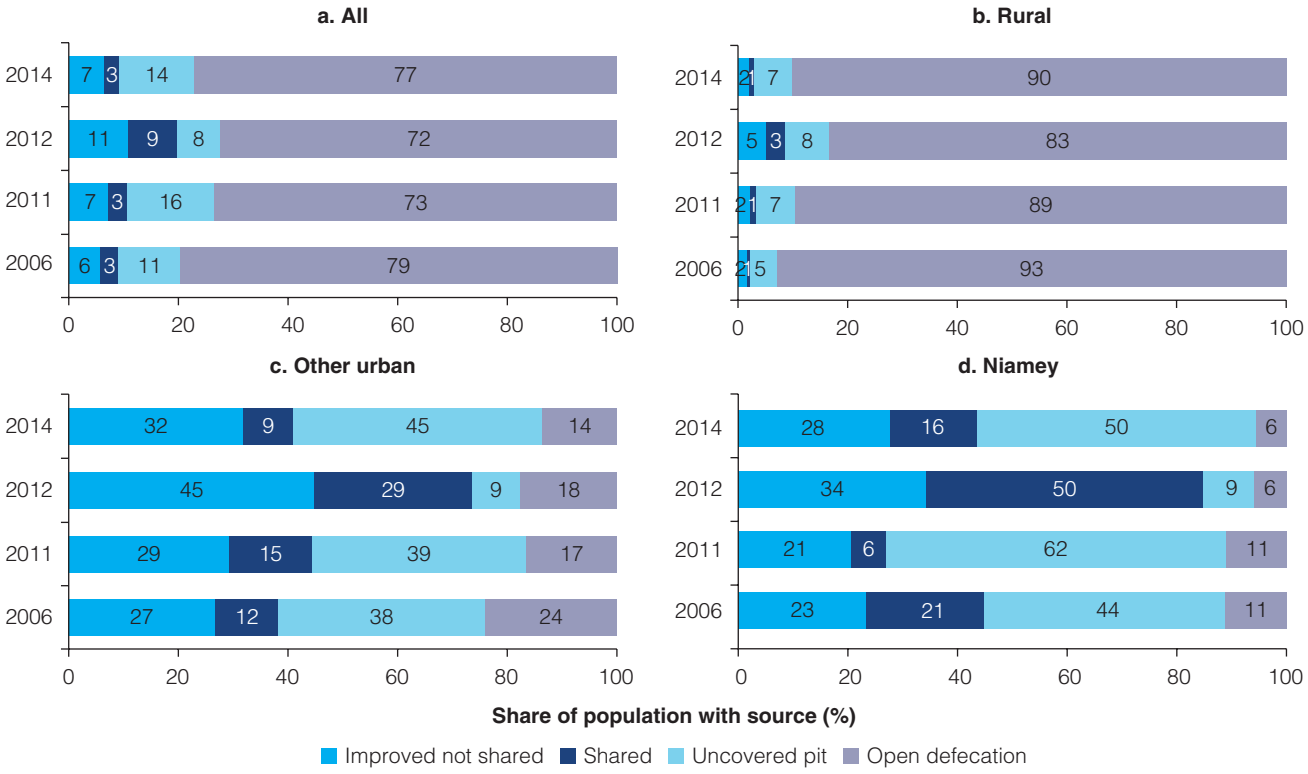


Figure P.2: Evolution of Sanitation Access Types, by Location



Appendix Q
Determinants of Household Access to WASH

Table Q.1: Determinants of Household Access to WASH

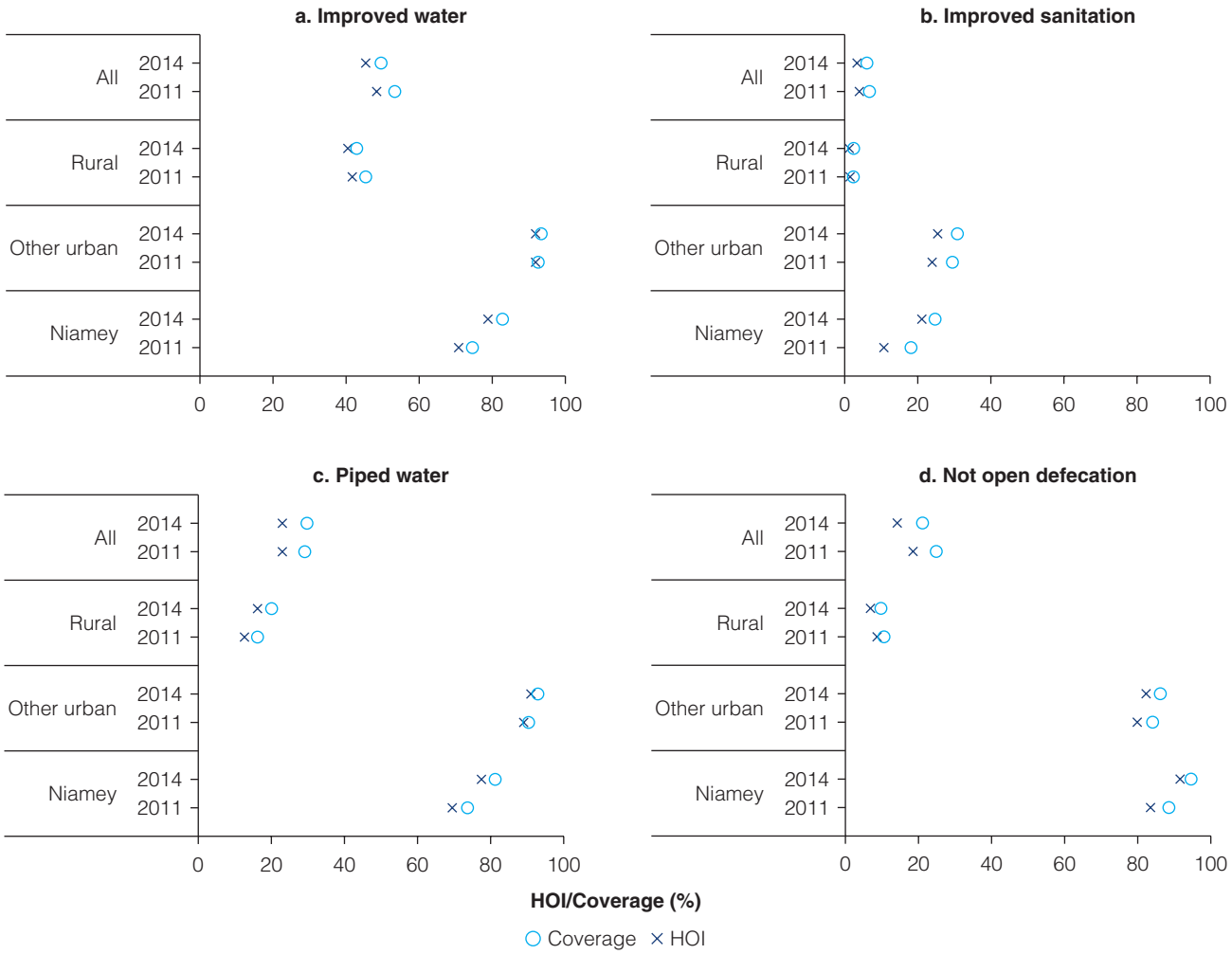
VARIABLES	(1) 2014 improved water	(2) 2011 improved water	(3) 2014 piped water	(4) 2011 piped water	(5) 2014 improved sanitation	(6) 2011 improved sanitation	(7) 2014 open defecation	(8) 2011 open defecation
urban	2.254***	1.734***	3.410***	3.320***	2.302***	2.064***	−3.961***	−3.961***
	(0.277)	(0.220)	(0.312)	(0.314)	(0.416)	(0.411)	(0.330)	(0.330)
Top60	0.0560	0.418**	0.376	0.381*	3.685***	1.378***	−1.502***	−1.502***
	(0.239)	(0.182)	(0.308)	(0.199)	(0.569)	(0.361)	(0.306)	(0.306)
Top60poor	−0.132	0.0869	−0.673**	−0.349	−1.048	−0.734*	0.485	0.485
	(0.493)	(0.210)	(0.324)	(0.317)	(0.971)	(0.412)	(0.450)	(0.450)
HH educ. primary complete	1.175***	0.686***	1.405***	0.793**	0.762**	1.219***	−1.374***	−1.374***
	(0.350)	(0.240)	(0.375)	(0.314)	(0.351)	(0.214)	(0.344)	(0.344)
HH educ. secondary complete	0.665	−0.0639	0.128	0.297	0.853	1.057***	−1.874*	−1.874*
	(0.769)	(0.443)	(0.549)	(0.446)	(0.679)	(0.405)	(1.013)	(1.013)
HH educ. tertiary	2.711***	1.504***	3.150***	2.256***	1.276***	2.400***		
	(0.581)	(0.452)	(0.758)	(0.617)	(0.311)	(0.258)		
hhsize	0.00129	0.0348**	0.0138	0.0103	0.114***	0.0759***	−0.0769***	−0.0769***
	(0.0257)	(0.0173)	(0.0240)	(0.0196)	(0.0267)	(0.0216)	(0.0274)	(0.0274)
HH Djerma/Songhai	−0.557	−0.421	−1.334***	−1.452***	−0.380	−1.018***	0.357	0.357
	(0.355)	(0.294)	(0.329)	(0.331)	(0.326)	(0.281)	(0.425)	(0.425)
HH Touareg	−0.358	−0.625**	−0.444	−0.606	0.0284	−0.00550	1.167***	1.167***
	(0.327)	(0.307)	(0.478)	(0.396)	(0.344)	(0.290)	(0.397)	(0.397)
HH Other	−0.142	−0.194	−0.0892	−0.483	0.143	−0.310	−0.104	−0.104
	(0.312)	(0.262)	(0.391)	(0.382)	(0.306)	(0.312)	(0.424)	(0.424)
Constant	−0.197	−0.518*	−1.562***	−1.653***	−7.820***	−5.212***	3.814***	3.814***
	(0.300)	(0.280)	(0.348)	(0.364)	(0.613)	(0.320)	(0.314)	(0.314)
Observations	26,539	24,707	26,539	24,707	26,529	24,697	25,705	25,705

Sources: LSMS/ISA 2011 and 2014.
Note: Standard errors in parentheses. HH = household; WASH = water supply, sanitation, and hygiene.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix R
Human Opportunity Index for Niger

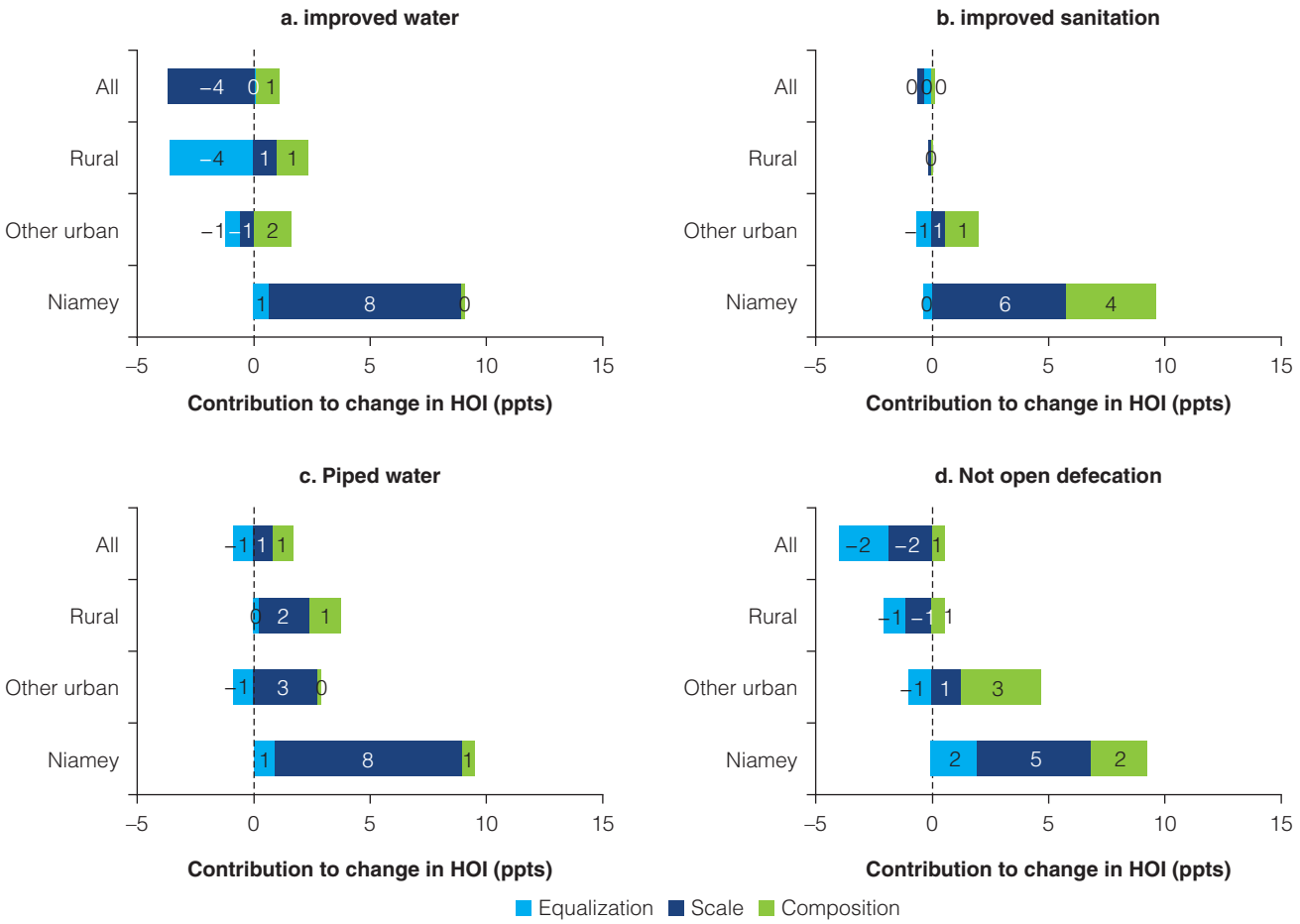
For all categories, **wealth status** followed by education are the main contributors to inequality. In some cases, in Niamey, education matters more than the wealth status. The D-Index looks large for sanitation, which is explained by the low access rates universally.

Figure R.1: Human Opportunity Indexes Over Time, across Location, 2011–14



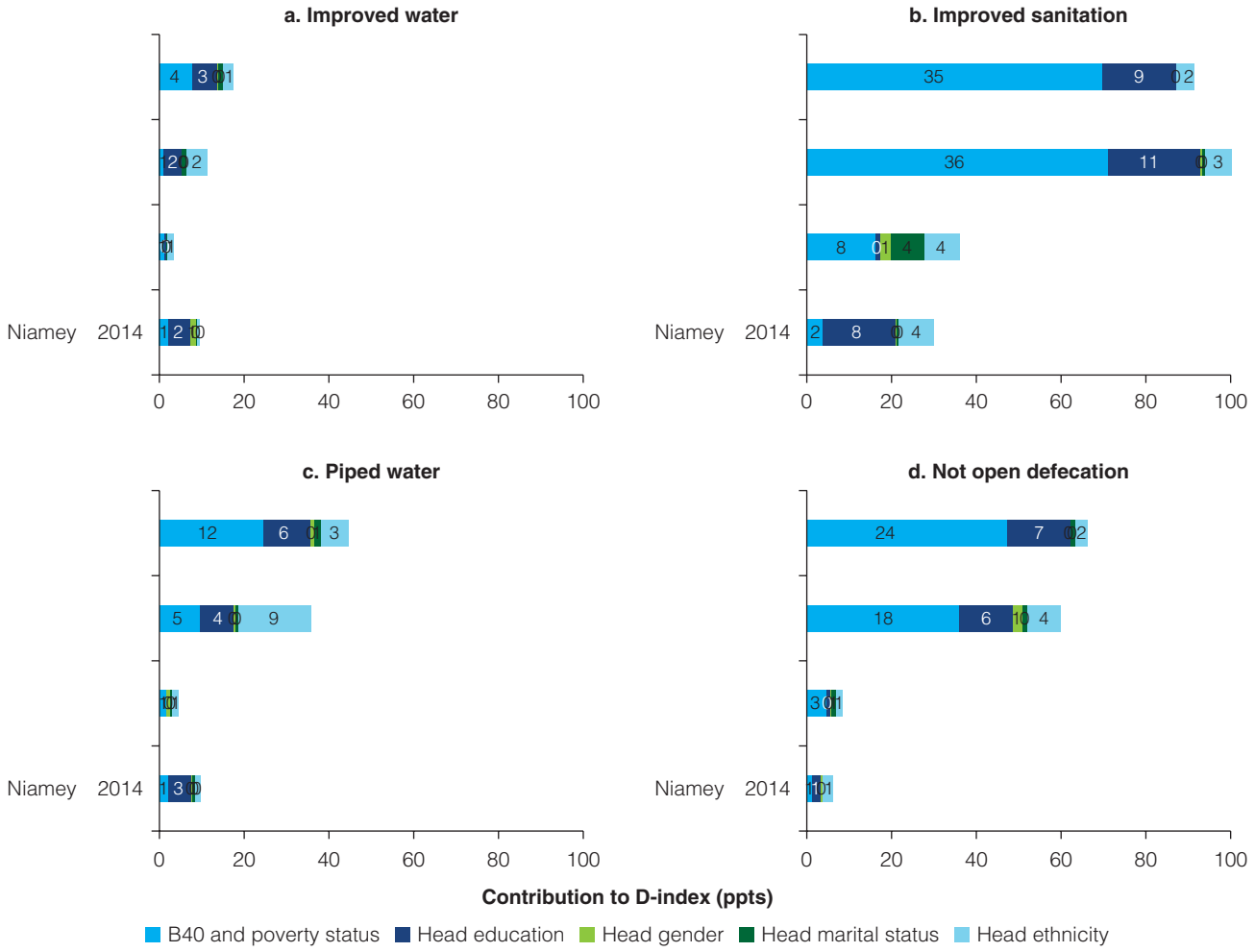
Source: LSMS 2011, 2014.
Note: Improved water is an average between wet and dry seasons is not shared (unadjusted).

Figure R.2: Contribution to Changes in the Human Opportunity Index 2011–14



Sources: LSMS 2011, 2014.
Note: Improved water is an average between wet and dry seasons. Improved sanitation is not shared (unadjusted).

Figure R.3: Contribution to D-Index in the Human Opportunity Index, 2011–14



Sources: LSMS 2011, 2014.
Note: Improved water is an average between wet and dry seasons. Improved sanitation is not shared (unadjusted). B40 = bottom 40 percent of the population.

Appendix S
Niger 2012 Census-Based Poverty Maps—Analysis of the Poorest Communes and WASH Indicators

The latest census-based poverty map report presents development indicators for the eight regions, 67 departments, and 266 communes of Niger as defined in 2012.[1] In the report, a long series of Sustainable Development Goal (SDG) (or SDG-influenced) indicators cover monetary poverty, education, employment, and demography indicators defined at individual level as well as dwelling characteristics. This note focuses on commune-level poverty headcount as well as on two water supply, sanitation, and hygiene (WASH) indicators linked to water supply and sanitation. We examine the WASH indicators for the poorest 100 communes.

Table S.1 shows that the poorest 100 communes are all found in rural areas. On average those 100 communes are 20 percentage points poorer that all communes but only 10 points poorer when compared to the rural communes only. When we look at the use of "proper" sanitation, we find that the access rate is lower for the poorest communes (15.4 percent) than the country as a whole (23.5 percent) but slightly higher when compare to all rural communes (13.8 percent). For the access to water indicator, the outcome of the poorest communes is no worse than national level and significantly better that all rural communes. The correlation matrix found in table S.2 confirms that finding as correlation between poverty headcount and both WASH indicators are rather low, particularly for the water indicator. To further highlight this finding, figures S.1 to S.4 show scatter plots between poverty headcount and the both WASH indicators for all communes as well as for only the poorest 100 communes. The slopes of the fitted line in each figure are the correlation rates found in table S.2.

Table S.1: Basic Indicators in Niger

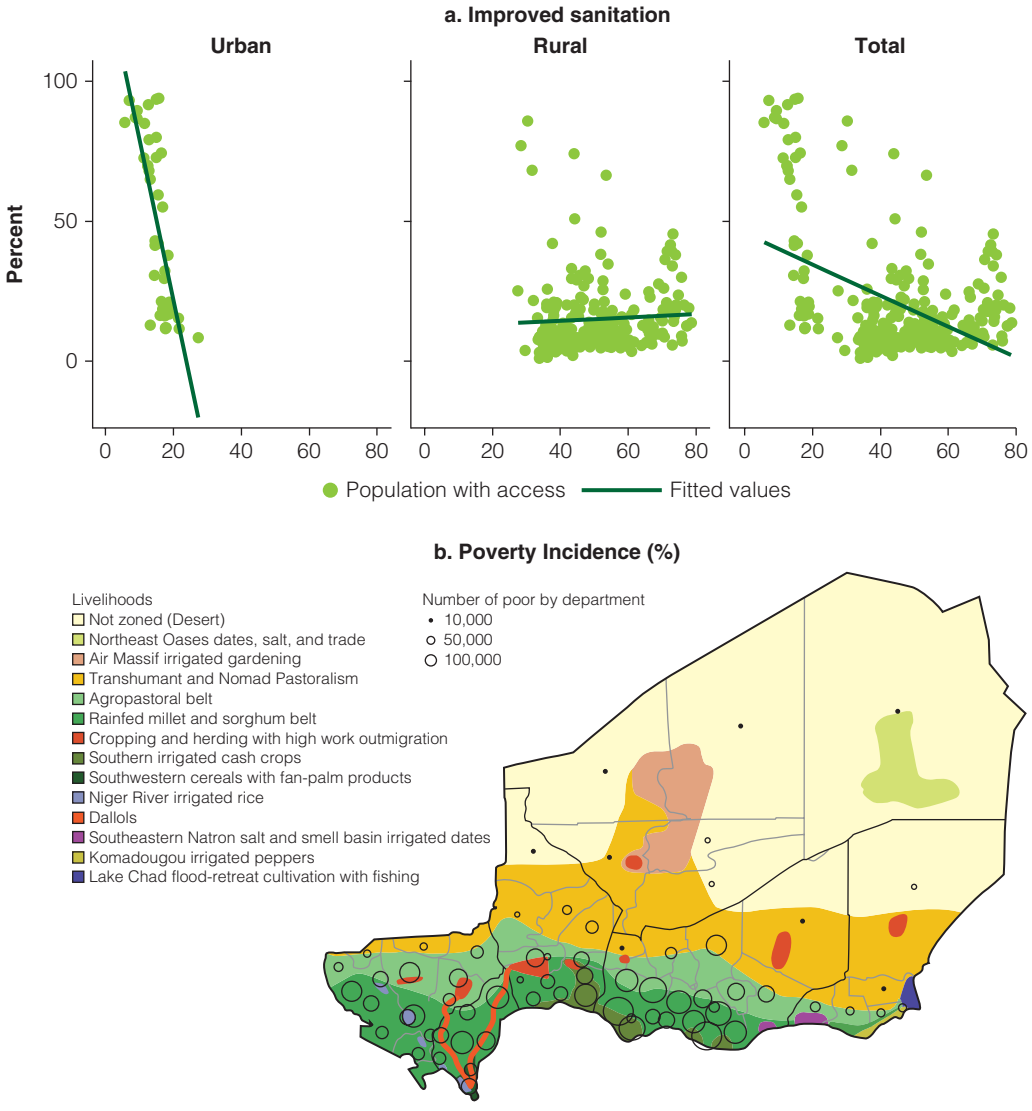
	All communes			Poorest 100 communes		
	Urban	Rural	All	Urban	Rural	All
Poverty Headcount	14.4	53.8	43.4	..	63.1	63.1
Having sanitation	53.7	13.8	23.5	..	15.4	15.4
Having water	86.9	70.5	74.5	..	73.7	73.7
Number of communes	42	224	266	0	100	100

Note: .. = negligible.

Table S.2: Correlation Between Poverty and WASH Indicators in Niger

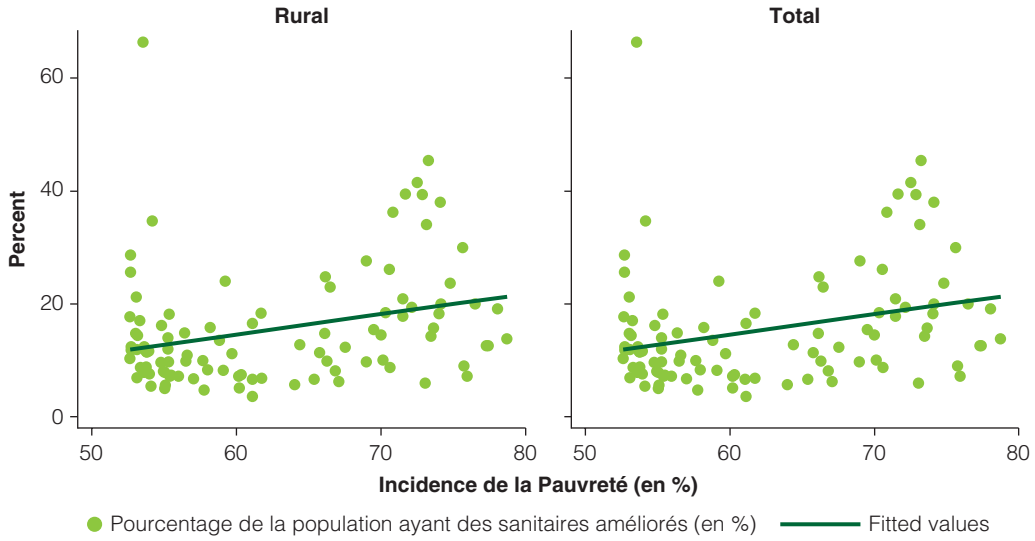
	All rural communes			Poorest 100 communes		
	Poverty headcount	Having sanitation	Having water	Poverty headcount	Having sanitation	Having water
Poverty Headcount	1.00			1.00		
Having sanitation	0.06	1.00		0.28	1.00	
Having water	0.17	−0.06	1.00	0.01	−0.09	1.00

Figure S.1: Scatter Plot, Poverty Headcount Compared to Sanitation, All Communes, Niger



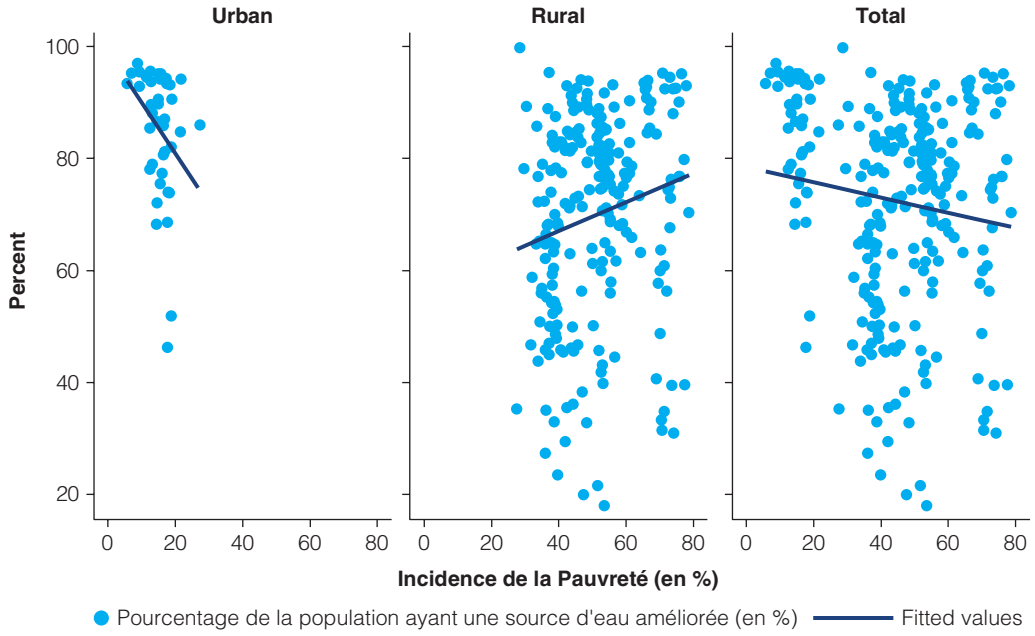
Source: Niger Poverty Map (2017) using the 2012 RPGH and 2014 LMS-ISA.

Figure S.2: Scatter Plot, Poverty Headcount vs Sanitation, Poorest 100 Communes



Source: Niger Poverty Map (2017) using the 2012 RPGH and 2014 LMS-ISA.

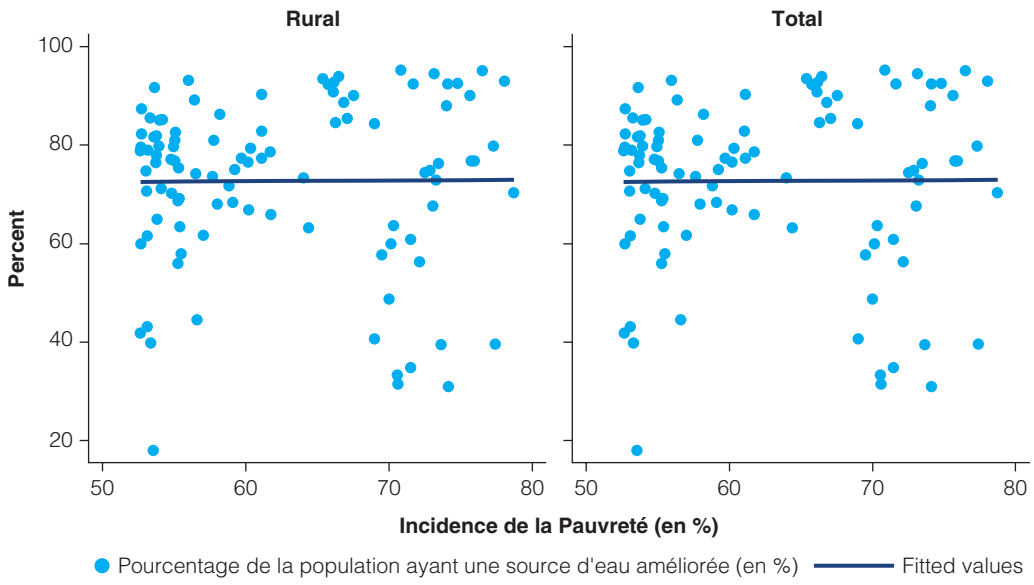
Figure S.3: Scatter Plot, Poverty Headcount Compared to Water, All Communes, Niger



Source: Niger Poverty Map (2017) using the 2012 RPGH and 2014 LMS-ISA.

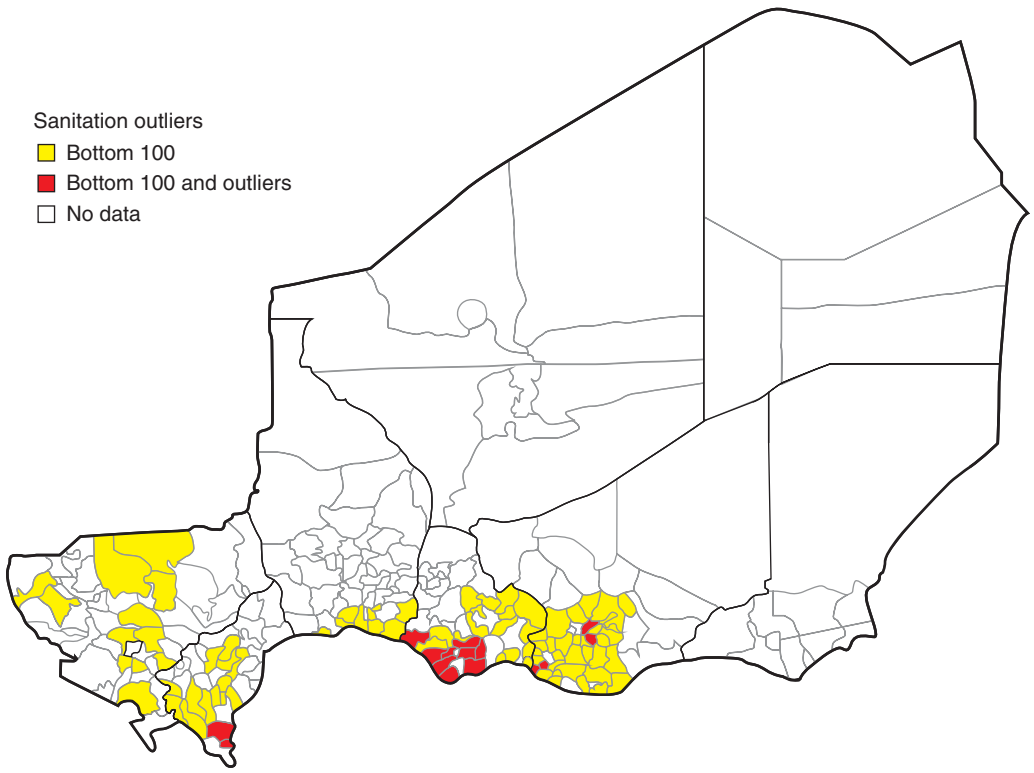
Maps S.1 and S.2 show the location of the poorest 100 communes. These communes are all rural and maps show that they are highly clustered. The communes show in red are the poorest communes, having water supply, sanitation, and hygiene (WASH) rates above the respective national average. In other words, although they show high levels of monetary poverty, they have above average access to sanitation (map S.1) or water (map S.2). The nationwide access rate to sanitation is 23.5 percent and 74.5 percent for water.

Figure S.4: Scatter Plot, Poverty Headcount Compared to Water, Poorest 100 Communes, Niger



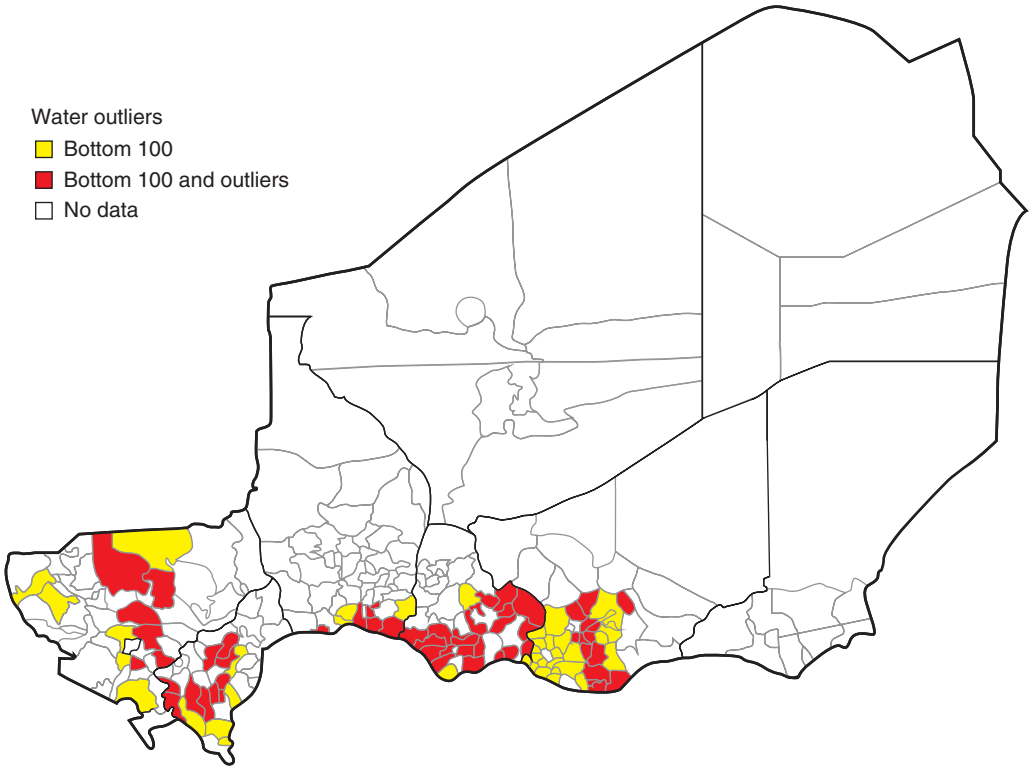
Source: Niger Poverty Map (2017) using the 2012 RPGH and 2014 LMS-ISA.

Map S.1: Poorest 100 Communes in Niger Including Communes with Sanitation Rate Above National Average



Note: "Bottom 100 and outliers" includes ones with sanitation rate above the national average.

Map S.2: Poorest 100 communes in Niger Including Communes with Access to Water Rate above National Average Map



Source: Niger Poverty Map (2017) using the 2012 RPGH and 2014 LMS-ISA.
Note: "Bottom 100 and outliers" includes ones with access to water rate above the national average.

Table S.3: Poverty Rate, WASH Rates, Poorest 100 Commune Indicators, and Sanitation Rates in Niger

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Agadez	Aderbissinat	Aderbissinat	Rural	36	9.9	45.8			
Agadez	Arlit	Arlit	Urban	8.8	87.1	97			
Agadez	Arlit	Dannet	Rural	29.6	3.7	78.1			
Agadez	Arlit	Gougaram	Rural	34	1.1	76.8			
Agadez	Bilma	Bilma	Rural	30.3	85.8	89.2			
Agadez	Bilma	Dirkou	Rural	31.7	68.2	46.8			
Agadez	Bilma	Djado	Rural	27.5	25.1	35.3			
Agadez	Bilma	Fachi	Rural	28.6	77.1	99.8			
Agadez	Iferouane	Iferouane	Rural	35.7	12.7	72.4			
Agadez	Iferouane	Timia	Rural	34.3	9	65.2			

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Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Agadez	Ingall	Ingall	Rural	36.4	11.7	55.2			
Agadez	Tchirozerine	Agadez	Urban	11.4	72.7	94.8			
Agadez	Tchirozerine	Dabaga	Rural	34	3.1	72.2			
Agadez	Tchirozerine	Tabelot	Rural	34.9	10.8	56			
Agadez	Tchirozerine	Tchirozerine	Urban	13.2	12.9	78.9			
Diffa	Bosso	Bosso	Rural	38	21	59.3			
Diffa	Bosso	Toumour	Rural	46.7	6	82.8			
Diffa	Diffa	Chetimari	Rural	38.2	16.3	82.8			
Diffa	Diffa	Diffa	Urban	12.9	68.1	89.5			
Diffa	Diffa	Gueskerou	Rural	39	20.7	87.4			
Diffa	Goudoumaria	Goudoumaria	Rural	37.2	3.9	47			
Diffa	Maine-Soroa	Foulatari	Rural	41.4	10.9	45.4			
Diffa	Maine-Soroa	Maine Soroa	Urban	17.8	11.5	68.5			
Diffa	Maine-Soroa	N'Guelbely	Rural	40.7	9.9	45.8			
Diffa	N'Gourti	N'Gourti	Rural	34.4	2.8	50.8			
Diffa	N'Guigmi	Kablewa	Rural	36.1	25.7	66.5			
Diffa	N'Guigmi	N'Guigmi	Urban	14.5	41.4	72			
Dosso	Boboye	Birni N'Gaoure	Urban	21.5	15.3	84.7			
Dosso	Boboye	Fabidji	Rural	53.9	11.6	79.8	1	1	2
Dosso	Boboye	Fakara	Rural	51.4	9.9	86.2			
Dosso	Boboye	Harikanassou	Rural	46.7	7.5	94			
Dosso	Boboye	Kankandi	Rural	54	7.6	85.1	1	1	2
Dosso	Boboye	Kiota	Rural	46.1	22.8	85.3			
Dosso	Boboye	Koygolo	Rural	48.1	10.1	89.5			
Dosso	Boboye	N'Gonga	Rural	45.4	16	92.4			
Dosso	Dioundiou	Dioundiou	Rural	52.5	11.1	74.6			
Dosso	Dioundiou	Karakara	Rural	53.1	6.9	61.5	1	1	1
Dosso	Dioundiou	Zabori	Rural	51.4	7.1	88.1			
Dosso	Dogondoutchi	Dan-Kassari	Rural	48.3	8.4	90.5			
Dosso	Dogondoutchi	Dogondoutchi	Urban	17.3	29.4	94.3			
Dosso	Dogondoutchi	Dogonkiria	Rural	49.1	7.5	74.4			
Dosso	Dogondoutchi	Kieche	Rural	48.7	5.1	93.9			
Dosso	Dogondoutchi	Matankari	Rural	48.4	8.8	89.6			
Dosso	Dogondoutchi	Soucoucoutane	Rural	45.9	18.7	89.1			
Dosso	Dosso	Dosso	Urban	15.4	59.5	94.2			
Dosso	Dosso	Farey	Rural	53.7	8.5	76.5	1	1	2
Dosso	Dosso	Garankedey	Rural	48.9	11.4	88.7			

table continues next page

Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Dosso	Dosso	Golle	Rural	53.7	11.5	78	1	1	2
Dosso	Dosso	Goroubankassam	Rural	52.5	10.7	79			
Dosso	Dosso	Karguibangou	Rural	53.6	7.8	81.6	1	1	2
Dosso	Dosso	Mokko	Rural	52.6	10.2	78.8	1	1	2
Dosso	Dosso	Sambera	Rural	57	6.7	61.7	1	1	1
Dosso	Dosso	Tessa	Rural	56	7.1	93.1	1	1	2
Dosso	Dosso	Tombokoirey I	Rural	55	5	76.8	1	1	2
Dosso	Dosso	Tombokoirey II	Rural	56.5	9.8	74.3	1	1	1
Dosso	Falmey	Falmey	Rural	55	8	79.6	1	1	2
Dosso	Falmey	Guilladje	Rural	55.3	18.1	69.1	1	1	1
Dosso	Gaya	Bana	Rural	53.5	66.4	18	1	2	1
Dosso	Gaya	Bengou	Rural	44	74.2	49.8			
Dosso	Gaya	Gaya	Urban	13.3	65	88.1			
Dosso	Gaya	Tanda	Rural	51.8	38.2	45.7			
Dosso	Gaya	Tounouga	Rural	52.1	46	76.8			
Dosso	Gaya	Yelou	Rural	52.7	28.6	60	1	2	1
Dosso	Loga	Falwel	Rural	53.7	8.8	81.8	1	1	2
Dosso	Loga	Loga	Rural	52.5	6.9	81.2			
Dosso	Loga	Sokorbe	Rural	45.8	6.2	83.8			
Dosso	Tibiri (Doutchi)	Doumega	Rural	52.2	12.4	84.6			
Dosso	Tibiri (Doutchi)	Guecheme	Rural	48.5	7.8	79.4			
Dosso	Tibiri (Doutchi)	Kore Mairoua	Rural	48.6	14	79.3			
Dosso	Tibiri (Doutchi)	Tibiri (Doutchi)	Rural	48.5	12.2	91.6			
Maradi	Aguie	Aguie	Urban	19.1	19.5	90.6			
Maradi	Aguie	Tchadoua	Rural	74.8	23.6	92.5	1	2	2
Maradi	Bermo	Bermo	Rural	42.1	3.6	29.5			
Maradi	Bermo	Gadabedji	Rural	42.3	7.1	35.5			
Maradi	Dakoro	Adjekoria	Rural	43.3	11.4	81.3			
Maradi	Dakoro	Azagor	Rural	38.4	4.8	63.4			
Maradi	Dakoro	Bader Goula	Rural	43.1	5.4	71.2			
Maradi	Dakoro	Birni Lalle	Rural	44.4	17	88.5			
Maradi	Dakoro	Dakoro	Urban	17.5	32.1	93.3			
Maradi	Dakoro	Dan-Goulbi	Rural	42.3	9.2	93			
Maradi	Dakoro	Korahane	Rural	43.8	5.1	91.2			
Maradi	Dakoro	Kornaka	Rural	44	8.5	89.9			
Maradi	Dakoro	Maiyara	Rural	45.2	8.3	84.7			
Maradi	Dakoro	Roumbou I	Rural	42.6	6.9	84.9			

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Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Maradi	Dakoro	Sabon Machi	Rural	43.3	15.4	84.1			
Maradi	Dakoro	Tagriss	Rural	46	5.2	73.2			
Maradi	Gazaoua	Gangara (Aguie)	Rural	78.1	19.1	93	1	1	2
Maradi	Gazaoua	Gazaoua	Rural	74.1	18.3	88	1	1	2
Maradi	Guidan-Roumdji	Chadakori	Rural	66.5	23	93.9	1	1	2
Maradi	Guidan-Roumdji	Guidan Roumdji	Rural	74.1	38	92.4	1	2	2
Maradi	Guidan-Roumdji	Guidan Sori	Rural	76.5	20	95.1	1	1	2
Maradi	Guidan-Roumdji	Sae Saboua	Rural	66.2	24.8	92.7	1	2	2
Maradi	Guidan-Roumdji	Tibiri (Maradi)	Rural	71.7	39.4	92.4	1	2	2
Maradi	Madarounfa	Dan-Issa	Rural	72.9	39.3	74.9	1	2	2
Maradi	Madarounfa	Djiratawa	Rural	75.7	29.9	90	1	2	2
Maradi	Madarounfa	Gabi	Rural	73.3	45.4	72.8	1	2	1
Maradi	Madarounfa	Madarounfa	Urban	16.7	55.1	87			
Maradi	Madarounfa	Safo	Rural	70.9	36.2	95.2	1	2	2
Maradi	Madarounfa	Sarkin Yamma	Rural	73.1	34.1	94.5	1	2	2
Maradi	Mayahi	Attantane	Rural	66.3	9.8	84.6	1	1	2
Maradi	Mayahi	El Allassane Maireyrey	Rural	67.1	6.2	85.4	1	1	2
Maradi	Mayahi	Guidan Amoumoune	Rural	64	5.6	73.3	1	1	1
Maradi	Mayahi	Issawane	Rural	66.9	8	88.7	1	1	2
Maradi	Mayahi	Kanan-Bakache	Rural	65.8	11.4	92.3	1	1	2
Maradi	Mayahi	Mayahi	Urban	21.6	11.6	94.1			
Maradi	Mayahi	Sarkin Haoussa	Rural	65.4	6.6	93.5	1	1	2
Maradi	Mayahi	Tchake	Rural	67.5	12.3	90	1	1	2
Maradi	Tessaoua	Baoudetta	Rural	78.8	13.8	70.2	1	1	1
Maradi	Tessaoua	Hawandawaki	Rural	77.4	12.6	39.6	1	1	1
Maradi	Tessaoua	Koona	Rural	72.5	41.5	74.4	1	2	1
Maradi	Tessaoua	Korgom	Rural	75.8	9	76.8	1	1	2
Maradi	Tessaoua	Maijirgui	Rural	66.1	14.7	90.8	1	1	2
Maradi	Tessaoua	Ourafane	Rural	69	9.7	84.3	1	1	2
Maradi	Tessaoua	Tessaoua	Urban	18.5	37.8	93.1			
Maradi	Ville de Maradi	Maradi Arrondissement 1	Urban	15.6	93.9	95			
Maradi	Ville de Maradi	Maradi Arrondissement 2	Urban	14.8	93.7	95			
Maradi	Ville de Maradi	Maradi Arrondissement 3	Urban	12.7	91.6	95.5			
Tahoua	Abalak	Abalak	Urban	18.8	16.9	51.9			

table continues next page

Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Tahoua	Abalak	Akoubounou	Rural	39.8	7.8	23.5			
Tahoua	Abalak	Azeye	Rural	38.7	3.2	33			
Tahoua	Abalak	Tabalak	Rural	39	5.6	48.6			
Tahoua	Abalak	Tamaya	Rural	38.7	19.3	54.5			
Tahoua	Bagaroua	Bagaroua	Rural	41.9	8.9	81.9			
Tahoua	Birni N'Konni	Allela	Rural	61.1	3.5	90.2	1	1	2
Tahoua	Birni N'Konni	Bazaga	Rural	56.4	14.8	89.1	1	1	2
Tahoua	Birni N'Konni	Birni N'Konni	Urban	14.6	43.1	86.5			
Tahoua	Birni N'Konni	Tsernaoua	Rural	55.2	13.9	68.8	1	1	1
Tahoua	Bouza	Allakaye	Rural	39.6	6.8	53.1			
Tahoua	Bouza	Babankatami	Rural	40.9	6.5	82.9			
Tahoua	Bouza	Bouza	Urban	16.8	18.6	81.2			
Tahoua	Bouza	Deoule	Rural	38.2	6.9	84.1			
Tahoua	Bouza	Karofane	Rural	40.2	11	83			
Tahoua	Bouza	Tabotaki	Rural	37.7	5.8	74			
Tahoua	Bouza	Tama	Rural	38.8	7.7	82			
Tahoua	Illela	Badaguichiri	Rural	37.2	13.1	44.9			
Tahoua	Illela	Illela	Urban	16.1	16.2	77.4			
Tahoua	Illela	Tajae	Rural	37.4	6.6	50			
Tahoua	Keita	Garhanga	Rural	39.2	9.2	78.2			
Tahoua	Keita	Ibohamane	Rural	39.9	9.3	67.9			
Tahoua	Keita	Keita	Urban	18	12	74			
Tahoua	Keita	Tamaske	Rural	40.8	13.6	77.5			
Tahoua	Madaoua	Azarori	Rural	54.8	9.6	77.2	1	1	2
Tahoua	Madaoua	Bangui	Rural	61.7	18.3	78.5	1	1	2
Tahoua	Madaoua	Galma Koudawatche	Rural	61.1	16.5	77.3	1	1	2
Tahoua	Madaoua	Madaoua	Urban	16.4	21.4	80.6			
Tahoua	Madaoua	Ourno	Rural	61.8	6.8	65.9	1	1	1
Tahoua	Madaoua	Sabon Guida	Rural	61.1	6.6	82.9	1	1	2
Tahoua	Malbaza	Doguerawa	Rural	53.1	14.7	74.7	1	1	2
Tahoua	Malbaza	Malbaza	Rural	53.3	8.7	39.8	1	1	1
Tahoua	Tahoua	Affala	Rural	39.1	7.9	53.8			
Tahoua	Tahoua	Bambeye	Rural	38.8	9.2	64.6			
Tahoua	Tahoua	Barmou	Rural	36.7	8.1	88.9			
Tahoua	Tahoua	Kalfou	Rural	38.4	10.8	60.4			
Tahoua	Tahoua	Takanamat	Rural	39.4	4.2	47.9			
Tahoua	Tahoua	Tebaram	Rural	42	12.4	72			

table continues next page

Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Tahoua	Tassara	Tassara	Rural	36.1	20.4	64.7			
Tahoua	Tchintabaraden	Kao	Rural	38.3	6.2	52.3			
Tahoua	Tchintabaraden	Tchintabaraden	Urban	17.7	11.9	46.3			
Tahoua	Tillia	Tillia	Rural	36.1	19.2	27.3			
Tahoua	Ville de Tahoua	Tahoua Arrondissement 1	Urban	12.5	69.8	78.1			
Tahoua	Ville de Tahoua	Tahoua Arrondissement 2	Urban	15	72.8	90.6			
Tillaberi	Abala	Abala	Rural	52	8	82.3			
Tillaberi	Abala	Sanam	Rural	49.7	10.4	81.3			
Tillaberi	Ayerou	Ayerou	Rural	47.5	32.1	19.9			
Tillaberi	Ayerou	Inates	Rural	51.6	12.6	21.6			
Tillaberi	Balleyara	Tagazar	Rural	52.2	17.2	79.5			
Tillaberi	Banibangou	Banibangou	Rural	54.8	16.2	70.2	1	1	1
Tillaberi	Bankilare	Bankilare	Rural	53.1	11.9	43.1	1	1	1
Tillaberi	Filingue	Filingue	Urban	17.5	16.1	93.3			
Tillaberi	Filingue	Imanan	Rural	52	4.8	88.8			
Tillaberi	Filingue	Kourfeye Centre	Rural	52	6.6	80.9			
Tillaberi	Filingue	Tondikandia	Rural	51.5	6.3	83.7			
Tillaberi	Gotheye	Dargol	Rural	50.2	13.4	50.1			
Tillaberi	Gotheye	Gotheye	Rural	46.9	22.1	56.3			
Tillaberi	Kollo	Bitinkodji	Rural	53.8	11.5	64.9	1	1	1
Tillaberi	Kollo	Diantchandou	Rural	33.6	7.7	85.7			
Tillaberi	Kollo	Hamdallaye	Rural	52.7	12.3	82.2	1	1	2
Tillaberi	Kollo	Karma	Rural	53.1	21.2	70.6	1	1	1
Tillaberi	Kollo	Kirtachi	Rural	50	20.4	61.2			
Tillaberi	Kollo	Kollo	Urban	18.8	21	82.1			
Tillaberi	Kollo	Koure	Rural	52.7	11.8	87.3	1	1	2
Tillaberi	Kollo	Libore	Rural	44.7	29	72.8			
Tillaberi	Kollo	Namaro	Rural	32	21.7	58.7			
Tillaberi	Kollo	N'Dounga	Rural	44	19.9	81.9			
Tillaberi	Kollo	Youri	Rural	55.3	9.7	75.4	1	1	2
Tillaberi	Ouallam	Dingazi	Rural	53.6	12.3	91.7	1	1	2
Tillaberi	Ouallam	Ouallam	Urban	27.3	8.3	86			
Tillaberi	Ouallam	Simiri	Rural	57.8	4.7	81	1	1	2
Tillaberi	Ouallam	Tondikiwindi	Rural	55.1	5.5	82.7	1	1	2
Tillaberi	Say	Ouro Gueladjo	Rural	38.9	20.8	70			

table continues next page

Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Tillaberi	Say	Say	Rural	49.9	18.4	63.9			
Tillaberi	Say	Tamou	Rural	56.6	10.9	44.5	1	1	1
Tillaberi	Tera	Diagourou	Rural	33.9	8.7	43.8			
Tillaberi	Tera	Gorouol	Rural	47.1	10.5	71.5			
Tillaberi	Tera	Kokorou	Rural	52.6	17.7	41.8	1	1	1
Tillaberi	Tera	Mehana	Rural	48.4	29.5	32.9			
Tillaberi	Tera	Tera	Rural	43.2	29.5	71.5			
Tillaberi	Tillaberi	Anzourou	Rural	42.1	19.9	81.4			
Tillaberi	Tillaberi	Bibiyergou	Rural	37.7	41.9	77.8			
Tillaberi	Tillaberi	Dessa	Rural	45.7	30.7	46.7			
Tillaberi	Tillaberi	Kourteye	Rural	47	26.9	38.3			
Tillaberi	Tillaberi	Sakoira	Rural	43.4	33.1	63			
Tillaberi	Tillaberi	Sinder	Rural	44.3	50.9	36.1			
Tillaberi	Tillaberi	Tillaberi	Urban	15.5	41.9	75.4			
Tillaberi	Torodi	Makalondi	Rural	33.3	15.5	64.7			
Tillaberi	Torodi	Torodi	Rural	38	18	57.3			
Zinder	Belbedji	Tarka	Rural	44.4	5	45.6			
Zinder	Damagaram Takaya	Albarkaram	Rural	58.8	13.5	71.7	1	1	1
Zinder	Damagaram Takaya	Damagaram Takaya	Rural	54.1	5.3	71.2	1	1	1
Zinder	Damagaram Takaya	Guidimouni	Rural	58	8.3	68	1	1	1
Zinder	Damagaram Takaya	Mazamni	Rural	55.4	7.2	63.5	1	1	1
Zinder	Damagaram Takaya	Moa	Rural	55	7.8	80.9	1	1	2
Zinder	Damagaram Takaya	Wame	Rural	60.3	7.4	79.3	1	1	2
Zinder	Dungass	Dogo-Dogo	Rural	77.3	12.6	79.8	1	1	2
Zinder	Dungass	Dungass	Rural	73.5	14.2	76.2	1	1	2
Zinder	Dungass	Gouchi	Rural	60.2	5	66.8	1	1	1
Zinder	Dungass	Malawa	Rural	76	7.2	76.7	1	1	2
Zinder	Goure	Alakoss	Rural	35.2	3	79			
Zinder	Goure	Boune	Rural	37	4.6	68.3			
Zinder	Goure	Gamou	Rural	37.1	19.5	95.2			
Zinder	Goure	Goure	Rural	37.8	14.8	54.2			
Zinder	Goure	Guidiguir	Rural	36.6	8	68			

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Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Zinder	Goure	Kelle	Rural	35.2	5.9	56.8			
Zinder	Kantche	Dan Barto	Rural	69	27.6	40.6	1	2	1
Zinder	Kantche	Daouche	Rural	70.3	18.5	63.7	1	1	1
Zinder	Kantche	Doungou	Rural	70	14.5	48.7	1	1	1
Zinder	Kantche	Ichirnawa	Rural	70.6	8.7	31.5	1	1	1
Zinder	Kantche	Kantche	Rural	71.5	20.9	60.9	1	1	1
Zinder	Kantche	Kourni	Rural	70.6	26.1	33.3	1	2	1
Zinder	Kantche	Matamey	Urban	14.4	30.6	68.2			
Zinder	Kantche	Tsaouni	Rural	71.5	17.8	34.9	1	1	1
Zinder	Kantche	Yaouri	Rural	69.5	15.5	57.7	1	1	1
Zinder	Magaria	Bande	Rural	70.2	9.9	59.9	1	1	1
Zinder	Magaria	Dantchiao	Rural	73.1	5.9	67.6	1	1	1
Zinder	Magaria	Kwaya	Rural	73.7	15.7	39.4	1	1	1
Zinder	Magaria	Magaria	Urban	18.2	20.3	73.9			
Zinder	Magaria	Sassoumbroum	Rural	74.2	20	30.9	1	1	1
Zinder	Magaria	Wacha	Rural	60.2	7.2	76.6	1	1	2
Zinder	Magaria	Yekoua	Rural	72.1	19.3	56.2	1	1	1
Zinder	Mirriah	Dogo	Rural	55.3	11.9	56	1	1	1
Zinder	Mirriah	Droum	Rural	55.5	7.4	58	1	1	1
Zinder	Mirriah	Gaffati	Rural	59.3	23.9	75	1	2	2
Zinder	Mirriah	Gouna	Rural	53.2	14.3	78.9	1	1	2
Zinder	Mirriah	Hamdara	Rural	57.7	9.9	73.7	1	1	1
Zinder	Mirriah	Kolleram	Rural	52.7	25.6	79.6	1	2	2
Zinder	Mirriah	Mirriah	Rural	54.2	34.7	85.1	1	2	2
Zinder	Mirriah	Zermou	Rural	58.2	15.8	86.2	1	1	2
Zinder	Takeita	Dakoussa	Rural	59.7	11.2	77.3	1	1	2
Zinder	Takeita	Garagoumsa	Rural	64.4	12.7	63.2	1	1	1
Zinder	Takeita	Tirmini	Rural	59.1	8.1	68.4	1	1	1
Zinder	Tanout	Falenko	Rural	43.7	2.1	46.2			
Zinder	Tanout	Gangara (Tanout)	Rural	39.5	4	50.2			
Zinder	Tanout	Ollelewa	Rural	39.7	8.6	68.5			
Zinder	Tanout	Tanout	Rural	37.8	9.4	64.9			
Zinder	Tanout	Tenhya	Rural	36.2	1.5	35.1			
Zinder	Tesker	Tesker	Rural	36.1	9.5	62.2			
Zinder	Ville de Zinder	Zinder Arrondissement 1	Urban	12.8	79.1	93.8			

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Table S.3: Continued

Region	Department	Commune	Area	p0	i21_ toilet	i22_ water	Bottom 100	i21c	i22c
Zinder	Ville de Zinder	Zinder Arrondissement 2	Urban	15	79.9	89.7			
Zinder	Ville de Zinder	Zinder Arrondissement 3	Urban	11.5	85	94.6			
Zinder	Ville de Zinder	Zinder Arrondissement 4	Urban	12.5	70	85.4			
Zinder	Ville de Zinder	Zinder Arrondissement 5	Rural	53.3	17	85.5	1	1	2
Niamey	Ville de Niamey	Niamey Arrondissement 1	Urban	5.7	85.4	93.4			
Niamey	Ville de Niamey	Niamey Arrondissement 2	Urban	9.3	89.6	95.4			
Niamey	Ville de Niamey	Niamey Arrondissement 3	Urban	7.1	93.1	95.2			
Niamey	Ville de Niamey	Niamey Arrondissement 4	Urban	9.2	86.8	92.9			
Niamey	Ville de Niamey	Niamey Arrondissement 5	Urban	16.5	74.3	85.8			

Source: Niger Povery Map (2016).
Note: The poorest commune indicator is in the "bottom 100" column. "Sanitation" column is ranked as 1 if in poorest 100 and sanitation NOT above national average, 2 if in poorest 100 and sanitation above national average; "water" column is ranked in the same way. p0 = poverty incidence; i21_ toilet = access to improved sanitation; i22_ water = access to improved water; Bottom 100 = commune is part of 100 poorest communes in Niger; i21c and i22c = 1 if in poorest 100 and sanitation NOT above national average, 2 if in poorest 100 and sanitation above national average and water (same).

Note

1. This note was prepared by Harold Coulombe (Consultant) as part of the preparation for the new Niger poverty map.

Appendix T
Oaxaca Decomposition of Child Nutritional Outcomes in Niger and Mali, 2006 and 2012

Table T.1: Oaxaca Decomposition of Child Nutritional Outcomes in Niger and Mali, 2006 and 2012

	Outcome: HAZ			
	Mali 2006	Mali 2012	Niger 2006	Niger 2012
Unimproved water	−1.54	−1.68	−2.06	−1.60
Improved water	−1.30	−1.27	−1.94	−1.66
GAP	**−0.24**	**−0.40**	**−0.12**	**0.06**
overall: explained	−0.17	−0.20	−0.23	0.00
explained: age in months	0.01	−0.01	0.01	0.01
explained: female	0.00	0.00	0.00	0.00
explained: mother's age	0.00	0.00	0.00	0.00
explained: mother's literacy	−0.01	0.00	−0.04	−0.01
explained: # of children	0.01	0.00	0.00	0.00
explained: rural	**−0.07**	**−0.13**	**−0.10**	**−0.06**
explained: region	−0.02	−0.07	−0.07	0.06
explained: wealth category	−0.09	0.00	−0.02	0.00
Unimproved sanitation	−1.50	−1.42	−2.05	−1.65
Improved sanitation	−1.03	−1.42	−1.56	−1.37
GAP	**−0.47**	**0.00**	**−0.50**	**−0.28**
overall: explained	−0.36	−0.16	−0.52	−0.22
explained: age in months	0.01	0.04	0.01	0.01
explained: female	0.00	0.00	0.01	0.00
explained: mother's age	0.00	0.01	0.00	−0.01
explained: mother's literacy	−0.02	−0.02	−0.09	−0.07
explained: # of children	0.01	0.00	0.00	0.00
explained: rural	**−0.12**	**−0.11**	**−0.29**	**0.00**
explained: region	−0.08	0.00	−0.05	−0.09
explained: wealth category	−0.15	−0.08	−0.11	−0.05

Sources: World Bank calculation based on DHS 2006 and 2012.
Note: Bolded values represent most relevant results. HAZ = height-for-age z-scores.

Appendix U
Shapley Decomposition of Height-for-Age and Weight-for-Age Scores in Niger

Table U.1: Shapley Decomposition of HAZ and WAZ in Niger, by Factor

		Child age			Child age	
Factor	Full sample	<24 months	24–60 months	Full sample	<24 months	24–60 months
HAZ						
Child	14.53	17.19	63.90	12.19	11.61	48.74
Mother	14.73	18.02	4.90	10.58	14.99	4.50
Head of household	29.67	28.79	9.80	22.10	25.85	8.37
Demography	0.57	1.49	0.68	0.57	1.40	0.51
Wealth	6.79	4.32	5.14	3.94	3.18	3.66
Sanitation	**17.79**	**17.20**	**7.34**	**13.42**	**15.60**	**6.48**
Community sanitation	**13.28**	**10.54**	**7.22**	**10.08**	**9.30**	**7.00**
Water access	2.63	2.44	1.02	1.97	2.21	0.87
Climate shocks				2.59	3.44	1.86
Disease environment				22.55	12.42	18.03
WAZ						
Child	6.97	7.26	30.22	5.53	5.88	24.45
Mother	16.73	17.65	19.15	13.07	13.66	17.69
Head of household	29.96	32.56	17.05	27.02	30.69	16.00
Demography	1.22	1.78	0.53	1.18	1.95	0.46
Wealth	5.56	4.01	5.58	4.14	3.02	4.72
Sanitation	**19.58**	**18.46**	**13.24**	**16.87**	**15.55**	**13.05**
Community sanitation	**14.80**	**13.46**	**10.28**	**13.61**	**12.33**	**10.28**
Water access	5.18	4.45	3.95	4.31	3.82	3.39
Climate shocks				1.70	2.48	3.47
Disease environment				12.59	10.62	6.49

Sources: World Bank calculation based on Niger LSMS 2011, LSMS 2014, and AFDM 2014.
Note: HAZ = height-for-age z-scores; WAZ = weight-for-age z-scores.

To overcome the issue of missing values and keep as many observations as possible, the following approach was followed for breastfeeding, dietary diversity, and reports of diarrhea incidence:

- For children without vaccination book, specific ***vaccines dummies*** were put with value zero
- For breastfeeding, the following variables were created
    - the variable ***breastfedupto6*** taking value 1 if the child was breastfed at least up to six months, and zero otherwise
    - the variable ***breastmiss*** taking value 1 if the child was missing this information
- For diarrhea incidence the variable ***diarrheeenfant_m*** was created, replacing missing values with zeros. This results in 11 percent children reported having suffered diarrhea in the last *two months*. Comparison with DHS 2012 data asking for the same question but with a recall period of *two weeks* reveals that LSMS percentage of the newly created variable is likely to underestimate the incidence of diarrhea. Therefore, we discard available information on diarrhea incidence.

Appendix V
Determinants of Malnutrition in Niger, 2006 and 2012

Table V.1: Determinants of Malnutrition in Niger, 2006 and 2012

	2006	2012	2006	2012	2006	2012	2006	2012
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
Improved water	0.494*	0.328	0.307	0.0826	−0.974***	−0.152	−0.526	−0.543**
	(0.290)	(0.235)	(0.297)	(0.201)	(0.250)	(0.359)	(0.449)	(0.269)
Open def	0.523**	0.506**	0.416*	0.429**	−0.710**	−0.179	−0.0572	−0.334
	(0.253)	(0.213)	(0.248)	(0.182)	(0.288)	(0.328)	(0.312)	(0.238)
inter_ODwat	−0.337	−0.258	−0.0302	−0.110	1.092***	0.130	0.422	0.382
	(0.309)	(0.256)	(0.318)	(0.226)	(0.268)	(0.377)	(0.458)	(0.280)
Age in months	0.157***	0.120***	0.118***	0.0769***	0.0384***	0.0496***	0.110***	−0.0319**
	(0.0107)	(0.00846)	(0.0108)	(0.00865)	(0.0118)	(0.0129)	(0.0136)	(0.0149)
Agesq	−0.00222***	−0.00172***	−0.00172***	−0.00118***	−0.00109***	−0.00168***	−0.00198***	−0.000115
	(0.000172)	(0.000137)	(0.000178)	(0.000146)	(0.000225)	(0.000273)	(0.000222)	(0.000211)
Female	−0.333***	−0.190***	−0.342***	−0.173**	0.0353	−0.143	−0.0298	−0.134
	(0.0926)	(0.0703)	(0.0899)	(0.0713)	(0.104)	(0.100)	(0.107)	(0.0837)
agemotherbirth	−0.0187*	−0.0134	−0.0166	−0.00619	0.0116	0.0105	−0.00488	−0.000126
	(0.0108)	(0.00880)	(0.0101)	(0.00880)	(0.0114)	(0.0132)	(0.0146)	(0.0102)
w_literacy	−0.564***	−0.529***	−0.342	−0.464***	−0.317	0.0231	−0.483**	−0.483***
	(0.211)	(0.189)	(0.213)	(0.167)	(0.233)	(0.206)	(0.221)	(0.176)
w_children	0.0109	−0.0222	0.0308	−0.0184	−0.0909***	−0.0648	0.0326	0.0117
	(0.0328)	(0.0284)	(0.0321)	(0.0281)	(0.0320)	(0.0446)	(0.0466)	(0.0334)
Rural	0.787***	0.251	0.632***	0.0933	0.298	0.136	0.216	0.375*
	(0.192)	(0.158)	(0.213)	(0.164)	(0.223)	(0.260)	(0.238)	(0.203)
_Icatwealth_2	0.0497	−0.0673	0.0199	−0.0567	−0.264*	0.140	−0.0409	0.314**
	(0.160)	(0.116)	(0.163)	(0.118)	(0.155)	(0.177)	(0.214)	(0.136)
_Icatwealth_3	−0.0554	−0.0657	0.0439	−0.162	−0.0561	−0.0150	−0.0863	0.00728
	(0.115)	(0.109)	(0.115)	(0.107)	(0.140)	(0.151)	(0.154)	(0.137)
_Icatwealth_4	0.244	−0.0370	0.240	−0.274**	−0.551**	0.0196	−0.0616	−0.284**
	(0.176)	(0.133)	(0.172)	(0.124)	(0.222)	(0.183)	(0.191)	(0.143)

table continues next page

Table V.1: Continued

	2006	2012	2006	2012	2006	2012	2006	2012
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
_lcatwealth_5	−0.129	−0.173	−0.136	−0.271*	−0.163	−0.108	0.109	0.0858
	(0.185)	(0.164)	(0.190)	(0.146)	(0.295)	(0.206)	(0.208)	(0.178)
Constant	−2.412***	−1.984***	−1.594***	−0.695*	−0.711	−1.417**	0.973*	2.784***
	(0.431)	(0.384)	(0.425)	(0.357)	(0.510)	(0.556)	(0.537)	(0.506)
Observations	3,480	4,664	3,418	4,489	3,897	4,345	3,511	4,329

Source: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls for the different regions are also added but not reported here. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix W
Determinants of Malnutrition in Mali, 2006 and 2012

Table W.1: Determinants of Malnutrition in Mali, 2006 and 2012

	2006	2012	2006	2012	2006	2012	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
impwater	−0.0561	−0.234**	0.00615	−0.247**	−0.0582	0.331*	−0.186	−0.388***
	(0.0572)	(0.0997)	(0.0592)	(0.100)	(0.0855)	(0.169)	(0.126)	(0.134)
impsanit	−0.256*	0.0651	−0.161	−0.0405	−0.0464	−0.324	−0.193	−0.312**
	(0.145)	(0.150)	(0.143)	(0.135)	(0.0980)	(0.274)	(0.135)	(0.156)
c_agemonths	0.133***	0.124***	0.0705***	0.0802***	0.0804***	0.0321**	0.0871***	−0.00658
	(0.00715)	(0.0115)	(0.00639)	(0.00986)	(0.0115)	(0.0139)	(0.0136)	(0.0153)
Agesq	−0.00195***	−0.00168***	−0.00114***	−0.00113***	−0.00185***	−0.000868***	−0.00153***	−0.000367*
	(0.000116)	(0.000177)	(0.000109)	(0.000155)	(0.000219)	(0.000246)	(0.000236)	(0.000214)
Female	−0.195***	−0.143*	−0.186***	−0.112	−0.0128	−0.206*	0.0601	−0.147
	(0.0516)	(0.0764)	(0.0543)	(0.0775)	(0.0636)	(0.107)	(0.134)	(0.0957)
c_ agemotherbirth	0.000584	−0.0166**	0.00337	−0.0102	0.0101	0.00769	−0.00183	−0.0201**
	(0.00597)	(0.00781)	(0.00582)	(0.00798)	(0.00652)	(0.0129)	(0.0179)	(0.0101)
w_literacy	−0.346***	−0.328**	−0.404***	−0.460***	0.00106	0.240	0.0319	−0.311**
	(0.129)	(0.162)	(0.120)	(0.153)	(0.150)	(0.252)	(0.263)	(0.136)
w_children	−0.0199	0.00403	−0.0340*	−0.0180	−0.0781***	−0.0619	−0.00679	0.0604*
	(0.0200)	(0.0279)	(0.0192)	(0.0270)	(0.0235)	(0.0471)	(0.0404)	(0.0348)
Rural	0.400***	0.525***	0.369***	0.344*	0.346**	0.832***	0.315*	0.606***
	(0.0855)	(0.184)	(0.0787)	(0.177)	(0.152)	(0.298)	(0.191)	(0.206)
_Icatwealth_2	−0.0612	0.192	−0.0501	0.0579	0.314***	−0.0183	−0.169	0.725***
	(0.0771)	(0.236)	(0.0753)	(0.216)	(0.109)	(0.328)	(0.160)	(0.172)
_Icatwealth_3	−0.0143	0.284	−0.0343	0.228	0.220*	−0.0965	−0.256	0.850***
	(0.0758)	(0.239)	(0.0760)	(0.217)	(0.122)	(0.350)	(0.175)	(0.214)
_Icatwealth_4	−0.118	0.368	−0.0479	0.292	0.377***	−0.0139	−0.537***	0.845***
	(0.0794)	(0.248)	(0.0774)	(0.231)	(0.125)	(0.365)	(0.196)	(0.233)

table continues next page

Table W.1: Continued

	2006	2012	2006	2012	2006	2012	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
_lcatwealth_5	−0.278**	0.454*	−0.263**	0.419*	0.0641	−0.364	−0.888***	0.825***
	(0.116)	(0.256)	(0.133)	(0.238)	(0.177)	(0.357)	(0.290)	(0.253)
Constant	−2.400***	−2.376***	−0.896***	−1.150***	−2.844***	−2.271***	1.256***	2.418***
	(0.223)	(0.348)	(0.202)	(0.310)	(0.256)	(0.478)	(0.431)	(0.400)
Observations	10,187	3,907	9,790	3,795	11,384	4,494	3,593	3,880

Source: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls for the different regions are also added but not reported here.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix X
Determinants of Malnutrition in Niger—Access to Piped Water, 2006–12

Table X.1: Determinants of Malnutrition in Niger and Connection to Access to Piped Water, 2006–12

	2006	2012	2006	2012	2006	2012	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
impwpiped	−0.360**	0.0286	−0.487***	0.0222	−0.0588	0.141	−0.295	−0.0666
	(0.174)	(0.111)	(0.172)	(0.106)	(0.213)	(0.165)	(0.202)	(0.144)
opendef	0.281	0.303**	0.326*	0.352***	−0.165	−0.0647	0.224	−0.0263
	(0.171)	(0.124)	(0.172)	(0.125)	(0.289)	(0.184)	(0.191)	(0.129)
c_agemonths	0.156***	0.120***	0.118***	0.0769***	0.0396***	0.0496***	0.110***	−0.0320**
	(0.0106)	(0.00848)	(0.0107)	(0.00865)	(0.0117)	(0.0131)	(0.0136)	(0.0148)
agesq	−0.00221***	−0.00172***	−0.00172***	−0.00118***	−0.00110***	−0.00168***	−0.00197***	−0.000115
	(0.000170)	(0.000137)	(0.000176)	(0.000146)	(0.000224)	(0.000276)	(0.000221)	(0.000210)
female	−0.330***	−0.190***	−0.340***	−0.173**	0.0387	−0.141	−0.0339	−0.131
	(0.0939)	(0.0701)	(0.0908)	(0.0714)	(0.103)	(0.101)	(0.107)	(0.0832)
c_agemotherbirth	−0.0182*	−0.0127	−0.0160	−0.00605	0.0121	0.0101	−0.00377	−0.000884
	(0.0108)	(0.00874)	(0.0102)	(0.00879)	(0.0111)	(0.0131)	(0.0148)	(0.0102)
w_literacy	−0.499**	−0.521***	−0.279	−0.466***	−0.395	0.0106	−0.485**	−0.494***
	(0.211)	(0.189)	(0.215)	(0.168)	(0.250)	(0.206)	(0.219)	(0.173)
w_children	0.0108	−0.0243	0.0298	−0.0186	−0.0929***	−0.0630	0.0288	0.0141
	(0.0329)	(0.0283)	(0.0322)	(0.0281)	(0.0320)	(0.0442)	(0.0468)	(0.0333)
rural	0.516***	0.212	0.364*	0.0973	0.612***	0.248	0.298	0.431*
	(0.182)	(0.161)	(0.206)	(0.168)	(0.236)	(0.267)	(0.199)	(0.220)
_Icatwealth_2	0.0440	−0.0544	0.0257	−0.0562	−0.241	0.131	−0.0374	0.288**
	(0.158)	(0.116)	(0.163)	(0.117)	(0.158)	(0.178)	(0.215)	(0.135)
_Icatwealth_3	−0.0563	−0.0626	0.0412	−0.165	−0.0589	−0.0227	−0.0950	−0.00160
	(0.115)	(0.110)	(0.114)	(0.108)	(0.142)	(0.152)	(0.154)	(0.136)
_Icatwealth_4	0.255	−0.0288	0.264	−0.275**	−0.519**	−0.00241	−0.0719	−0.301**
	(0.174)	(0.132)	(0.173)	(0.123)	(0.223)	(0.183)	(0.197)	(0.143)

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Table X.1: Continued

	2006	2012	2006	2012	2006	2012	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
_Icatwealth_5	−0.0655	−0.153	−0.0493	−0.269*	−0.152	−0.148	0.155	0.0540
	(0.197)	(0.163)	(0.205)	(0.146)	(0.295)	(0.203)	(0.216)	(0.178)
Constant	−1.871***	−1.737***	−1.176***	−0.640*	−1.531***	−1.646***	0.573	2.375***
	(0.320)	(0.369)	(0.311)	(0.343)	(0.436)	(0.486)	(0.434)	(0.478)
Observations	3,480	4,664	3,418	4,489	3,897	4,345	3,511	4,329

Source: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls for the different regions are also added but not reported here. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix Y
Determinants of Malnutrition in Niger—Piped Water on Premises, 2006 and 2012

Table Y.1: Determinants of Malnutrition in Niger—Piped Access on Premise, 2006 and 2012

	2006	2012	2006	2012	2006	2012	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
impwpipdw	−0.275	0.302	−0.401**	−0.0607	0.0918	−0.121	−0.260	−0.102
	(0.181)	(0.367)	(0.178)	(0.338)	(0.211)	(0.406)	(0.194)	(0.223)
opendef	0.290*	0.301**	0.338**	0.349***	−0.161	−0.0846	0.230	−0.0185
	(0.171)	(0.121)	(0.172)	(0.125)	(0.292)	(0.180)	(0.190)	(0.131)
c_agemonths	0.157***	0.120***	0.119***	0.0768***	0.0396***	0.0496***	0.110***	−0.0321**
	(0.0106)	(0.00848)	(0.0107)	(0.00866)	(0.0117)	(0.0131)	(0.0136)	(0.0148)
agesq	−0.00221***	−0.00173***	−0.00173***	−0.00118***	−0.00110***	−0.00168***	−0.00197***	−0.000113
	(0.000171)	(0.000137)	(0.000176)	(0.000146)	(0.000224)	(0.000277)	(0.000221)	(0.000210)
female	−0.329***	−0.191***	−0.339***	−0.173**	0.0396	−0.142	−0.0350	−0.130
	(0.0938)	(0.0701)	(0.0908)	(0.0714)	(0.103)	(0.101)	(0.107)	(0.0834)
c_agemotherbirth	−0.0184*	−0.0130	−0.0162	−0.00600	0.0119	0.0102	−0.00381	−0.000734
	(0.0108)	(0.00874)	(0.0101)	(0.00878)	(0.0111)	(0.0131)	(0.0148)	(0.0102)
w_literacy	−0.513**	−0.535***	−0.299	−0.461***	−0.415*	0.0251	−0.494**	−0.493***
	(0.209)	(0.184)	(0.214)	(0.166)	(0.246)	(0.209)	(0.218)	(0.175)
w_children	0.0111	−0.0236	0.0305	−0.0187	−0.0926***	−0.0635	0.0289	0.0137
	(0.0329)	(0.0284)	(0.0321)	(0.0282)	(0.0320)	(0.0440)	(0.0467)	(0.0333)
rural	0.554***	0.222	0.413**	0.0795	0.642***	0.155	0.329*	0.462**
	(0.183)	(0.158)	(0.203)	(0.158)	(0.237)	(0.242)	(0.190)	(0.197)
_Icatwealth_2	0.0428	−0.0523	0.0238	−0.0558	−0.241	0.135	−0.0392	0.285**
	(0.158)	(0.117)	(0.163)	(0.117)	(0.158)	(0.180)	(0.214)	(0.137)
_Icatwealth_3	−0.0549	−0.0594	0.0432	−0.164	−0.0576	−0.0144	−0.0942	−0.00503
	(0.115)	(0.110)	(0.114)	(0.108)	(0.142)	(0.152)	(0.154)	(0.137)
_Icatwealth_4	0.256	−0.0298	0.263	−0.272**	−0.518**	0.0143	−0.0760	−0.306**
	(0.174)	(0.132)	(0.173)	(0.123)	(0.223)	(0.187)	(0.197)	(0.145)

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Table Y.1: Continued

	2006	2012	2006	2012	2006	2012	2006	2012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	c_stunting	c_stunting	ciaf	ciaf	diarrhea	diarrhea	c_anemia	c_anemia
_lcatwealth_5	−0.0860	−0.165	−0.0746	−0.260*	−0.169	−0.112	0.142	0.0475
	(0.195)	(0.164)	(0.203)	(0.144)	(0.293)	(0.205)	(0.214)	(0.182)
Constant	−1.910***	−1.735***	−1.223***	−0.619*	−1.566***	−1.535***	0.542	2.329***
	(0.321)	(0.358)	(0.312)	(0.337)	(0.437)	(0.456)	(0.430)	(0.449)
Observations	3,480	4,664	3,418	4,489	3,897	4,345	3,511	4,329

Source: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls for the different regions are also added but not reported here. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix Z
Water Treatment and Nutritional Outcomes in Niger, 2012

Table Z.1: Water Treatment and Nutritional Outcomes in Niger, 2012

	(1)	(2)	(3)
VARIABLES	stunting	diarrhea	anemia
Treat water	−0.291**	−0.290*	−0.438***
	(0.122)	(0.154)	(0.114)
agemonths	0.0198***	−0.0326***	−0.0398***
	(0.00224)	(0.00275)	(0.00283)
female	−0.181***	−0.138	−0.126
	(0.0691)	(0.1000)	(0.0834)
Agemotherbirth	−0.00888	0.0122	−0.000220
	(0.00849)	(0.0129)	(0.0104)
w_literacy	−0.504***	0.0324	−0.517***
	(0.185)	(0.211)	(0.178)
w_children	−0.0391	−0.0769*	0.0107
	(0.0276)	(0.0435)	(0.0337)
rural	0.354***	0.138	0.516***
	(0.134)	(0.215)	(0.175)
_Icatwealth_2	−0.0362	0.157	0.276**
	(0.110)	(0.174)	(0.134)
_Icatwealth_3	−0.0914	−0.00352	0.0141
	(0.104)	(0.155)	(0.140)
_Icatwealth_4	−0.0715	0.0252	−0.323**
	(0.122)	(0.182)	(0.145)
_Icatwealth_5	−0.262*	−0.109	0.0263
	(0.149)	(0.195)	(0.183)
Constant	−0.608**	−0.964**	2.407***
	(0.302)	(0.446)	(0.393)
Observations	4,662	4,343	4,327

Source: DHS 2012.
Note: Robust standard errors in parentheses. Controls for the different regions are also added but not reported here. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Reference

DHS (Demographic and Health Surveys). 2012. Niger: Standard DHS, 2012 (database). Rockville, MD. http://dhsprogram.com/what-we-do/survey/survey-display-407.cfm#sthash.7UChnBM9.dpuf.

Appendix AA
Climatic Variation and Anthropometric Failures in Niger and Mali, 2006 and 2012

Table AA.1: Climatic Variation and Anthropometric Failures in Niger and Mali, 2006 and 2012

Niger	2006	2012	2006	2012	2006	2012	2006	2012
VARIABLES	(1) stunting	(2) stunting	(3) wasting	(4) wasting	(5) underweight	(6) underweight	(7) ciaf	(8) ciaf
SPI12	0.0250***	0.00986	0.0240**	0.0165**	0.0157*	0.0138**	0.0239***	0.0134**
	(0.00854)	(0.00611)	(0.0108)	(0.00716)	(0.00891)	(0.00584)	(0.00860)	(0.00587)
SPI6	0.0132	0.0150**	0.0117	0.0269***	0.00197	0.0245***	0.0125	0.0175***
	(0.00906)	(0.00634)	(0.0117)	(0.00737)	(0.00896)	(0.00631)	(0.00846)	(0.00648)
SPI3	0.00985	0.0225***	0.00358	0.0354***	0.00135	0.0267***	0.00872	0.0213***
	(0.0107)	(0.00846)	(0.0153)	(0.00961)	(0.0108)	(0.00843)	(0.00989)	(0.00825)
Observations	3,481	4,664	3,655	4,812	3,740	5,029	3,419	4,489

	2006	2012	2006	2012	2006	2012	2006	2012
VARIABLES	(1) stunting	(2) stunting	(3) wasting	(4) wasting	(5) underweight	(6) underweight	(7) ciaf	(8) ciaf
sp12_sum	0.00581	–0.00281	0.00969**	0.0201**	0.00395	0.00307	0.00585	0.00408
	(0.00430)	(0.00785)	(0.00487)	(0.00923)	(0.00497)	(0.00767)	(0.00462)	(0.00706)
spi6_sum	0.00311	0.00666	0.0185***	0.0179	0.00848	0.0108	0.00941*	0.0110
	(0.00503)	(0.00940)	(0.00618)	(0.0110)	(0.00547)	(0.00845)	(0.00572)	(0.00837)
spi3_sum	0.00534	0.0119	0.0327***	0.00842	0.0157**	0.0105	0.0156**	0.0133
	(0.00580)	(0.0112)	(0.00729)	(0.0149)	(0.00653)	(0.0106)	(0.00626)	(0.00993)
Observations	10,214	3,907	10,548	4,060	10,969	4,248	9,817	3,795

Source: DHS 2006 and 2012.
Note: Robust standard errors in parentheses Controls include age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix BB
Access to WASH and Droughts, 2011 and 2014

Table BB.1: Access to WASH and droughts in Niger, 2011 and 2014

	Sanitation						Water	
	Share OD 2014				Share improved sanit. 2014	Share other unimproved sanit. 2014	Improved water	Improved water
Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought (# months)	0.063***	0.013***	0.011**	0.010**	0.004	–0.014**	0.024*	0.026**
	(0.012)	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)	(0.013)	(0.012)
share OD 2011		0.958***	0.653***	0.585***	–0.324***	–0.265***		
		(0.015)	(0.085)	(0.090)	(0.070)	(0.086)		
Improved water 2011							0.439***	0.438***
							(0.056)	(0.056)
Urban			–0.298***	–0.238***	0.117	0.120	–0.039	–0.032
			(0.076)	(0.080)	(0.077)	(0.088)	(0.097)	(0.097)
Ln population size				–0.001	–0.030	0.031	–0.029	–0.031
				(0.011)	(0.032)	(0.032)	(0.024)	(0.024)
Wealth index				–0.004	0.018	–0.014	0.001	0.002
				(0.008)	(0.018)	(0.019)	(0.018)	(0.019)
Dist. to road (in km)				0.014*	–0.007	–0.006	–0.035***	–0.034***
				(0.007)	(0.012)	(0.014)	(0.012)	(0.011)
Dist. to city>20,000 inh. (in km)				0.033***	0.011	–0.044**	0.014	0.015
				(0.012)	(0.022)	(0.019)	(0.019)	(0.019)
Dist. to market (in km)				–0.007	0.014	–0.007	–0.015	–0.019
				(0.011)	(0.019)	(0.018)	(0.020)	(0.019)
Dist. to border (in km)				0.014	0.001	–0.015	–0.023	–0.023
				(0.016)	(0.022)	(0.021)	(0.026)	(0.026)
Dist. to Reg. capital (in km)				–0.011	–0.011	0.022	0.006	0.003
				(0.008)	(0.020)	(0.020)	(0.014)	(0.014)

table continues next page

Table BB.1: Continued

	Sanitation						Water	
	Share OD 2014				Share improved sanit. 2014	Share other unimproved sanit. 2014	Improved water	Improved water
Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dist. to Dep. capital (in km)				−0.001	−0.023	0.023	−0.002	0.002
				(0.009)	(0.018)	(0.018)	(0.018)	(0.018)
Improved water 2014				−0.050*	0.034	0.017		
				(0.030)	(0.049)	(0.053)		
share OD 2014							−0.262***	−0.263***
							(0.095)	(0.095)
Change water access within 30’								0.063
								(0.070)
Constant	0.401***	−0.016	0.294***	0.182	0.204	0.612***	0.587***	0.575***
	(0.036)	(0.011)	(0.081)	(0.111)	(0.186)	(0.179)	(0.190)	(0.190)
Region dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Agoecol.zone dummy	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	268	268	268	268	268	268	268	268
R-squared	0.066	0.905	0.928	0.934	0.529	0.571	0.679	0.681

Sources: LSMS 2011, 2014.
Notes: Robust standard errors in parentheses. OD = open defecation.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix CC
Access to WASH and Floods in Niger, 2011 and 2014

Table CC.1: Access to WASH and Floods in Niger, 2011 and 2014

	Sanitation						Water	
	Share OD 2014				Share improved sanit. 2014	Share other unimproved sanit. 2014	Improved water 2014	Improved water 2014
Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Flood (# months)	0.048***	0.003	0.003	−0.000	−0.002	0.001	−0.010	−0.010
	(0.007)	(0.003)	(0.004)	(0.004)	(0.006)	(0.005)	(0.009)	(0.010)
share OD 2011		0.962***	0.651***	0.585***	−0.324***	−0.264***		
		(0.016)	(0.086)	(0.091)	(0.070)	(0.088)		
Improved water 2011							0.446***	0.445***
							(0.056)	(0.056)
Urban			−0.305***	−0.240***	0.118	0.122	−0.020	−0.015
			(0.076)	(0.081)	(0.077)	(0.089)	(0.103)	(0.103)
Ln population size				0.002	−0.030	0.027	−0.025	−0.026
				(0.011)	(0.032)	(0.031)	(0.024)	(0.024)
Wealth index				−0.004	0.018	−0.013	−0.002	−0.001
				(0.008)	(0.018)	(0.019)	(0.018)	(0.018)
Dist. to road (in km)				0.016**	−0.006	−0.009	−0.030***	−0.029***
				(0.007)	(0.012)	(0.014)	(0.011)	(0.011)
Dist. to city>20,000 inh. (in km)				0.033***	0.011	−0.044**	0.015	0.016
				(0.012)	(0.022)	(0.019)	(0.019)	(0.019)
Dist. to market (in km)				−0.008	0.014	−0.006	−0.014	−0.017
				(0.010)	(0.020)	(0.019)	(0.018)	(0.018)
Dist. to border (in km)				0.015	0.001	−0.016	−0.026	−0.026
				(0.017)	(0.022)	(0.022)	(0.026)	(0.026)
Dist. to Reg. capital (in km)				−0.011	−0.012	0.024	0.002	0.000
				(0.008)	(0.021)	(0.021)	(0.014)	(0.014)
Dist. to Dep. capital (in km)				−0.001	−0.023	0.023	−0.002	0.001
				(0.009)	(0.018)	(0.018)	(0.018)	(0.018)

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Table CC.1: Continued

	Sanitation						Water	
	Share OD 2014				Share improved sanit. 2014	Share other unimproved sanit. 2014	Improved water 2014	Improved water 2014
Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Improved water 2014				−0.043	0.036	0.008		
				(0.031)	(0.048)	(0.052)		
share OD 2014							−0.248**	−0.248**
							(0.101)	(0.101)
Change water access within 30'								0.043
								(0.069)
Constant	0.384***	−0.005	0.309***	0.195*	0.216	0.590***	0.658***	0.653***
	(0.034)	(0.011)	(0.080)	(0.115)	(0.188)	(0.183)	(0.194)	(0.194)
Region dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Agoecol.zone dummy	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	268	268	268	268	268	268	268	268
R-squared	0.117	0.903	0.927	0.933	0.528	0.567	0.674	0.675

Sources: LSMS 2011, 2014.
Notes: Robust standard errors in parentheses. OD = open defecation.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix DD
Children under 24 Months—Height for Age, WASH, and Climatic Shocks in Niger, 2014

Table DD.1: Children under 24 months—Height for Age, WASH and Climatic Shocks in Niger, 2014

VARIABLES	(1) <24 months HAZ	(2) <24 months HAZ	(3) <24 months HAZ	(4) <24 months HAZ	(5) <24 months HAZ	(6) <24 months HAZ	(7) <24 months HAZ	(8) <24 months HAZ	(9) <24 months HAZ
Drought (# months in lifetime)	−0.051	−0.055	−0.057	−0.056	−0.058	0.400*	−0.059	−0.064	−0.058
	(0.101)	(0.100)	(0.098)	(0.098)	(0.097)	(0.204)	(0.097)	(0.095)	(0.097)
Flood (# months in lifetime)	−0.038	−0.032	−0.031	−0.031	−0.030	−0.020	0.095	−0.029	−0.030
	(0.050)	(0.050)	(0.050)	(0.051)	(0.052)	(0.052)	(0.081)	(0.051)	(0.052)
Max temperature (°C, lifetime, stdz.)	−0.088	−0.094	−0.091	−0.098	−0.094	−0.104	−0.105	−0.103	−0.098
	(0.074)	(0.074)	(0.074)	(0.076)	(0.076)	(0.075)	(0.076)	(0.076)	(0.123)
Evaporation (mm/day, lifetime, stdz.)	−0.015	−0.012	−0.008	−0.010	−0.006	0.002	−0.007	−0.125	−0.006
	(0.093)	(0.093)	(0.093)	(0.094)	(0.094)	(0.093)	(0.093)	(0.152)	(0.094)
Sanitation: open defecation	−0.443	−0.437	−0.500*	−0.472	−0.532*	−0.380	−0.375	−0.599**	−0.531*
	(0.287)	(0.286)	(0.287)	(0.291)	(0.292)	(0.302)	(0.281)	(0.300)	(0.286)
Sanitation: other unimproved	−0.206	−0.194	−0.188	−0.209	−0.203	−0.221	−0.182	−0.204	−0.204
	(0.269)	(0.268)	(0.264)	(0.272)	(0.268)	(0.257)	(0.255)	(0.266)	(0.261)
Neighbors' sanitation: improved	−0.097	−0.125	0.328	−0.154	0.284	0.143	0.358	0.176	0.285
	(0.481)	(0.485)	(0.553)	(0.487)	(0.551)	(0.540)	(0.545)	(0.572)	(0.552)
Water: improved	−0.108	−0.096	−0.087	−0.093	−0.085	−0.080	−0.082	−0.085	−0.085
	(0.140)	(0.142)	(0.143)	(0.141)	(0.143)	(0.140)	(0.141)	(0.143)	(0.143)
Wealth index		0.047	0.048	0.042	0.044	0.047	0.054	0.048	0.044
		(0.061)	(0.060)	(0.061)	(0.061)	(0.061)	(0.062)	(0.062)	(0.062)
Urban household			−0.432		−0.418	−0.419	−0.398	−0.425	−0.418
			(0.307)		(0.307)	(0.288)	(0.302)	(0.302)	(0.304)
Food insecurity 1 = high				0.238	0.234	0.241	0.220	0.231	0.234
				(0.311)	(0.315)	(0.313)	(0.315)	(0.314)	(0.315)
DroughtXOD						−0.493***			
						(0.190)			

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Table DD.1: Continued

VARIABLES	(1) <24 months HAZ	(2) <24 months HAZ	(3) <24 months HAZ	(4) <24 months HAZ	(5) <24 months HAZ	(6) <24 months HAZ	(7) <24 months HAZ	(8) <24 months HAZ	(9) <24 months HAZ
FloodXOD							−0.169**		
							(0.078)		
intEVAPOD								0.156	
								(0.177)	
intTMAXOD									0.004
									(0.125)
Observations	830	830	830	827	827	827	827	827	827
R-squared	0.218	0.219	0.222	0.221	0.223	0.233	0.227	0.224	0.223
F-test joint significance						0.0067	0.0175	0.1294	0.1828

Sources: World Bank calculation based on Niger LSMS 2014 and AFDM 2014.
Notes: OLS estimations with standard errors clustered at the PSU level accounting for stratification at the region and urban/rural location. Dependent variable is child height for age (HAZ), observations are children below 24 months. Drought (flood) is calculated as number of months in which the SPI3 indicator is 1 standard deviation below (above) the climate normal. Evaporation and maximum temperature are assumed to capture the prevalent disease environment; they are reported in terms of standard deviations from respective sample means. WASH: sanitation is accounted through a dummy variable for open defecation and a dummy variable for access to other unimproved sanitation, the reference category is access to improved sanitation; PSU level access to improved sanitation and household access to improved water sources are captured by two additional dummy variables. Additional control variables included are log age of child in months, sex of child, a dummy variable accounting if the child was breastfed at least for her/his first 6 months, a dummy variable taking value 1 for children with missing values on breastfeeding, log age of the mother, a dummy taking value 1 if the mother can read, dummy variables for the marital status of the mother, log age of the head of household and sex of the head of household, a dummy taking value 1 if the head of household can read, a dummy taking value 1 if the head of the household works in the agricultural sector, household size, share of children under five, wealth, urban dummy, a categorical variable from 0 to 1 ranking perceived household food insecurity and region dummies (reference region is Agadez). HAZ = height-for-age z-scores; OLS = ordinary least squares; PSU = primary sample unit; SPI = Standard Precipitation Index; WASH = water supply, sanitation, and hygiene.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix EE
Drought and Flood Shocks, WASH, and Anthropometric Outcomes in Niger and Mali, 2006 and 2012

Table EE.1: Composite Index of Anthropometric Failures, Water, in Niger and Mali, 2006 and 2012

	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	CIAF	CIAF	CIAF	CIAF	VARIABLES	CIAF	CIAF	CIAF	CIAF
Floods (based on SPI 12 months)	0.000483	0.00991***	0.00861	0.00919**	**Drought** (based on SPI 12 months)	0.00423**	–0.0255***	–0.00675	–0.0302***
	(0.00)	(0.00)	(0.01)	(0.00)		(0.00)	(0.01)	(0.01)	(0.01)
Piped water in dwelling	–0.0317	–0.0168	–0.0965**	**–0.0406**	Piped water in dwelling	0.00877	–0.0329	–0.108**	–0.0414
	(0.03)	(0.07)	(0.04)	**(0.07)**		(0.03)	(0.07)	(0.04)	(0.06)
Floods * Piped water in dwelling	0.0153	–0.00749	0.00701	0.016	**Drought** * Piped water in dwelling	–0.0134	–0.310***	0.0179	0.0564
	(0.02)	(0.01)	(0.02)	(0.02)		(0.01)	(0.08)	(0.02)	(0.05)

Sources: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. CIAF = Composite Index of Anthropometric Failure; SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table EE.2: Composite Index of Anthropometric Failures, Sanitation, in Niger and Mali, 2006 and 2012

	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	CIAF	CIAF	CIAF	CIAF	VARIABLES	CIAF	CIAF	CIAF	CIAF
Floods (based on SPI 12 months)	0.00614*	0.00953***	0.00803	0.00922**	**Drought** (based on SPI 12 months)	0.00480**	−0.0232**	−0.00621	−0.0302***
	(0.00)	(0.00)	(0.01)	(0.00)		(0.00)	(0.01)	(0.00)	(0.01)
Improved sanitation	−0.0196	−0.00274	−0.0485	−0.0855***	Improved sanitation	−0.0199	0.00459	−0.0407	−0.0854***
	(0.02)	(0.04)	(0.04)	(0.03)		(0.03)	(0.03)	(0.04)	(0.03)
Floods * Improved sanitation	−0.0178	0.00366	0.0127	0.00853	**Droughts** * Improved sanitation	−0.00698	−0.0472**	0.00127	0.0292
	(0.02)	(0.01)	(0.01)	(0.01)		(0.00)	(0.02)	(0.02)	(0.05)

Sources: DHS 2006 and 2012.
Note: Robust standard errors in parentheses Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. CIAF = Composite Index of Anthropometric Failure; SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table EE.3: Wasting and Water in Niger and Mali, 2006 and 2012

	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	WASTING	WASTING	WASTING	WASTING	VARIABLES	WASTING	WASTING	WASTING	WASTING
Floods (based on SPI 12 months)	−0.00215	0.00105	0.00885**	0.00339	**Drought** (based on SPI 12 months)	−0.00406***	0.00192	−0.00292	−0.0016
	(0.00)	(0.00)	(0.00)	(0.00)		(0.00)	(0.01)	(0.00)	(0.01)
Piped water in dwelling	0.0135	−0.0315	−0.00742	−0.0608**	Piped water in dwelling	−0.00377	−0.00324	−0.0254	−0.0755***
	(0.02)	(0.05)	(0.02)	(0.02)		(0.03)	(0.05)	(0.02)	(0.02)
Floods * piped water in dwelling	−0.0152***	0.0125	−0.0143**	−0.0173***	**Drought** * piped water in dwelling	0.00232	−0.135**	0.00594	−0.00605
	(0.00)	(0.01)	(0.01)	(0.00)		(0.00)	(0.06)	(0.01)	(0.01)

Sources: DHS 2006 and 2012.
Note: SPI = Standard Precipitation Index.

Table EE.4: Wasting and Sanitation in Niger and Mali, 2006 and 2012

	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	WASTING	WASTING	WASTING	WASTING	VARIABLES	WASTING	WASTING	WASTING	WASTING
Floods (based on SPI 12 months)	−0.00266	0.000557	0.0101**	0.00364	**Drought** (based on SPI 12 months)	−0.00448***	0.00336	−0.00306	−0.00192
	(0.00)	(0.00)	(0.00)	(0.00)		(0.00)	(0.01)	(0.00)	(0.01)
Improved sanitation	−0.0026	−0.0238	0.00245	−0.0491*	Improved sanitation	−0.00973	−0.0061	−0.0234	−0.0620**
	(0.01)	(0.02)	(0.02)	(0.03)		(0.02)	(0.02)	(0.03)	(0.03)
Floods * improved sanitation	−0.00138	0.00735	−0.0254***	−0.0117	**Droughts** * Improved sanitation	0.00238	−0.0295**	0.00392	0.0134
	(0.01)	(0.01)	(0.01)	(0.01)		(0.00)	(0.01)	(0.01)	(0.02)

Sources: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix FF
Flood Shocks, WASH, and Anthropometric Outcomes in Urban and Rural Areas of Niger and Mali, 2006 and 2012

Table FF.1: Composite Index of Anthropometric Failures, Water, Urban and Rural, Mali and Niger, 2006 and 2012

	Urban					Rural			
	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	CIAF	CIAF	CIAF	CIAF	VARIABLES	CIAF	CIAF	CIAF	CIAF
Floods (according to SPI 12 months)	–0.0135	0.00329	–0.00692	0.00299	**Floods** (according to SPI 12 months)	0.0052	0.0112***	0.0118*	0.0100**
	(0.01)	(0.00)	(0.01)	(0.01)		(0.00)	(0.00)	(0.01)	(0.00)
Piped water in dwelling	–0.0265	0.00619	–0.0579	–0.113**	Piped water in dwelling	–0.198***	–0.281***	–0.653***	0.310*
	(0.03)	(0.07)	(0.04)	(0.05)		(0.07)	(0.07)	(0.05)	(0.17)
Floods * Piped water in dwelling	0.0205	–0.00115	0.0184	0.0308*	**Floods** * Piped water in dwelling	0.0617***	0.0356	1.068***	
	(0.01)	(0.01)	(0.02)	(0.02)		(0.02)	(0.06)	(0.09)	

Sources: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. CIAF = Composite Index of Anthropometric Failures; SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table FF.2: Composite Index of Anthropometric Failures, Sanitation, Urban and Rural, Mali and Niger, 2006 and 2012

	Urban					Rural			
	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	CIAF	CIAF	CIAF	CIAF	VARIABLES	CIAF	CIAF	CIAF	CIAF
Floods (according to SPI 12 months)	0.0272***	0.0021	–0.00751	0.00778	**Floods** (according to SPI 12 months)	0.00447	0.0111***	0.0110*	0.00963**
	(0.01)	(0.00)	(0.01)	(0.01)		(0.00)	(0.00)	(0.01)	(0.00)
Improved sanitation	–0.0206	–0.00226	–0.0556	–0.0427	Improved sanitation	–0.0157	–0.0101	–0.0858	–0.139***
	(0.03)	(0.06)	(0.04)	(0.05)		(0.03)	(0.05)	(0.08)	(0.04)
Floods * Improved sanitation	–0.0588***	0.00739	0.0136	0.00219	**Floods** * Improved sanitation	0.0106	0.00293	0.0407***	0.0699***
	(0.02)	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)

Sources: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. CIAF = Composite Index of Anthropometric Failures; SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table FF.3: Wasting (Weight-for-Age Z-Scores) and Water, Urban and Rural, Mali and Niger, 2006 and 2012

	Urban					Rural			
	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	WASTING	WASTING	WASTING	WASTING	VARIABLES	WASTING	WASTING	WASTING	WASTING
Floods (according to SPI 12 months)	–0.00916***	–0.0012	–0.00206	0.00111	**Floods** (according to SPI 12 months)	0.000104	0.00101	0.0105**	0.00378
	(0.00)	(0.00)	(0.01)	(0.01)		(0.00)	(0.00)	(0.00)	(0.00)
Piped water in dwelling	0.0168	–0.039	0.00291	–0.0423	Piped water in dwelling	–0.0283	–0.0758***	0.00304	–0.142***
	(0.02)	(0.05)	(0.03)	(0.03)		(0.05)	(0.02)	(0.03)	(0.03)
Floods * Piped water in dwelling	–0.00916**	0.0206*	–0.00442	–0.0174**	**Floods** * Piped water in dwelling	0.00523	–0.00632	–0.195***	
	(0.00)	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.06)	

Sources: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table FF.4: Wasting (Weight-for-Age Z-Scores) and Sanitation, Urban and Rural, Mali and Niger, 2006 and 2012

	Urban					Rural			
	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	WASTING	WASTING	WASTING	WASTING	VARIABLES	WASTING	WASTING	WASTING	WASTING
Floods (according to SPI 12 months)	−0.00742**	−0.00117	0.00197	0.00543	**Floods** (according to SPI 12 months)	−0.00162	0.000629	0.0111**	0.00356
	(0.00)	(0.00)	(0.01)	(0.01)		(0.00)	(0.00)	(0.00)	(0.00)
Improved sanitation	−0.00661	−0.00899	−0.0128	−0.0455*	Improved sanitation	−0.00472	−0.0347	0.0157	−0.0462
	(0.02)	(0.04)	(0.02)	(0.03)		(0.02)	(0.03)	(0.04)	(0.05)
Floods * Improved sanitation	−0.00581	0.00768	−0.0150**	−0.0196**	**Floods** * Improved sanitation	0.0145**	0.00456	−0.0324***	0.0596***
	(0.00)	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)

Sources: DHS 2006 and 2012.
Note: Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix GG
Diarrhea, Improved WASH, and Floods in Niger, 2012

Table GG.1: Diarrhea, Improved WASH and floods in Niger (DHS 2012)

	1	2	3	4	5	6
VARIABLES	diarrhea	diarrhea	diarrhea	diarrhea	diarrhea	diarrhea
floodsp12_sum	0.00684*	0.00712*				
	(0.00400)	(0.00402)				
floodspi6_sum			0.0127***	0.0129***		
			(0.00456)	(0.00459)		
floodspi3_sum					0.0190***	0.0197***
					(0.00550)	(0.00552)
Impwpipdw	−0.00302		0.0204		−0.00936	
	(0.0588)		(0.0645)		(0.0559)	
Floodimpwpipdw	−0.0195		−0.0281		−0.00275	
	(0.0161)		(0.0184)		(0.0278)	
c_agemonths	−0.00351***	−0.00352***	−0.00311***	−0.00311***	−0.00313***	−0.00314***
	(0.000350)	(0.000350)	(0.000390)	(0.000389)	(0.000358)	(0.000357)
Female	−0.0176	−0.0177	−0.0172	−0.0173	−0.0177	−0.0179
	(0.0119)	(0.0119)	(0.0119)	(0.0119)	(0.0118)	(0.0118)
c_agemotherbirth	0.00132	0.00131	0.00128	0.00128	0.00123	0.00125
	(0.00147)	(0.00146)	(0.00146)	(0.00145)	(0.00145)	(0.00144)
w_literacy	0.00650	0.00654	0.00683	0.00650	0.00316	0.00446
	(0.0285)	(0.0278)	(0.0285)	(0.0279)	(0.0287)	(0.0280)
w_children	−0.00857*	−0.00854*	−0.00829*	−0.00836*	−0.00808*	−0.00818*
	(0.00489)	(0.00488)	(0.00483)	(0.00482)	(0.00480)	(0.00479)
2.catwealth_own	0.0175	0.0179	0.0168	0.0172	0.0173	0.0177
	(0.0211)	(0.0211)	(0.0212)	(0.0212)	(0.0213)	(0.0213)
3.catwealth_own	0.000206	0.000453	−0.000288	−6.76e−05	0.000239	0.000480
	(0.0174)	(0.0174)	(0.0174)	(0.0174)	(0.0174)	(0.0174)
4.catwealth_own	0.00410	0.00428	0.00433	0.00408	0.00680	0.00669
	(0.0209)	(0.0209)	(0.0211)	(0.0212)	(0.0211)	(0.0211)
5.catwealth_own	−0.0100	−0.00781	−0.0104	−0.00868	−0.00811	−0.00606
	(0.0217)	(0.0225)	(0.0217)	(0.0225)	(0.0217)	(0.0226)

table continues next page

Table GG.1: Continued

	1	2	3	4	5	6
VARIABLES	diarrhea	diarrhea	diarrhea	diarrhea	diarrhea	diarrhea
Rural	0.00871	0.00388	0.00941	0.00352	0.01000	0.00500
	(0.0216)	(0.0237)	(0.0216)	(0.0241)	(0.0217)	(0.0238)
Impsanit		–0.0216		–0.00662		–0.00239
		(0.0284)		(0.0307)		(0.0322)
Floodimpsanit		–0.0193		–0.0224*		–0.0256
		(0.0121)		(0.0125)		(0.0176)
Constant	0.243***	0.247***	0.219***	0.225***	0.211***	0.214***
	(0.0548)	(0.0551)	(0.0557)	(0.0561)	(0.0562)	(0.0564)
Observations	4,345	4,345	4,345	4,345	4,345	4,345
R-squared	0.056	0.057	0.058	0.058	0.059	0.060

Source: DHS 2012.
Note: Robust standard errors in parentheses. Controls for the different regions are also added but not reported here. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Reference

DHS (Demographic and Health Surveys). 2012. Niger: Standard DHS, 2012 (database). Rockville, MD. http://dhsprogram.com/what-we-do/survey/survey-display-407.cfm#sthash.7UChnBM9.dpuf.

Appendix HH
Community WASH Coverage, Floods, and Height-for-Age Z-Scores, Mali and Niger, 2006 and 2012

Table HH.1: Height-for-Age Z-Scores and Piped Water, Mali and Niger, 2006 and 2012

	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	HAZ	HAZ	HAZ	HAZ	VARIABLES	HAZ	HAZ	HAZ	HAZ
Floods (according to SPI 12 months)	−0.015 (0.01)	−0.0301** (0.01)	−0.0252 (0.02)	−0.0260** (0.01)	**Floods** (according to SPI 12 months)	−0.016 (0.01)	−0.0292** (0.01)	−0.0241 (0.02)	−0.0261** (0.01)
Piped water in dwelling	0.459*** (0.10)	0.0783 (0.24)	0.308* (0.16)	−0.0928 (0.31)	Piped water in dwelling	0.418*** (0.09)	0.105 (0.24)	0.366** (0.15)	−0.0811 (0.28)
Piped water in dwelling: More than 50% of cluster	−0.00516 (0.15)	0.0206 (0.27)	0.145 (0.15)	0.13 (0.25)	Piped water in dwelling: More than 75% of cluster	0.217 (0.13)		0.0337 (0.22)	0.463 (0.28)
Floods * Piped water in dwelling	−0.130*** (0.03)	0.000637 (0.06)	−0.131* (0.07)	−0.0795 (0.05)	Floods * Piped water in dwelling	−0.144*** (0.04)	0.0419 (0.05)	−0.0548 (0.06)	−0.0823* (0.05)
Floods * More than 50% cluster has piped water in dwelling	−0.0635 (0.05)	0.201*** (0.07)	0.136** (0.06)	−0.0193 (0.06)	**Floods** * More than 75% cluster has piped water in dwelling			0.051 (0.09)	−0.0445 (0.04)

Source: DHS 2006 and 2012.
Note: Focus on households located in clusters where at least 50 percent and 75 percent of households of said cluster have access to piped water. Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. HAZ = height-for-age z-scores; SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table HH.2: HAZ and improved sanitation (50% and 75% of cluster)

	Mali		Niger			Mali		Niger	
	2006	2012	2006	2012		2006	2012	2006	2012
VARIABLES	HAZ	HAZ	HAZ	HAZ	VARIABLES	HAZ	HAZ	HAZ	HAZ
Floods (according to SPI 12 months)	−0.0226* (0.01)	−0.0276** (0.01)	−0.0219 (0.02)	−0.0248** (0.01)	**Floods** (according to SPI 12 months)	−0.0251** (0.01)	−0.0270** (0.01)	−0.0209 (0.02)	−0.0250** (0.01)
Improved sanitation	0.160** (0.06)	−0.0882 (0.13)	0.145 (0.13)	0.283** (0.14)	Improved sanitation	0.182*** (0.06)	−0.0519 (0.13)	0.11 (0.13)	0.220* (0.13)
Improved sanitation: More than 50% of cluster	0.0931 (0.09)	0.494 (0.35)	0.000525 (0.14)	−0.266** (0.13)	Improved sanitation: More than 75% of cluster	0.0195 −0.118	0.496*** −0.164	0.326* −0.168	0.00628 −0.151
Floods * Improved sanitation	0.0181 (0.02)	−0.029 (0.04)	−0.117*** (0.04)	−0.0552** (0.03)	Floods * Improved sanitation	0.0145 (0.02)	−0.0235 (0.04)	−0.0939** (0.05)	−0.0473** (0.02)
Floods * More than 50% cluster has improved sanitation	−0.0780** (0.04)	−0.00722 (0.10)	0.0771* (0.04)	−0.0236 (0.04)	Floods * More than 75% cluster has improved sanitation	−0.104* −0.0564	0.221*** −0.0407	0.0911** −0.044	−0.111*** −0.0216

Source: DHS 2006 and 2012.
Note: Focus on households located in clusters where at least 50 percent and 75 percent of households of said cluster have access to piped water Robust standard errors in parentheses. Controls: age of child; age^2; gender, age of mother at birth of child; mother's literacy; number of children of the given mother; area (rural); wealth index; regions. Breastfeeding controls not included since over 97 percent of children in sample were breastfed for their first six months of life in Niger in both 2006 and 2012. HAZ = height-for-age z-scores; SPI = Standard Precipitation Index.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Appendix II
Reported Natural Disasters in Niger, 2000–14

DesInventar is a conceptual and methodological tool for the generation of National Disaster Inventories and the construction of databases of damage, losses, and, in general, the effects of disasters. It is the Disaster Information Management System for the systematic collection, documentation, and analysis of data about losses caused by disasters associated with natural hazards. The DesInventar database includes data for a large number of countries, including Niger. For Niger, the dataset reports 2,441 disasters from 1973 to 2014. Note that 78 percent of the reported disasters occurred since 2000. Disasters are reported at the location, commune, department, and regional level.

Table II.1: Number of Events and Population Affected by Disasters

a. Number of events

Event	2000	2001	2002	2003	2004	2005	**2006**	2007	2008	2009	2010	2011	**2012**	2013	2014	Total
DROUGHT	3	3	5	1	9	16	**4**	10	7	15	18	35	**10**	32	2	170
EPIDEMIC	2	3	6	7	17	20	**17**	19	29	22	23	22	**13**	19	0	219
FIRE	1	1	1	1	3	0	**3**	3	4	1	6	8	**23**	29	0	84
FLOOD	4	8	5	3	3	4	**24**	10	26	14	112	60	**204**	190	1	668
FOREST FIRE	5	2	2	4	2	5	**4**	14	9	10	15	13	**32**	50	0	167
OTHER	25	32	36	42	49	34	**24**	29	24	26	61	104	**52**	57	2	597
Total	40	49	55	58	83	79	**76**	85	99	88	235	242	**334**	378	5	1,906

b. Number of affected (1,000 individuals)

Event	2000	2001	2002	2003	2004	2005	**2006**	2007	2008	2009	2010	2011	**2012**	2013	2014	Total
DROUGHT	0	0	0	0	29.38	0	**12.64**	0	0.22	0	85.76	41.95	**2.17**	42.99	0.70	215.8
EPIDEMIC	0	0	0	0	0	0	**0**	0	0	0	0	0	**0**	0	0	0
FIRE	0.12	0.06	0.05	0.04	0.11	0	**0.02**	0.02	0.03	0.02	0.04	0.36	**0.35**	0.51	0	1.73
FLOOD	0.55	0	0	0	0.11	0.01	**6.05**	0.60	0.02	14.67	30.05	0.47	**10.37**	6.21	0	69.11
FOREST FIRE	0	0	0	0	0.10	0	**0**	0	0	0	0	0	**0**	0.01	0	0.11
OTHER	0.04	0.04	0.02	0.08	0.55	0.41	**8.89**	11.24	0.17	0.27	31.75	19.19	**1.95**	0.24	0.01	74.85
Total	0.71	0.1	0.07	0.12	30.25	0.42	**27.6**	11.86	0.44	14.96	147.6	61.97	**14.84**	49.96	0.71	361.6

Source: DesInventar database.
Notes: DesInventar defines *affected* as the number of persons who suffer indirect or secondary effects related to a disaster.

Appendix JJ
DHS and LSMS Weather and Climate Indicators Used in Analysis

Table JJ.1: DHS and LSMS Weather and Climate Indicators Used in Analysis

Data	Source	Definition	Variable
Meteorology			
Precipitation	NASA–3B42RT	Daily total surface precipitation	prec
Max temp	NOAA–GFSA	Daily maximum temperature measured at 2 meters above the surface	tmax
Min temp	NOAA–GFSA	Daily minimum temperature measured at 2 m above the surface	tmin
Hydrology			
Soil moisture (%) – Layer1	Derived hydrologic products VIC	Relative soil moisture of the top layer (0–10 cm) calculated from the land surface model output	vc1
Evaporation (mm/day)	VIC hydrologic model–3B42RT	Sum of land surface model's soil evaporation, canopy interception, and plant transpiration	evap
Surface runoff (mm/day)	VIC hydrologic model–3B42RT	Excess water from rain, snowmelt, or other sources that does not infiltrate due to soil saturation of high intensity but instead flows overland	runoff
Baseflow (mm/day)	VIC hydrologic model–3B42RT	Portion of streamflow that comes from the sum of deep subsurface flow and delayed shallow subsurface flow	baseflow
Streamflow (m^3/s)	VIC hydrologic model–3B42RT	Daily basin discharge calculated by inputting the baseflow and surface runoff from the VIC land surface model at each grid cell into the Velocity Driven Spatially Continuous routing model	flw
Vegetation			
NDVI	MODIS	NDVI is a measure of life green vegetation (0–1)	ndvi30
Indices			
SPI (1-month)	Derived meteorology	1-month SPI is the number of standard deviations that observed 1-month cumulative precipitation deviates from the climatological average[a]	spi1

table continues next page

Table JJ.1: Continued

Data	Source	Definition	Variable
SPI (3-month)	Derived meteorology	3-month SPI is the number of standard deviations that observed 3-month cumulative precipitation deviates from the climatological average[b]	spi3
SPI (6-month)	Derived meteorology	6-month SPI is the number of standard deviations that observed 6-month cumulative precipitation deviates from the climatological average[c]	spi6
SPI (12-month)	Derived meteorology	The 12-month SPI is the number of standard deviations that observed 12-month cumulative precipitation deviates from the climatological average[d]	spi12
Drought Index (%)	Derived hydrology	Measure of the severity of drought in soil moisture; low values indicate drought conditions	vcpct
Streamflow perc. (%)	VIC hydrologic model	Measure of the severity of hydrological drought; low values indicate drought conditions Percentile of the simulated discharge at each stream gauge with respect to historical simulations (1950–2008)	flw_pct
NDVI percentile (30-day moving average)	MODIS	Measure of the severity of agricultural drought; low values indicate drought conditions 30-day moving average of NDVI is compared to the historical record of NDVI via the empirical cumulative distribution function to determine the percentile	pct30day

Source: Princeton 2015.
Notes: The hydrologic cycle is modeled using the VIC model, which is forced by a combined model and observation dataset of meteorological forcings (precipitation, temperature, etc.). For further information on modeling sources see Princeton University's website: http://hydrology.princeton.edu/~justin/research/project_global_monitor/overview.html. GFSA = Global Forecasting System Analysis; NDVI = Normalized Difference Vegetation Index; SPI = Standard Precipitation Index; VIC = Variable Infiltration Capacity. a., b., c., d. McKee et al. 1993.

Reference

Princeton University. 2015. African Flood and Drought Monitor (database). Princeton, NJ. http://stream.princeton.edu/AWCM/WEBPAGE/interface.php?locale=en.

Appendix KK
Service Delivery Indicators in Niger—Health and Education

Table KK.1: Availability of Functioning Sanitation in Schools, Niger

Indicator (% unless otherwise noted)	Niger	Public	Private	Difference (%)	Urban public	Rural public	Difference (%)
Minimum teaching equipment	**24.7**	**23.4**	**72.4**	**−49*****	**38.9**	**20.1**	**−18.8*****
Pupils with pencils	91.1	90.9	97.6	−6.7***	97.7	89.5	−8.3***
Pupils with exercise books	45.5	44.4	89.8	−45.4***	69.8	39	−30.8***
Classroom with board	100	100	100	0	100	100	0
Classroom with chalk	95.8	95.8	97.2	−1.5	98.2	95.2	−2.9
Minimum infrastructure	**21.3**	**19.7**	**80.7**	**−61.1*****	**28.3**	**17.9**	**−10.4**
Contrast to read the board	32.1	34.1	28.0	6.2	10.5	38.8	28.3***
Minimum visibility by enumerator	86.4	86.2	94.5	−8.3*	100.0	83.3	−16.7***
Toilet functioning and available	24.3	22.6	83.5	−60.9***	28.3	21.4	−6.9
Toilet clean	42.7	41.1	100.0	−58.9***	70.4	34.9	−35.5***
Toilet private	27.7	26.2	83.5	−57.3***	35.2	24.3	−10.9
Toilet available	42.2	40.8	94.5	−53.7***	74.1	33.7	−40.3***
Observed pupil-teacher ratio	38.3	38.1	46.9	−8.8***	48.2	36	−12.2***
Textbook availability	9.3	8.7	33.6	−25**	9.5	8.5	−1.0
Pupils with math textbook	7.1	5.5	48.9	−43.4***	7.9	5.0	−2.9
Pupils with French textbook	10.7	10.3	27.0	−16.7*	10.6	10.3	−0.3

Source: World Bank 2017.
Note: Results based on observations in 256 schools. Information on rural and urban breakdowns for the same set of indicators is in. Minimum infrastructure resources is a binary variable capturing availability of (a) functioning toilets operationalized as being clean, private, and accessible; and (b) sufficient light to read the blackboard from the back of the classroom. Functioning toilets: whether the toilets were functioning was verified by the enumerators as being accessible, clean, and private (enclosed and with gender separation). Electricity: functional availability of electricity is assessed by checking whether the light in the classroom works and gives minimum light quality. The enumerator places a printout on the board and checks (assisted by a mobile light meter) whether it was possible to read the printout from the back of the classroom.
Significance level: * = 10 percent, *** = 1 percent.

Availability of Functioning Water Supply and Sanitation in Niger's Health Centers

Table KK.2: Availability of Water, Sanitation, and Infrastructure in Health Infrastructure in Niger
Percent

	All	Public	Private	Difference (%)	Rural public	Urban public	Difference (%)
Clean water	54.4	52.5	92.5***	(76.2)	49.3	100.0***	(102.7)
	(7.6)	(7.8)	(4.5)	(9.4)	(8.2)	0.0	(8.2)
Toilet for outpatients	25.5	23.3	69.8***	(200.1)	20.6	63.7***	(209.4)
	(5.6)	(5.4)	(11.3)	(13.5)	(5.5)	(12.6)	(13.7)
Electricity	26.4	22.7	98.0***	(330.9)	18.4	88.2***	(378.1)
	(4.4)	(4.2)	(1.9)	(4.9)	(4.0)	(6.5)	(7.6)
Electricity with no regular outages	21.3	18.4***	79.4	(332.2)	14.3	80.3***	(462.0)
	(3.7)	(3.4)	(5.9)	(7.2)	(3.2)	(6.5)	(7.2)

Source: World Bank 2017 a-c.
Note: Robust standard errors in parentheses. Regular outages are defined as 15 or more outages lasting at least two hours each over the three months prior to the survey. Comparisons within facility type are relative to public and rural public; comparisons across facility types are relative to hospitals.
Significance level: *** = 1 percent.

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World Bank. 2017a. *Niger Service Delivery Indicators: Education 2015*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/28471.

———. 2017b. *Niger Service Delivery Indicators: Health 2015*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/28472.

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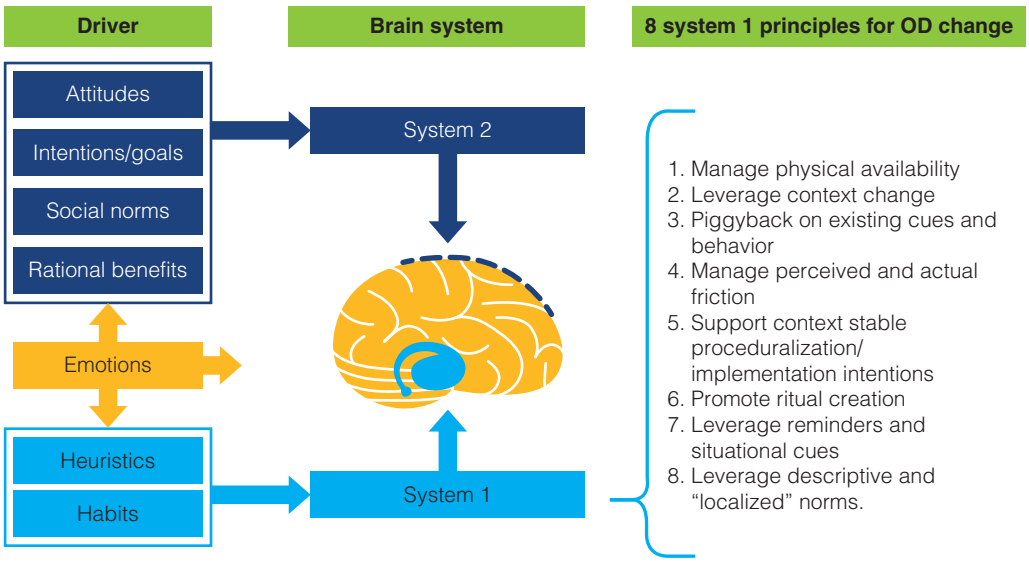
Appendix LL
Tapping Behavioral Systems to Support Open-Defecation Behavior Change

Figure LL.1: Principles for Leveraging Nudges and Habit Change Tactics (System 1) to Support Open-Defecation Behavior Change



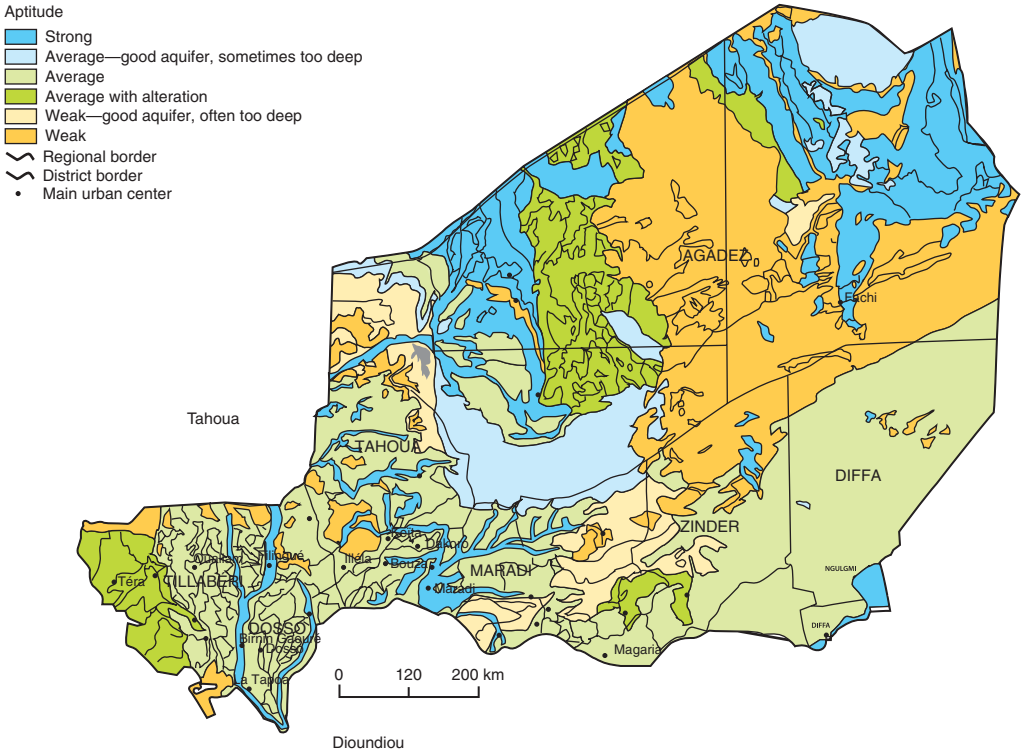
Source: Neal et al. 2016.

Reference

Neal, D., J. Vujcic, R. Burns, W. Wood, and J. Devine. 2016. Nudging and Habit Change for Open Defecation: New Tactics from Behavioral Science. Washington, DC: World Bank.

Appendix MM
Manual Drilling Potential in Niger

Map MM.1: Manual Drilling Potential, by Area, Niger, 2010



Source: GoN 2010.

Reference

GoN (Government of Niger), Ministry of Water. 2010. "Etude de faisabilité des forages manuels: Identification des zones potentiellement favorables." New York: UNICEF.

Appendix NN Framework for Service Characteristic Analysis

Service characteristics shed light on the bias toward infrastructures (compared to operations and maintenance [O&M]), toward settled urban neighborhood, and the relative neglect of sanitation overall. Service characteristics concern the nature of the good being delivered, the type of market failure being addressed, the tasks involved in delivery, and how a service is demanded and consumed. Politicians' incentive to provide or improve a service is greatest where the service offers exclusive and targetable private rather than public benefits; where it benefits users directly rather than through external effects on the wider population; and where citizens have information to understand the benefits and results are visible in the short term and can therefore be clearly attributed to politicians' action (e.g., construction of water wells rather than improvement of water quality). Policy makers and managers are better able to monitor and control providers in the following situations:

- Providers do not have a high degree of professional dominance and they exercise relatively little discretion
- Procedures and outputs (e.g., infrastructure construction) are easily specified and measured
- Service delivered is a public good offering few opportunities for disruptive rent-seeking (e.g., public health campaigns)
- Managerial information is accessible because the service offers direct benefits (rather than external effects) to defined clients within clear territorial boundaries

Users' power and capacity to organize collectively is greater in the following situations:

- Service is used frequently and predictably within a limited territory (e.g., irrigation schemes by comparison with hospital health care)
- Users are able to assess the quality of the service, allowing the formation of shared opinion and demands
- Choice in supply exists rather than monopoly
- Service offers easily visible and short-term benefits to known beneficiaries (a health center rather than a public health campaign)

However, collective organization is easily diverted by users' competition for private benefits (such as access to water in irrigation schemes) that can be targeted to favor people at the discretion of the provider. Together, service characteristics affect the political salience of a service. Based on this framework, small-scale irrigation could be expected to have a high rating for political salience because it is both easily attributable to political effort (targetable, visible, and measurable) and presents possibilities for organized demand (frequently and predictably used within a limited territory). Sanitation, on the other hand, has not. Recognizing that services have their own profile can help identify the political feasibility of interventions and identify entry points for actions.

Source: Adapted from Batley and McLoughlin (2015) for the SCD Niger and WASH chapter (2017).

Reference

Batley, Richard, and Claire McLoughlin. 2015. “The Politics of Public Services: A Service Characteristics Approach.” *World Development* 74(C): 275–285.

Appendix OO
Simulation of Job Creation as Response to Improved Sanitation Needs in Niger, 2014 and 2030

Table OO.1: Simulation of Job Creation based on Improved Sanitation Needs in Niger

		Work days qualif	Work days unqualif	Unit cost qualif (XOF)	Unit cost unqualif (XOF)	Number of workers qual	Number of workers unqual	Total (XOF)
LOWER BOUND estimation: Mozambique-type								
Brick construction and dalette		1.5	1.5	5,000	2,500	1	1	11,250
Terrassement/realisation de la fosse		1	2	5,000	2,500	1	2	15,000
Construction de la latrine		1	2	5,000	2,500	1	2	15,000
Total		**3.5**	**5.5**	**15,000**	**7,500**	**3**	**5**	**41,250**
total days	9	3.5	5.5	15,000	7,500			
number of household without access in 2014	2,408,451	2,408,451	2,408,451	2,408,451	2,408,451			
number of household needing access by 2030	4,690,141	4,690,141	4,690,141	4,690,141	4,690,141			
value to provide access in 2014 (days or costs)	**21,676,056**	**8,429,577**	**13,246, 479**	**36,126, 760,560**	**18,063, 380,280**			**99,348, 591,540**
value to provide access by 2030 (days or costs)	**42,211,268**	**16,415,493**	**25,795, 775**	**70,352, 112,675**	**35,176, 056,338**			**193,468, 309,856**
Number of working days (total year - WE)	260	260	260					
total full-time jobs-access 2014 (unqual and qual)	83,369	32,421	50,948					
total full-time jobs-access 2030 (Unqual and qual)	162,351	63,137	99,215					

table continues next page

Table OO.1: Continued

		Work days qualif	Work days unqualif	Unit cost qualif (XOF)	Unit cost unqualif (XOF)	Number of workers qual	Number of workers unqual	Total (XOF)
UPPER BOUND estimation (hard terrain): Mozambique type								
Brick construction and dalette		1.5	1.5	5,000	2,500	1	1	11,250
Terrassement/realisation de la fosse		2	4	5,000	2,500	1	2	30,000
Construction de la latrine		1	2	5,000	2,500	1	2	15,000
Total	**12**	**4.5**	**7.5**	**15,000**	**7,500**	**3**	**5**	**56,250**
total days	12	4.5	7.5	15,000	7,500			
number of household without access in 2014	2,408,451	2,408,451	2,408,451	2,408,451	2,408,451			
number of household needing access by 2030	4,690,141	4,690,141	4,690,141	4,690,141	4,690,141			
value to provide access in 2014 (days or costs)	**28,901,408**	**10,838,028**	**18,063,380**	**36,126, 760,560**	**18,063, 380,280**			**135,475, 352,100**
value to provide access by 2030 (days or costs)	**56,281,690**	**21,105,634**	**35,176,056**	**70,352, 112,675**	**35,176, 056,338**			**263,820, 422,531**
Number of working days (total year - WE)	260	260	260					
total full-time jobs-access 2014 (unqual and qual)	111,159	41,685	69,475					
total full-time jobs-access 2030 (Unqual and qual)	216,468	81,176	135,293					

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Table OO.1: Continued

	Total work days	Work days qualif	Work days unqualif	Unit cost qualif (XOF)	Unit cost unqualif (XOF)	Total (XOF)
LOWER BOUND estimation: EcoSan Latrine						
Confection des agglos	3	1	2	5,000	2,500	10,000
Terrassement/realisation de la fosse	6	2	4	5,000	2,500	20,000
Construction de la latrine sans dalle	6	2	4	5,000	2,500	20,000
Coulage dalle	5	2	3	5,000	2,500	17,500
Total	**20**	**7**	**13**	**15,000**	**7,500**	**67,500**
total days	20	7	13	15,000	7,500	
number of household without access in 2014	2,408,451	2,408,451	2,408,451	2,408,451	2,408,451	
number of household needing access by 2030	4,690,141	4,690,141	4,690,141	4,690,141	4,690,141	
value to provide access in 2014 (days or costs)	**48,169,014**	**16,859,155**	**31,309,859**	**36,126, 760,560**	**18,063, 380,280**	**162,570, 422,520**
value to provide access by 2030 (days or costs)	**93,802,817**	**32,830,986**	**60,971,831**	**70,352, 112,675**	**35,176, 056,338**	**316,584, 507,038**
Number of working days (total year - WE)	260	260	260			
total full-time jobs-access 2014 (unqual and qual)	185,265	64,843	120,423			
total full-time jobs-access 2030 (unqual and qual)	360,780	126,273	234,507			

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Table OO.1: Continued

	Total work days	Work days qualif	Work days unqualif	Unit cost qualif (XOF)	Unit cost unqualif (XOF)	Total (XOF)
UPPER BOUND estimation (Hard terrain): EcoSan						
Confection des agglos	3	1	2	5,000	2,500	10,000
Terrassement/realisation de la fosse	12	4	8	5,000	2,500	40,000
Construction de la latrine sans dalle	6	2	4	5,000	2,500	20,000
Coulage dalle	5	2	3			
Total	**26**	9	**17**	**15,000**	**7,500**	**70,000**
total days	26	9	17	15,000	7,500	
number of household without access in 2014	2,408,451	2,408,451	2,408,451	2,408,451	2,408,451	
number of household needing access by 2030	4,690,141	4,690,141	4,690,141	4,690,141	4,690,141	
value to provide access in 2014 (days or costs)	**62,619,718**	**21,676,056**	**40,943,662**	**36,126,760,560**	**18,063,380,280**	**168,591,549,280**
value to provide access by 2030 (days or costs)	**121,943,662**	**42,211,268**	**79,732,394**	**70,352,112,675**	**35,176,056,338**	**328,309,859,150**
Number of working days (total year - WE)	260	260	260			
total full-time jobs-access 2014 (unqual and qual)	240,845	83,369	157,476			
total full-time jobs-access 2030 (Unqual and qual)	469,014	162,351	306,663			

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Table OO.1: Continued

	Total work days	Work days qualif	Work days unqualif	Unit cost qualif (XOF)	Unit cost unqualif (XOF)	Total (XOF)
LOWER BOUND estimation : SanPlat						
Confection des agglos	3	1	2	5,000	2,500	10,000
Terrassement/realisation de la fosse	3	1	2	5,000	2,500	10,000
Construction de la latrine sans dalle	3	1	2	5,000	2,500	10,000
confection et pose de la dalle	3	1	2	5,000	2,500	10,000
Total	**12**	**4**	**8**	**15,000**	**7,500**	**40,000**
total days	12	4	8	15,000	7,500	
number of household without access in 2014	2,408,451	2,408,451	2,408,451	2,408,451	2,408,451	
number of household needing access by 2030	4,690,141	4,690,141	4,690,141	4,690,141	4,690,141	
value to provide access in 2014 (days or costs)	**28,901,408**	**9,633,803**	**19,267,606**	**36,126,760,560**	**18,063,380,280**	**96,338,028,160**
value to provide access by 2030 (days or costs)	**56,281,690**	**18,760,563**	**37,521,127**	**70,352,112,675**	**35,176,056,338**	**187,605,633,800**
Number of working days (total year - WE)	260	260	260			
total full-time jobs-access 2014 (unqual and qual)	111,159	37,053	74,106			
total full-time jobs-access 2030 (Unqual and qual)	216,468	72,156	144,312			

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Table OO.1: Continued

	Total work days	Work days qualif	Work days unqualif	Unit cost qualif (XOF)	Unit cost unqualif (XOF)	Total (XOF)
UPPER BOUND estimation (Hard terrain): SanPlat						
Confection des agglos	3	1	2	5,000	2,500	10,000
Terrassement/realisation de la fosse	6	2	4	5,000	2,500	20,000
Construction de la latrine sans dalle	3	1	2	5,000	2,500	10,000
confection et pose de la dalle	3	1	2	5,000	2,500	10,000
Total	**15**	**5**	**10**	**15,000**	**7,500**	**50,000**
total days	15	5	10	15,000	7,500	
number of household without access in 2014	2,408,451	2,408,451	2,408,451	2,408,451	2,408,451	
number of household needing access by 2030	4,690,141	4,690,141	4,690,141	4,690,141	4,690,141	
value to provide access in 2014 (days or costs)	**36,126,761**	**12,042,254**	**24,084,507**	**36,126,760,560**	**18,063,380,280**	**120,422,535,200**
value to provide access by 2030 (days or costs)	**70,352,113**	**23,450,704**	**46,901,408**	**70,352,112,675**	**35,176,056,338**	**234,507,042,250**
Number of working days (total year - WE)	260	260	260			
total full-time jobs-access 2014 (unqual and qual)	138,949	46,316	92,633			
total full-time jobs-access 2030 (unqual and qual)	270,585	90,195	180,390			

Source: World Bank calculation based on cost estimates defined in Niger.