WASH
Poverty Diagnostic | SERIES

Maintaining the Momentum while Addressing Service Quality and Equity

A Diagnostic of Water Supply, Sanitation, Hygiene, and Poverty in Ethiopia

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Executive Summary

The WASH Poverty Diagnostic (WPD) in Ethiopia is part of a global initiative to understand the linkages between service delivery of water supply, sanitation, and hygiene (WASH) and eliminating poverty. The WPD provides a detailed analysis of the history, status, strengths, and weaknesses of WASH service delivery in Ethiopia to inform policy, planning, and programming for universal access to safely managed water supply and sanitation and attainment of the new Sustainable Development Goals (SDGs).

Poverty in Ethiopia

Between 2000 and 2011 the proportion of households living below the national poverty line fell from just under 45 percent to just under 30 percent. Over this same period there was also convergence in the rate of poverty, to around one person in three, across all regions of Ethiopia. Though poverty rates were slightly lower in urban (26 percent) than in rural areas (30 percent), the great majority of Ethiopia's poor households still live in rural areas. Ethiopia's population lives predominantly in rural areas (83 percent) though there are strong signs that urbanization is accelerating with some estimates forecasting urban growth at 5.4 percent a year (World Bank 2015c).

In support of its predominantly rural population and its livelihoods, the Government of Ethiopia's (GoE's) poverty reduction efforts have, since 2000, focused on rural and agricultural development. There has been a very deliberate effort to promote agricultural development, provide basic rural services equitably, and develop safety nets for households especially in the eastern half of the country, which has less food security and lower rainfall than other regions. These basic services have been delivered at industrial scale through a two-tier decentralization, first to regional states and subsequently to over 800 districts (woredas). Funding for these basic services has grown consistently from the early 2000s, supported by both GoE and donor sources.

Poverty reduction efforts in urban areas have been less focused and deliberate with a sizable and growing divide emerging among households living in urban areas. Recognizing this growing urban inequality, and alongside investments in urban infrastructure promoting growth, GoE began to address poverty in urban areas through large-scale investments in housing in the mid-2000s. This investment has aimed to replace traditional social housing nationalized in the Derg era and managed by urban local governments (kebeles) with "condominium housing" units, which are large blocks of flats being built in the peri-urban areas of particularly larger cities. Yet Ethiopia's urban growth is not just in its large cities but includes a very broad base of even faster growing small towns for which a separate strategy is needed to finance their infrastructure needs.

WASH Services in Ethiopia

In 2015 Ethiopia met its Millennium Development Goal (MDG) for water supply. This significant achievement was largely driven by the very rapid increase in rural areas where 35 million people got access to piped and protected water sources between 1994 and 2015. In urban areas, an additional 10 million people benefited from gaining access to piped water on premises, including the benefits of convenience and time savings.

The MDG for sanitation was not met but good progress was made in reducing open defecation in rural areas. Over 40 million people built basic latrines in rural areas and in urban areas good progress was made with 8 million people moving up the sanitation ladder from basic to

Figure ES.1: Shifts in Service Delivery over the Past 20 Years in Ethiopia, 2017

Rural water	Rural sanitation	Urban water	Urban sanitation
From surface to improved sources	**From open defecation to basic sanitation**	**From public taps to taps in the compound**	**From basic latrines to improved facilities**
35 million people	**40 million people**	**10 million people**	**8 million people**
have gained access to water from piped systems, protected hand pumps and springs	have built basic latrines and no longer defecate in the open	have joined those with access to more convenient piped water in their home or compound	have gained access to improved toilet facilities

Source: DHS.

improved toilet facilities. However, gains in urban sanitation coverage have been offset by increases in urban population and a lack of improvement on the entire sanitation service chain.

The progress in improving access to WASH services has been driven by a combination of decentralization and sector reforms. The backbone for all basic service delivery in Ethiopia is political, fiscal, and administrative decentralization. Decentralization has provided the basic financing, staffing, and administrative systems in regions and woredas for service delivery, including for water supply and sanitation. In tandem, sector reforms to guide the specifics of water supply and sanitation service delivery have put in place the policies, plans, and basic technical guidance needed by sector professionals to deliver services. This includes establishing clear expenditure assignments for rural water supply and sanitation at both regional and woreda levels and policies establishing progress toward cost recovery in urban areas—albeit thus far only for operations and some maintenance.

Financing of WASH service delivery has been through a combination of general and special purpose grants, as well as development assistance. The largest flows to WASH—over 60 percent—have been through the regional and woreda block grants, the food security program, the productive safety nets program, and more recently the MDG Fund. Donor finance that is not specific to WASH service delivery supports many of these general and special purpose grants especially through the Protection of Basic Services program and the Productive Safety Nets Program (PSNP). In addition, there has been donor funding specifically for WASH services through a wide range of projects, and more recently consolidated as programmatic funding through the One WASH National Program.

Although WASH sector investments from donors have not been the main financing sources, donor investment has been instrumental in building capacity at regional and woreda levels. From the mid-1990s, donors have supported policy and institutional development, underpinning the formation of the Federal Ministry of Water Resources. Since service delivery was decentralized, donor projects shaped the formation and capacity building of regional water bureaus and woreda water desks, town water boards, and utilities. Administrative and technical capacity building benefitted from a learning-by-doing approach through the rigorous design, procurement, contract management, and reporting required, especially by African Development Bank (AfDB) and the World Bank. In turn, support from the United Nations Children's Fund (UNICEF) and the World Bank Water Supply and Sanitation Program (WSP) have had a big influence on approaches and capacity to deliver rural sanitation and behavioral changes, integrating these into the nationwide, GoE-led Health Extension Program.

Rural water supply and sanitation infrastructure has been delivered at scale and equitably but is of poor quality. This means that the putative economic benefits expected as a result of investment in WASH services delivery have not been fully realized. Albeit from a low base, the rollout of rural water supply infrastructure has been rapid since 2000 with increases in coverage being some of the fastest in the world. However, this improved infrastructure used by an additional 35 million people has not translated into the expected time savings for fetching water. Even by 2016 less than half this number of people (<17 million) were brought into the fetching water within 30 minutes category. Between 2000 and 2011 the proportion of people able to fetch water within 30 minutes fell (from 65 percent to 57 percent) as many people walked further to improved water sources than previously to unimproved sources. Only by 2016 did the proportion of people able to fetch water within half an hour return to the 2000 level.

There is little difference in water quality between improved and unimproved sources in rural areas. *E. coli* contamination of both protected and unprotected springs and wells was reported at over 90 percent in the 2016 Ethiopia Socioeconomic Survey (ESS). Even in more expensive interventions contamination rates were extremely high: tube wells (>85 percent) and piped water systems (>75 percent).[1]

The functionality of systems remains a challenge, especially as the stock of infrastructure grows. The National WASH Inventory, last conducted in 2011, reported that 25 percent of schemes were nonfunctional. Discontinuity of supply and unpredictable breakdowns interrupt access, jeopardizing the health benefits associated with continuous access. The recent drought raised concerns about the resilience of systems, with in particular very high rates of hand-dug wells running dry, and raising the question of whether progress in extending access to basic services has masked a problem with their underlying vulnerability.

Increases in rural sanitation coverage have resulted in increased convenience and improved safety and dignity, especially for women, but the poor quality of infrastructure has resulted in limited health benefits. Very few latrines reliably separate people from fecal matter. Though survey data lack the ability to reliably define this quality, very few latrines have a washable slab with effective covers, prerequisites to avoid fecal-oral transmission.

Though the rollout of both rural water supply and sanitation has been equitable across wealth groups, access to these services has lagged behind in pastoralist and agropastoralist areas. In Ethiopia, people in rural areas pursue broadly three livelihood types: agrarian, agropastoralist, and pastoralist. Together pastoralists and agropastoralists are a significant minority group in

Figure ES.2: Key Challenges in Service Quality in Four WASH Subsectors in Ethiopia, 2016

Rural water	Rural sanitation	Urban water	Urban sanitation
Over **85 percent** of **improved** rural **water** sources were **contaminated** with *E. coli*	Less than **10 percent** of all **latrines** constructed in rural areas **qualify** as an **improved** latrine	Average **revenue** per cubic meter sold was just **US$0.32** against costs of **US$0.29**	**55 percent** of **households** with a latrine **share** with two or more households

Source: DHS.

Ethiopia making up around 10 percent of the population. While progress on water supply and sanitation coverage has been made in the predominantly pastoralist and agropastoralist regions of Afar and Somali, it lags behind that of other regions. Furthermore, coverage in the pockets of pastoralist and agropastoralist areas of other large predominantly agrarian regions (including Oromia and Southern Nations, Nationalities, and People Region [SNNPR]) has also lagged behind, pointing to systemic problems in the ability of the decentralized service delivery machinery to reach pastoralists and agropastoralists. The problems are driven by a combination of complex hydrogeology, remoteness, financing modalities, and the interface between the bureaucracy and these more mobile forms of livelihood.

In contrast to rural WASH services, urban WASH services have delivered real benefits but not equitably or sustainably. With over 10 million people joining those who are able to access water from a piped source on premises, significant time savings have been realized in urban areas. However, these time savings have been disproportionally captured by wealthier households (top 60 percent [T60] of the wealth index), which are nearly four times more likely to have access to piped water on premises than poorer households (those in the bottom 40 percent [B40] of the wealth index). The reasons for this inequitable uptake is twofold. For around one-third of unconnected households, mainly in smaller towns, there is a basic lack of infrastructure to hook up to. For the other two-thirds of unconnected households, mainly in large urban centers, there is infrastructure to hook up to but there are barriers in the form of connection charges and utility inertia.

In the case of urban sanitation, while driven by individual investment rather than through capture of a public service, households in the wealthiest quintile are six times more likely to have improved their latrines than those in the poorest quintile. Over half of urban households share latrines with two or more other households, and this proportion is significantly higher among households that rent (77 percent) rather than own (29 percent) their houses. The expanding private rental market requires increased dialogue with the private sector and greater regulation to maintain standards.

Though delivering real benefits WASH services are far from sustainable. In the case of water supply, cost recovery is barely covering operational costs, is only partially covering maintenance costs, and is not covering the replacement of infrastructure. Much routine maintenance is being deferred because costs are only marginally below revenues. Moreover, the new sources of water that will need to be developed to meet rapidly increasing urban demands will incur higher marginal costs as existing urban and peri-urban sources are depleted. In the case of urban sanitation services, though both the numbers and the proportion of improved latrines

Figure ES.3: Inequalities in Service Delivery across the Four WASH Subsectors in Ethiopia, 2017

Rural water	Rural sanitation	Urban water	Urban sanitation
Access to improved water sources in **pastoralist** areas is **twothirds** of that in **agrarian** areas	Latrine coverage in **Emerging regions** is **half** that of coverage in the **Large regions**	**Wealthier** households are nearly **four times** more likely to have access to piped water on premises than **poorer** households	Households in the **wealthiest** quintile are **six times** more likely to have an improved latrine than those in the **poorest** quintile

Source: DHS.

have risen over the past 20 years, fecal sludge management chains are nascent at best. In many towns these chains are nonexistent, resulting in fecal sludge being dumped untreated into the environment.

The potential health benefits of providing access to water supply and sanitation services are not being fully realized due to communities not reaching high enough coverage levels to break the transmission of disease. This is further compounded by poor quality of services—unimproved latrines and poor water quality—upon which most households rely. The health burden of inadequate access to WASH services is disproportionately borne by poorer children and those in vulnerable geographic areas. Children in poor households are up to 2.7 times more likely to be underweight and five times more likely to be severely underweight. Overlapping vulnerabilities substantially modify the impact of WASH investments. Children in poor households have higher exposure and susceptibility than children in rich households, with the B40 having approximately 50 percent of the cumulative share of the susceptibility and risk.

Conclusions and Recommendations

The GoE has been successful at linking the decentralized generic service delivery machinery it has put in place with the sector policy direction, plans, and capacity to rollout basic WASH services at an industrial scale. This has been done with strong country leadership that directs both domestic public and overseas aid resources well with basic, public access WASH services (nonrivalrous, nonexclusive goods). However, when WASH services have added value and a private dimension (rivalrous and exclusive goods), progress on implementing the policy direction, particularly on cost recovery, has been limited and the sector outcomes regressive, with wealthier households disproportionately capturing the benefits of public expenditure.

The rollout of basic WASH services has been equitable across wealth groups though albeit less equitable across livelihood types. Basic water supply services in rural areas include public water points (protected wells, springs, and boreholes). In the case of sanitation and hygiene this has been through knowledge disseminated from health extension workers across the country.

The challenge for basic WASH services will be to improve quality and functionality while achieving universality. Without making these shifts, the contribution of WASH services to improving key health indicators, such a reducing diarrhea and stunting, will not be realized. In the case of rural water supply there are two priorities. First, to ensure that rural water services deliver their potential health benefits, water quality needs to be improved. Second, rural water supply needs to deliver on the economic promise of freeing people's time by bringing services closer to peoples' homes, and do so reliably by addressing mechanical functionality. This, in turn, will increase demand for water quantity, which requires more systematic approaches to water resource assessment and monitoring both to respond to the increase in demand and to reduce vulnerability to extreme climate events.

For sanitation, the main aim is to improve the quality of latrines to ensure they separate people from fecal material. Moving the millions of rural households using unimproved latrines up the sanitation ladder is going to require a combination of demand- and supply-side approaches. Health extension workers will need additional skills and updated communication tools to more effectively combine demand creation with supply-side interventions. This would include market development for businesses selling sanitation products as well as nonhardware subsidies for bringing supply and demand together.[2]

This study shows that the availability of microfinance in Ethiopia is positively correlated with improved sanitation coverage. Expanding financing options for producers and consumers of sanitation products should be promoted, and targeted subsidies, possibility through PSNP, should be explored to ensure that the very poorest households are not left behind.

Remaining inequalities in basic services are principally in pastoralist and agropastoralist areas. GoE is well aware of this service gap and in 2009 set up the Ministry of Federal Affairs principally to close the service and capacity gaps between large and low-income regions. Addressing this gap requires building greater technical expertise in areas with difficult hydrogeology and finding ways for the decentralized service delivery machinery to interface with pastoralist and agropastoralist communities. As part of the rollout of the Millennium Development Goal (MDG) special purpose grant, the regions of Afar and Somali drew on capacity in larger regions to set up drilling agencies. While this may be part of the solution, the same larger regions are having difficulty delivering services to pastoralists and agropastoralists in their own regions. This suggests that both the existing technologies and the service delivery interface in pastoralist and agropastoralist areas needs revisiting for both water supply and sanitation services.

There has also been progress in the rollout of *WASH services with added value* and a private dimension. These value added services—though often not yet safely managed—are piped water on premises and sustainably managed sanitation. To date, the rollout and uptake of these services have mainly been in urban areas and have been regressive, with wealthier households disproportionately capturing piped water on premises and finding it easier to invest in building or upgrading their own toilet facilities. Yet even these value added WASH services have flaws in both quality and sustainability.

The challenge for value added WASH services will be addressing equity while improving quality and sustainability. For piped water supply the greatest barrier to equity needs to be tackled at the level of service providers. With two-thirds of unconnected urban dwellers in areas where they could hook up to utilities, there needs to be much stronger incentives for utilities to connect them.

The qualitative work for this report brings to light both that connection charges are a barrier and that the interface between service providers and customers makes requesting connections an unnecessarily long and complicated process. There is also room to gradually increase tariffs and improve the efficiency with which bill payments are collected to overcome a second problem raised by utilities: collecting revenues from poorer households connected to utilities cost more than the amount collected. This would also start to address the broader underlying need to work toward full cost recovery.

Investment is needed in water treatment and water quality monitoring. This is especially the case for towns that have transitioned from being classified as rural to being classified as urban local governments (ULGs). As towns make this transition, they lose access to woreda block grants but have yet to increase their own source revenue capacity for investment. A transitional infrastructure financing arrangement is needed to plug this gap. The MDG special purpose grant for capital investment that was introduced in 2011 may be part of the solution, but it is too early to tell. The MDG grant's highly discretionary nature, being both multisector and for rural or urban, does not favor targeting this transitional demographic. In parallel, improving the performance and reach of the Water Resources Development Fund, a public sector lending facility for utilities set up in 2002, could also help small towns with their water supply investment needs.

Value added sanitation solutions, particularly in urban areas, require a citywide approach to tackle the full service chain, and to ensure fecal sludge is safely captured, transported, and treated. This needs increased public investment in the management and treatment of fecal sludge, and, where appropriate, investment in sewers to enable transportation. However, the current low sewerage access levels, high cost, and challenge of retrofitting sewers in fast expanding, unplanned cities mean most transportation will be through vacuum trucks (which is one opportunity to engage the private sector). A second opportunity to involve the private sector at scale is through the private urban housing sector, which can bring innovation and efficiency to fecal sludge management, e.g., management of decentralized treatment plants.

To improve sanitation services for the poorest households, better access to fecal sludge transportation services is needed in unplanned urban areas. While the private sector can play a role in driving down the cost of latrines and developing innovative solutions for challenging areas, government subsidies might also be considered. Subsidies could be focused at lowering borrowing costs for improving household sanitation infrastructure, facilitating connection to sewers, and encouraging the use of fecal sludge transportation services. These subsidies could be channeled through the new urban safety net initiative.

Incentives for landlords, including for kebele-managed housing,[3] is needed to facilitate investment to reduce sharing rates and to improve the quality of latrines. This could be facilitated for new housing through building regulations. The qualitative work for this report highlights the need for greater responsiveness by kebele administrations to encourage rather than discourage home improvements that tenants are prepared to make.

Geographic targeting of WASH investments to areas with higher concentrations of children who face poor nutrition status and health access offers a simple compass for reaching the most vulnerable. The regional distributions of exposure, susceptibility, and risk index values in the B40 population indicate that every region has highly vulnerable children. This emphasizes the importance of combining geographic and poverty targeting of WASH and health investments. The implementation of pro-poor targeting in the WASH sector would be further enhanced through coordination with social protection programs that focus on households with young children who are vulnerable.

On top of the challenges of delivering services under the MDG framework, GoE and its development partners now need to consider the additional rigor required in delivering on the SDGs. Improving and expanding both basic and safely managed WASH services call for continuing GoE's twin track development of both its core country systems for decentralized service delivery and its sector institutions that together have driven progress at scale over the past decade and more.

The transition to the SDGs needs to be done with two supporting factors in mind: (a) a massive upgrading of skills in the public and private sector to provide the right mix of skills and services needed to tackle the SDG, and (b) a full integration of WASH service delivery into the broader water governance agenda to ensure that water services are able to compete with other fast growing demands for water.

With the estimated SDG financing gap running into billions of dollars a year, much more than incremental improvements to past progress are needed. The reward for making this transition from MDGs to SDGs is the real prospect of delivering on the health and economic gains that have been elusive under the MDG framework.

Notes

1. Previous smaller water quality surveys reported lower levels of contamination but lacked the scale and representativeness of the 2016 Ethiopia Socioeconomic Survey Water Quality Test module.
2. Subsidies that facilitate market functioning, e.g., training sanitation entrepreneurs, include lowering interest rates for borrowing for sanitation-related improvements rather than subsidies for sanitation hardware (e.g., slabs).
3. A kebele, similar to a ward, is the smallest administrative unit in Ethiopia; it translates to "neighborhood."

Reference

World Bank 2015c. *Ethiopia Urbanization Review: Urban Institutions for a Middle-Income Ethiopia*. Washington, DC: World Bank.

Abbreviations

AAWSA	Addis Ababa Water and Sewerage Authority
AfDB	African Development Bank
B20	bottom 20 percent of the wealth index
B40	bottom 40 percent of the wealth index
BGS	British Geological Survey
BoFED	Bureau of Finance and Economic Development (regional)
CDF	Community Development Foundation
CLTHS	community-led total sanitation and hygiene
CSA	Central Statistical Agency
CWA	consolidated WASH Account
DALY	disability-adjusted life year
DHS	Demographic Health Survey
DP	development program
EED	environmental enteric dysfunction
ESRDF	Ethiopia Social Rehabilitation and Development Fund
ESS	Ethiopia Socioeconomic Survey
ESS-WQT	Ethiopia Socioeconomic Survey-Water Quality Testing Component
EWSSP	Ethiopian Water Supply and Sanitation Project
GBD	global burden of disease
GoE	Government of Ethiopia
GPG	General Purpose Grant
GPW	Gridded Population of the World
GTP	Growth and Transformation Plan
HEP	health extension program
HEW	health extension worker
HI	Hydrological Index

HICES	Household Income Consumption and Expenditure Survey
IBEX	Integrated Budget and Expenditure Management System
IHDP	Integrated Housing Development Program
ISA	Integrated Surveys on Agriculture
IUSHS	Integrated Urban Sanitation and Hygiene Strategy
JMP	Joint Monitoring Programme for Water Supply and Sanitation (WHO/UNICEF)
LIU	Livelihoods Integration Unit
LSHTM	London School of Hygiene and Tropical Medicine
LSMS	Living Standards Measurement Study
MDG	Millennium Development Goal
MoE	Ministry of Education
MoFEC	Ministry of Finance and Economic Cooperation
MoFED	Ministry of Finance and Economic Development
MoH	Ministry of Health
MoU	memorandum of understanding
MoWIE	Ministry of Water, Irrigation and Electricity
MoWUDC	Ministry of Works, Urban Development and Housing Construction
NHSS	National Hygiene and Sanitation Strategy
NGO	nongovernmental organization
NRW	nonrevenue water
NSDS	National Strategy for the Development of Statistics
NWCO	National WASH Coordination Office
NWI	National WASH Inventory
NWSC	National WASH Steering Committee
NWTT	National WASH Technical Team
ODI	Overseas Development Institute
ORT	oral rehydration treatment
OLS	ordinary least squares
OWNP	ONE WASH National Program

PASDEP	A Plan for Accelerated and Sustained Development to End Poverty
PMU	project management unit
PSNP	Productive Safety Nets Program
PSU	primary sampling units
RADWQ	Rapid Assessment of Drinking-Water Quality
RCT	randomized controlled trials
RR	relative risk
RWCO	Regional WASH Coordination Office
SD	standard deviation
SDG	Sustainable Development Goal
SDPRP	Sustainable Development and Poverty Reduction
SNNPR	Southern Nations, Nationalities and People Region
SPG	specific purpose grant
T20	top 20 percent of the wealth index
T60	top 60 percent of the wealth index
ToFED	Town Administration Office of Finance and Economic Development
TVET	Technical and Vocational Education and Training Agency
UAP	Universal Access Plan
ULG	urban local government
UNICEF	United Nations Children's Fund
VIP	ventilated improved pit (latrine)
WASH	water supply, sanitation, and hygiene
WASHCO	water supply, sanitation, and hygiene committee
WASH PRM	WASH Poverty Risk Model
WDI	World Development Indicators
WFA	weight-for-age
WIF	WASH Implementation Framework
WMS	Welfare Monitoring Survey
WoFED	Woreda Office of Finance and Economic Development

WPD	WASH Poverty Diagnostic
WQT	water quality testing
WRDF	Water Resource Development Fund
WSG	woreda support groups
WSP	Water Supply and Sanitation Program
WWTP	wastewater treatment plant
WQ	wealth quintile
YLL	years of life lost
ZoFED	Zonal Administration Office of Finance and Economic Development

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Chapter 1
Introduction

The WASH Poverty Diagnostic (WPD) in Ethiopia is part of a global initiative with the objective of improving the evidence on the linkages between water supply, sanitation, and hygiene (WASH) and poverty, as well as identifying opportunities and bottlenecks in the sector. Following the structure of all WPDs, this diagnostic uses existing and newly collected data to answer four core questions:

- Who and where are the poor populations and bottom 40 percent (B40) of the national distribution (consumption)?
- What is the level of access and quality of WASH services experienced by poor households and the B40 as compared to the nonpoor and to the top 60 percent (T60)?
- 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 households and B40?

By answering these core questions, the WPD aims to provide a comprehensive analysis of the current state of access to water supply and sanitation services, including understanding the drivers behind the significant progress in coverage in Ethiopia over the last 20 years. Ethiopia achieved the drinking water Millennium Development Goals (MDG) target of 57 percent, successfully halving the number of households without access to improved drinking water since 1990. In doing so over 52 million people in Ethiopia now have access to an improved drinking water source (within 1.5 kilometers) as compared to only 6 million people in 1990 (see figure 1.1).

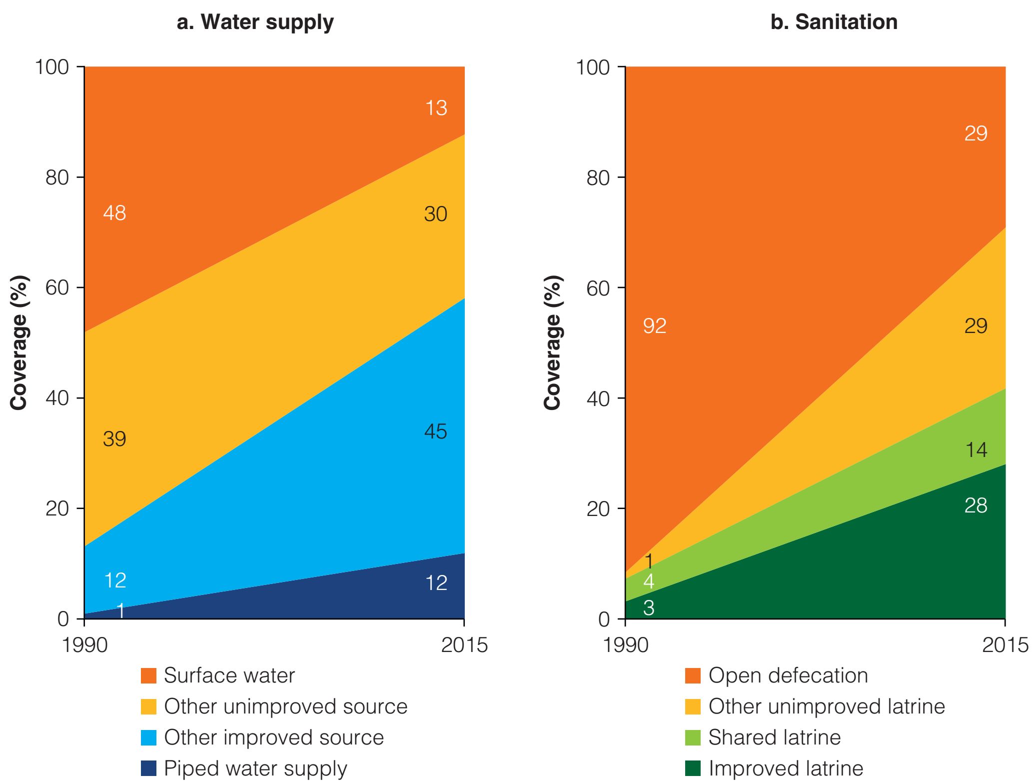
This achievement is primarily the consequence of significant improvements in access to drinking water supplies in rural areas. The Sustainable Development Goals (SDGs) aim for universal access to safe water supply and sanitation, raise the bar for the WASH sector. Water quality has been added to the definition of the SDGs water indicator for safely managed water coverage. Ethiopia has a significant challenge to increase the quality of coverage to address this.

While Ethiopia did not achieve the MDG for sanitation, the practice of open defecation was decreased by 63 percent, which was the largest decrease in the proportion of the population practicing open defecation of any country globally. As a result, 67 million people gained access to a latrine over the MDG period at an average of 2.6 million people per year. This progress was achieved through the integration of sanitation and hygiene promotion into the wider health deliver mechanism, and a strong focus on behavior change. However, despite this progress just 10 percent of all latrines constructed in rural areas qualify as an improved latrine.

Urbanization has increased the pressure on existing services, specifically sanitation, and historic funding levels have struggled to keep up with demand. Just as water needs to be safely managed under SDG goals, the SDG definition for sanitation targets requires sanitation to be safely managed. Ethiopia currently has limited infrastructure and service delivery systems to ensure fecal waste can be safely managed across the service chain. The combination of increased demand and expectation of higher standards in urban areas require new approaches to be adapted, as well as significant increases in financing and greater institutional capacity to address these more complex challenges. The WPD examines the challenges that need to be addressed around three main areas:

- Increasing the quality of services, both for greater impact and to meet the higher bar set by the SDGs
- Effective targeting and delivery mechanisms to reach and provide sustainable services to underserved sections of the population, specifically pastoralist communities
- Solutions to the growing urban water supply and sanitation service delivery gap, both in large urban centers and smaller emerging towns.

Figure 1.1: JMP Estimates of Water Supply and Sanitation Coverage in Ethiopia, 1990–2015



Source: UNICEF/WHO 2015.
Note: JMP = Joint Monitoring Programme.

Box 1.1: Data Used in This Report

This report draws on a wide range of household surveys; administrative data from the water, urban, and agriculture sectors; financial BOOST data for Ethiopia; and Ethiopia's national integrated budget and expenditure management system (IBEX).

box continues next page

Box 1.1: Continued

National representative household surveys. The main nationally representative surveys used are the Demographic Health Survey (DHS), the Welfare Monitoring Survey (WMS) and the Housing and Population Census. The Mini-DHS 2014 was not used. Though nationally representative and representative at regional level, the sample frame was not suitable for urban versus rural analysis at the regional level particularly in smaller regions.

Each of these types of survey has its strengths and weaknesses. The DHS series (2000, 2005, 2011, 2014, 2016) has water supply and sanitation definitions, which are best aligned to MDG and SDG monitoring. The WMS series (2000, 2010/11) are linked to the Household Incomes, Consumption, and Expenditure surveys, which enable econometric analysis. The 2007 Housing and Population Census, which has a long form of the questionnaire administered to one in five households across the country, yields by far the highest resolution and enables analysis at the woreda level (district units of around 100,000 population). Though dated, the sector outcomes in the 2007 Census are in line with the trajectories of later surveys meaning that the analysis of differences in coverage among categories is insightful.

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) reports on global, regional, and country progress on access to WASH. The JMP data served as the basis for monitoring the MDGs and building indicators for WASH within the Sustainable Development Goals (SDGs). The JMP relies on a number of government data points and applies some assumptions to reach their coverage figures. Apart from instances in which the report directly references JMP data, the analysis in this report has used the original government survey data and not applied any assumptions. It was felt, specifically in relation to sanitation coverage, that the original government survey data provides a more accurate picture than data generated using the JMP assumptions.

Atlas of Ethiopian Livelihoods. In 2010 the Livelihoods Integration Unit at the Ministry of Agriculture and Rural Development released a national database and atlas of livelihoods for Ethiopia. The data are based both on household surveys and broader field work on rural livelihoods. Building on work done by the *Ethiopia Poverty Assessment* (World Bank 2015a), the livelihoods database underpinning the atlas was fully integrated with the 2007 Census data, and the 2010/11 poverty data from HICES, as well as with hydrogeological data from the University of Addis Ababa.

National WASH Inventory. In 2010/11 the Ministry of Water, Irrigation and Electricity (MoWIE) compiled a national inventory of improved water points (piped and protected sources). Though this data have not been made public in full, summary data have been used to analyze aspects of service delivery such as water point functionality not possible to estimate from national surveys.

Learning journeys. In addition to examining the quantitative data, the team has identified and followed the personal journeys of people in different parts of Ethiopia who faced basic problems in accessing WASH or in fixing systems that have broken down. These personal learning journeys are used to illustrate specific issues including: affordability, age, gender, and governance.

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Bosena Abeetew, widow and mother of 7, Aboakokit Kebele, Fogera Woreda, Amhara Region
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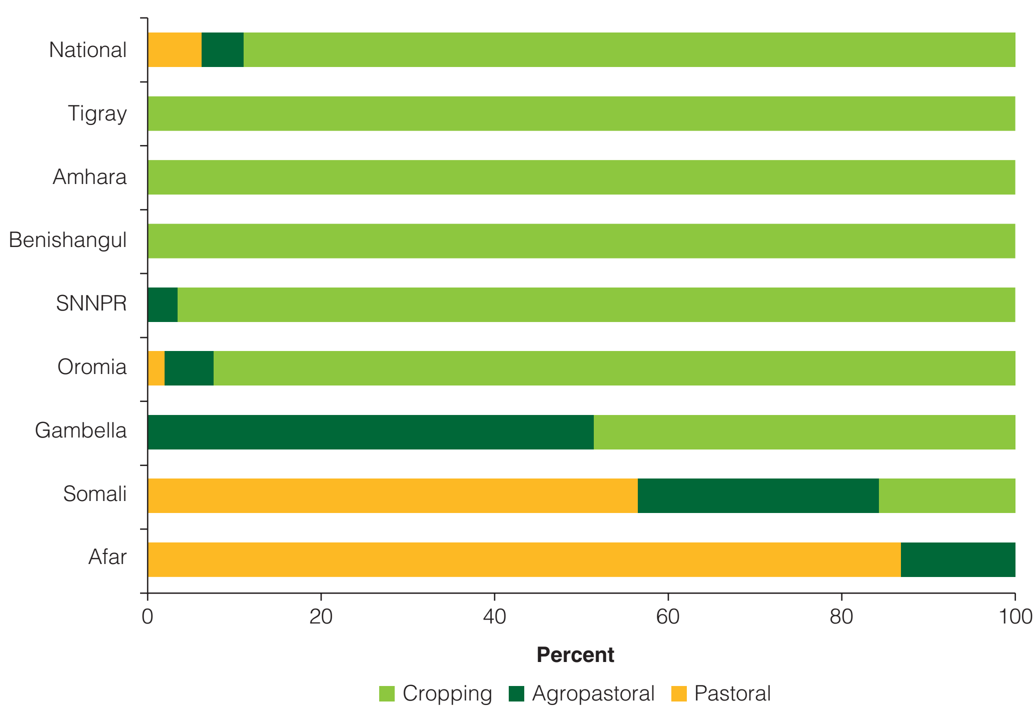
Chapter 2 Demographic and Poverty Overview

In 2015 Ethiopia's population approached 100 million people. Over 80 million people live in rural areas. Rural livelihoods are shaped by Ethiopia's extremely diverse geography. Rainfall, altitude, topology, soils, culture, and population density interact to form a complex mosaic of livelihood zones. Understanding and responding to the needs of different livelihood types have been key to reducing poverty and promoting growth in rural areas.

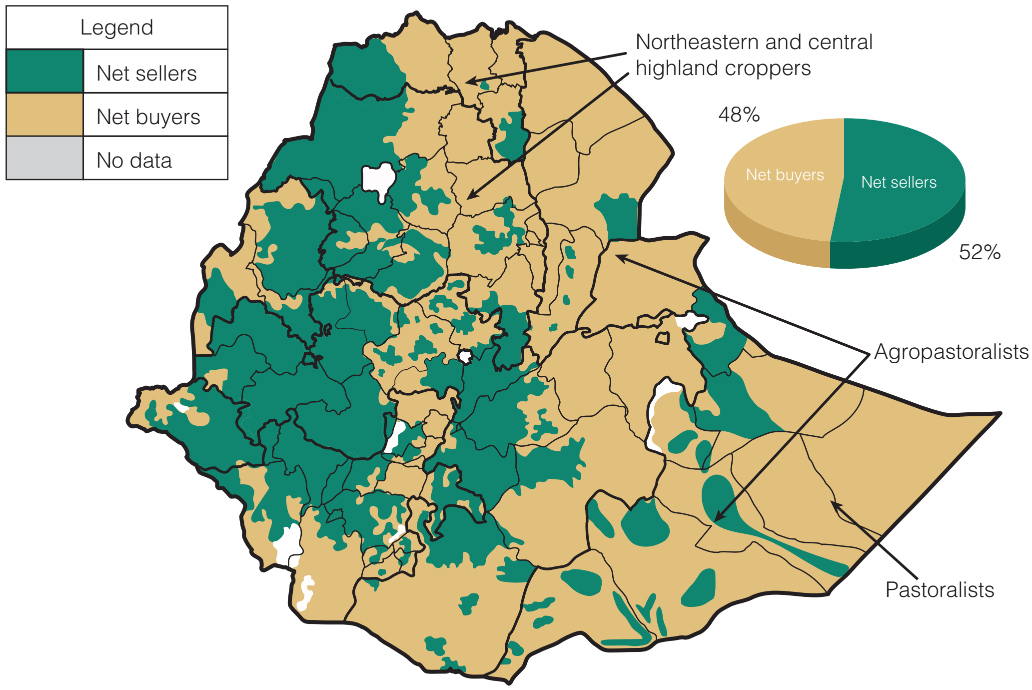
Three broad livelihood types that emerge from this mosaic are: pastoralist, agropastoralist, and agrarian cropping. Pastoralist and agropastoralist livelihoods are dominant in the sparsely populated eastern and southern dry lowland areas; agrarian copping is dominant in the mid- to higher altitude areas, which also have higher population densities. Within agrarian cropping areas the lower rainfall eastern half of the country is less food secure than the west of the country leading to a consistent pattern of net buyers and net sellers of food crops (map 2.1).

Figure 2.1: Livelihood Types by Region in Ethiopia, 2010



Source: GoE 2010.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Map 2.1: Net Sellers and Buyers of Food Crops in Ethiopia, 2010



Source: GoE 2010.

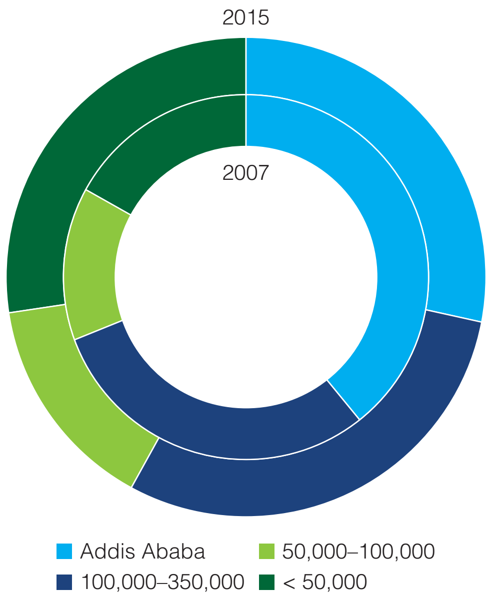
Box 2.1: Ethiopia's Absolute Poverty Line

In Ethiopia, absolute poverty is measured by comparing a household's consumption per adult equivalent to the national poverty line, defined as Br 3,781 per year in 2011. The poverty line indicates the minimum money required to afford the food covering the minimum required caloric intake (estimated at Br 1,985) and additional essential nonfood items (Br 1,796), totaling Br 3,781. This was based on the 2010/11 Household Income Consumption and Expenditure Survey (HICES).

Following years of ad hoc food aid to many eastern areas of the country, including some pastoral and agropastoral areas, the Government of Ethiopia (GoE) and its development partners launched the Productive Safety Nets Program (PSNP) in 2005, which covers around 300 woredas (box 2.1). PSNP has become a structural feature of both defining and alleviating rural poverty.

Of the people living in urban areas, just under one-third live in Addis Ababa, just under one-third in 16 secondary cities with over 100,000 people, and, the remainder in over 200 small towns

Figure 2.2: Share of Population by Population Size of Towns and Cities in Ethiopia, 2007 and 2015



Source: National Survey 2007.

spread throughout the country. The share of the urban population outside of Addis Ababa is growing, as urbanization in secondary cities and small towns outpaces that in the capital (figure 2.2).

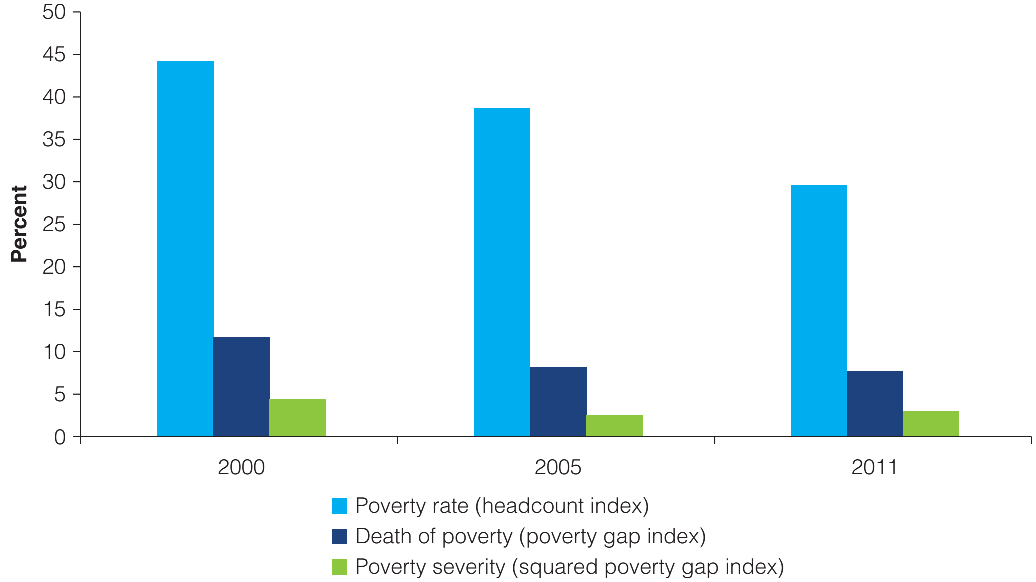
While Ethiopia has been slow to urbanize compared to other countries in Africa, urbanization is accelerating, with recent estimates putting urban growth at above 5 percent. The "Ethiopia Urbanization Review" (Ozlu et al. 2015) points to the need to proactively manage urbanization if it is to provide jobs, infrastructure, services, and housing that will drive poverty reduction and growth in future. With much of this growth happing outside of Addis Ababa in both secondary cities and hundreds of small towns, strategic decisions on systems to support this distributed urban development today will have far reaching implications for Ethiopia's cities of tomorrow (Ozlu et al. 2015).

Between 2000 and 2011 the proportion of households living below the national poverty line fell from just under 45 percent to just under 30 percent (figure 2.3). Over this same period there was also convergence in the rate of poverty, to around one person in three, across all regions of Ethiopia (figure 2.4).

Though poverty headcount rates were not dissimilar in urban (26 percent) and rural areas (30 percent), 85 percent of Ethiopia's poor households live in rural areas (figure 2.5). With Ethiopia's regional states being of uneven size over half of poor people in 2011 lived in rural Oromia and Amhara.

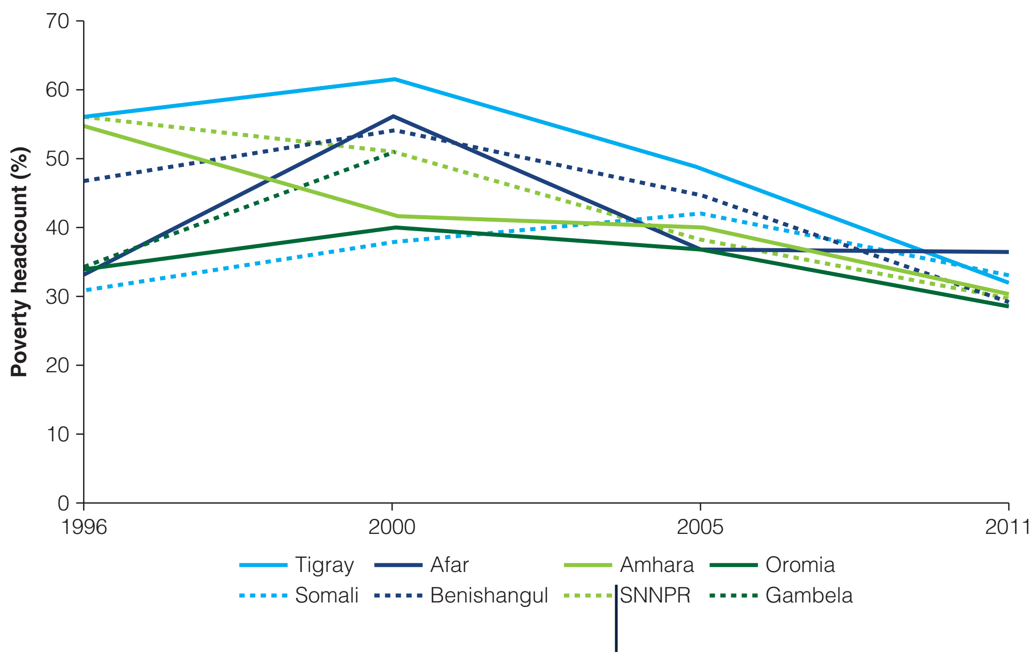
In addition to being predominantly rural households, the household heads of poor households are older, less educated, and more often married than nonpoor household heads, and they have a greater number of dependents than wealthier households. Households in the bottom 10 percent of the consumption distribution have even lower levels of education, are in households of larger size, have more dependents, and are headed by more elderly heads than other poor households.

Figure 2.3: National Poverty Trends in Ethiopia, 2000–11



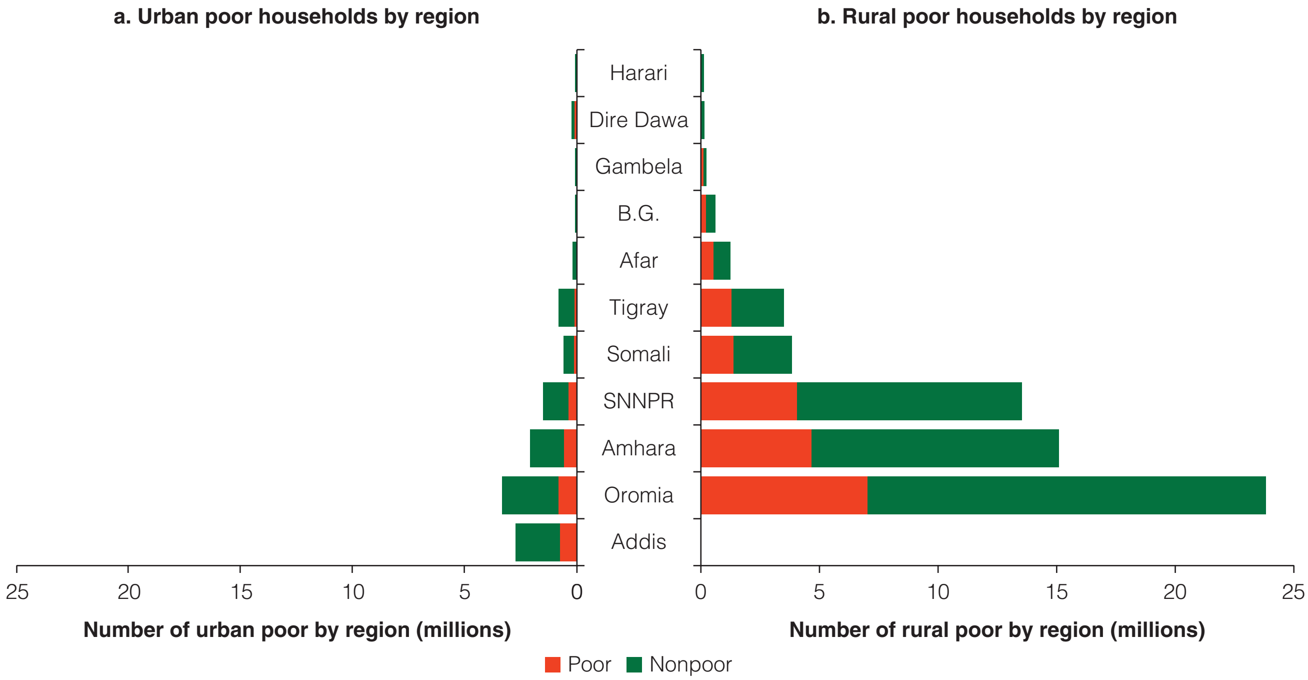
Source: World Bank 2015a.

Figure 2.4: Poverty Headcount by Region in Ethiopia, 1996–2011



Source: World Bank 2015a.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Figure 2.5: Absolute Numbers of Poor and Nonpoor Households, by Region and Residence in Ethiopia, 2012



Sources: World Bank calculations based on GoE 2012 and 2007 Census data.
Note: B.G. = Benishangul-Gumuz; SNNPR = Southern Nations, Nationalities, and People Region.

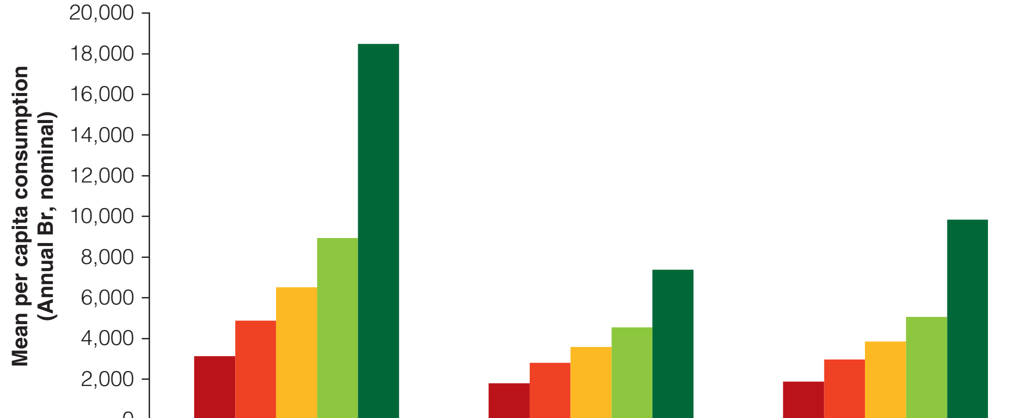
Across urban areas, poverty rates in small urban centers—rural towns—are higher than larger urban centers (see figure 2.6). The exception to this is Addis Ababa, which has a higher poverty headcount ratio and greater inequality than most other cities, independent of size.

Households with elderly members, widows, and with elderly or female heads are much more likely to be poor if they are in urban areas compared to rural areas (see figure 2.7). In urban areas households with an elderly member or an elderly head are 12 and 13 percentage points more likely to be poor than other households. This contrasts with elderly household members or elderly heads in rural areas, who are less likely to be poor than other rural households. A similar pattern is observed for female-headed households who are less likely to be poor in rural areas and more likely to be poor in urban areas. A number of factors influence these different characteristics of the poor households across rural and urban areas including (a) that urban households are smaller on average; (b) that there are more single adult urban households; and (c) that there are a higher proportion of female-headed households in urban than rural areas.

Another contributing factor to the difference in poverty across rural and urban households is that, whereas the PSNP provides support to the poor and vulnerable households in rural areas, there is no equivalent in urban areas. Urban households do benefit more than rural households from indirect subsidies in fuel and food, but this benefit is not large enough to compensate for the lack of direct transfers among the bottom percentiles (Ozlu et al. 2015.).

In rural areas, poverty rates are higher among households with pastoralist and agropastoralist livelihoods than among those areas where agrarian cropping is dominant. This is particularly the case in the regional states of SNNPR and Oromia where pastoralists and agropastoralist are minorities among households pursuing agrarian livelihoods.

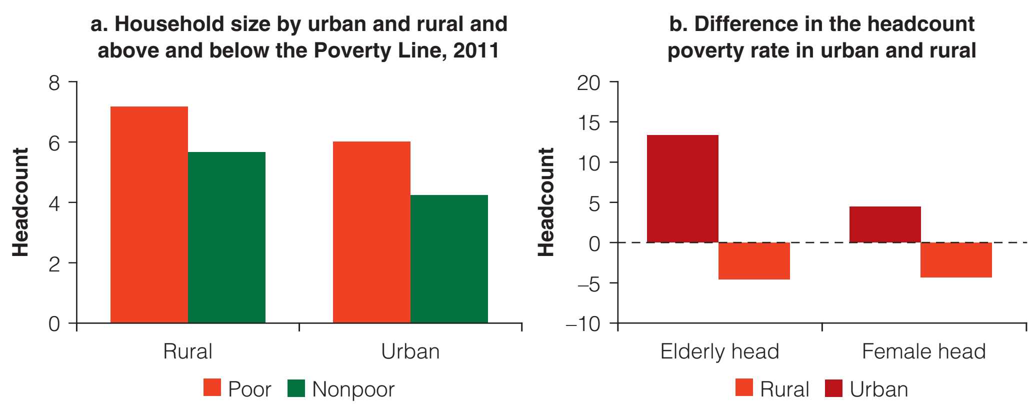
Figure 2.6: Mean Consumption, by Urban, Rural, and National Quintiles in Ethiopia, 2011



	a. Urban	b. Rural	c. National
Poorest	3,125	1,796	1,891
Poorer	4,883	2,806	2,970
Middle	6,516	3,588	3,857
Richer	8,934	4,545	5,062
Richest	18,493	7,374	9,837

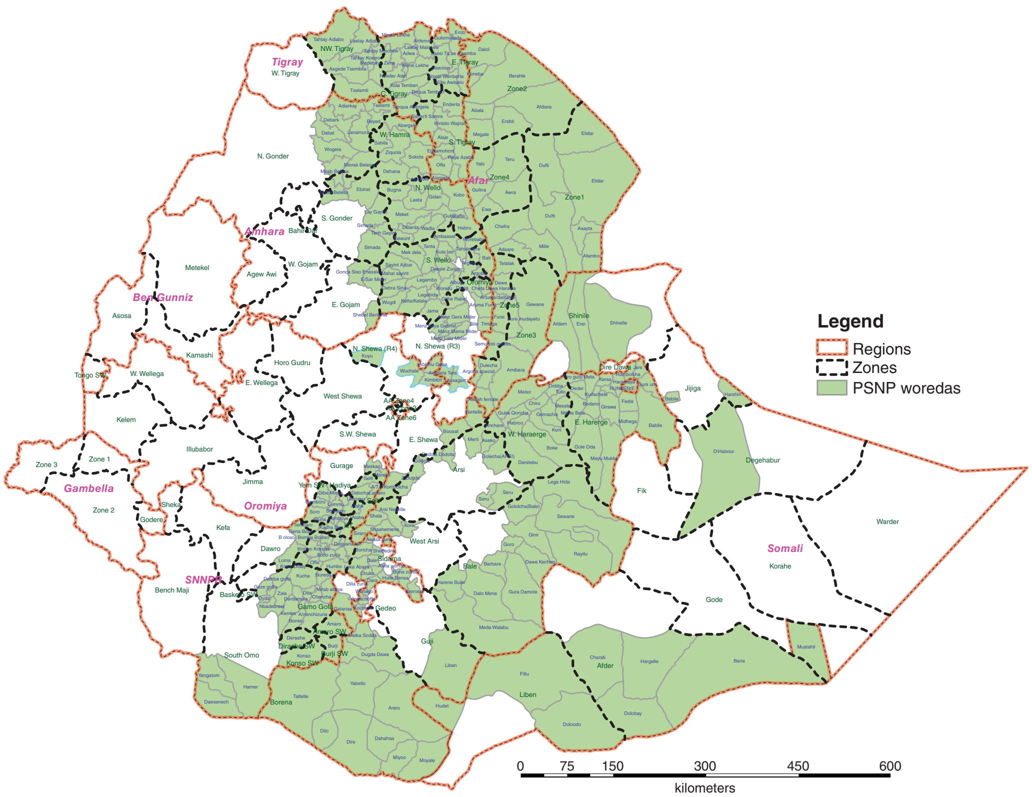
Source: HICES 2011.

Figure 2.7: Household Size and Poverty



Source: HICES 2011.

Map 2.2: Productive Safety Nets Program in Woredas and Responsible Agency in Ethiopia, 2010



Source: World Bank calculations based on the merged 2011 HICES and the 2010 LIU livelihoods database.
Note: PSNP = Productive Safety Nets Program.

Figure 2.8: Poverty by Livelihood Type in Ethiopia, 2007

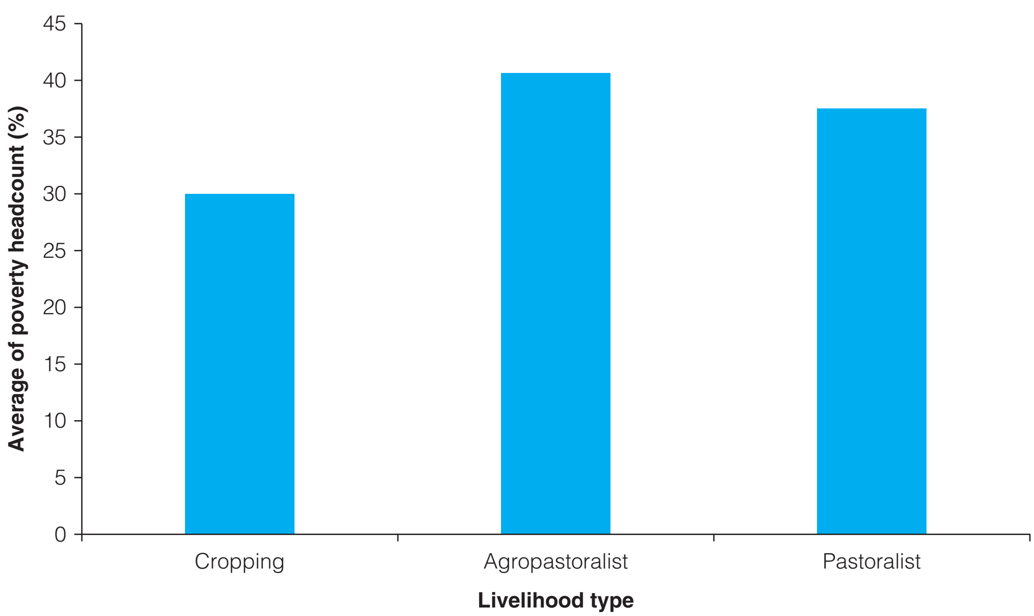
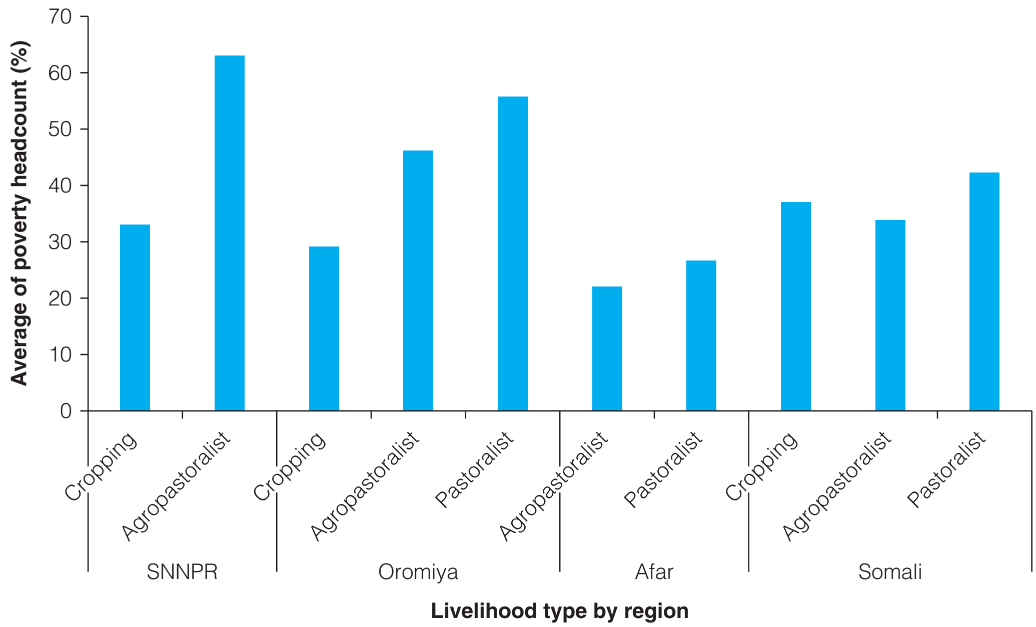
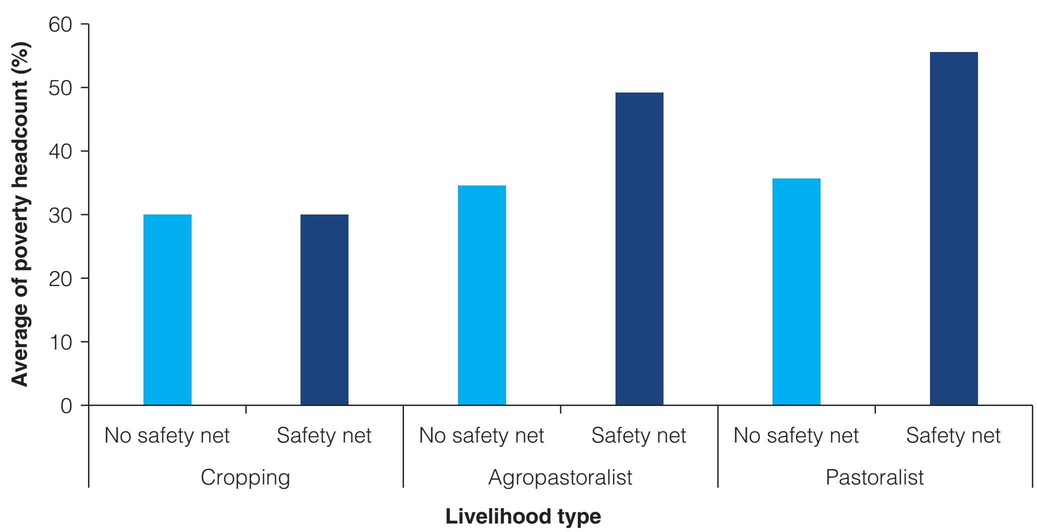


Figure 2.9: Poverty by Livelihood Type and Region in Ethiopia, 2007



Note: SNNPR = Southern Nations, Nationalities, and People Region.

Figure 2.10: Poverty Rates by Livelihood Type and Safety Net Coverage in Ethiopa, 2011



Source: FAO 2010.
Note: PSNP = Productive Safety Net Program.

Box 2.2: Ethiopia's Rural Productive Safety Nets Program

In 2005 the GoE launched the PSNP to help address the needs of chronically food insecure households. The PSNP is a flagship program both in its scope, covering around 10 million people, and in its partnership approach. The PSNP provides up to 10 million people with (a) predictable food and cash transfers to targeted beneficiary households so as to avoid asset depletion in times of need; and (b) the creation of productive and sustainable community assets through a public works program that contributes to the rehabilitation of severely degraded areas and increases household productivity.

PSNP has contributed significantly to improved food security in Ethiopia over the past decade. In the highland regions, PSNP clients have seen their average months of food security rise from 8.4 per year in 2006 to 10.1 in 2012. The public works program addresses root causes of vulnerability and food insecurity by supporting the development of a productive watershed and linking rural communities to small towns where they can access inputs, markets, and services. Further, PSNP public works have led to important improvements in rural infrastructure and have contributed to improved access to education and health services, enhanced water retention, and reduced soil and water run-off. The public works have also protected land in area enclosures, which increases soil fertility and carbon sequestration.

In 2014 the annual budget of the PSNP program was over US$500 million a year. PSNP has provided important disaster response through contingency budgets at woreda and regional levels and a federal risk financing mechanism. Since its launch, PSNP has grown the number of rural woredas that it covers: 260 in 2005, 290 in 2009, 320 in 2014, and a planned 411 in 2018. This expansion has been driven both by the splitting of woredas and the expansion of the program into Afar and Somali regions. The analysis in this report examines data for PSNP woredas from 2005–09.

Source: World Bank 2014b.

By contrast to the marked differences in poverty rates between agrarian and pastoralist livelihoods, there was little difference in the poverty rates across the different categories of crop–market interaction types within the agrarian livelihoods category. Poverty rates for households pursuing agrarian cropping livelihoods were also very similar to those covered and those not covered by the PSNP safety net. This may be the result of the positive effects of the PSNP. However, poverty rates in pastoralist and agropastoralist were much higher in woredas covered by PSNP, pointing to the possibility that the program has had less of an equalizing effect in these areas. These variations in the poverty characteristics of rural and urban areas are foundational to the analysis of service delivery explored in this report.

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Chapter 3
Framework for WASH Service Provision in Ethiopia

Ethiopia has taken a progressive approach to instilling rights to basic services—including the right to clean, safe, and adequate water supply and sanitation—in its Constitution and through the ratification of international conventions. Article 90 of the 1994 Constitution states that "… to the extent the country's resources permit, policies shall aim to provide all Ethiopians access to public health and education, clean water, housing, food and social security." Although universal coverage to basic service has not yet been achieved, Ethiopia has made significant steps to create the necessary enabling environment: sector policies and plans; institutions at federal, regional, and woreda (district) level; and financing modalities to support progress. Key to creating this enabling environment is that both the core systems for rolling out service delivery in general (for all basic services) and sector-specific systems for shaping that service delivery have evolved in tandem with one reinforcing the other enabling at-scale service delivery.

The establishment of a decentralized system of service delivery has taken place gradually but deliberately over the last 20 years. The 1995 Constitution established a federal system with nine ethnically based regional states and two chartered cities with the right to self-determination. Each state has a parliamentary assembly, which elects representatives to the upper chamber of the federal parliament, the House of the Federation. Regions are split into two distinct groups, which also act a useful reference point of analysis in this report: large regions (Amhara; Oromia; Southern Nations, Nationalities, and People Region [SNNPR]; and Tigray) and emerging regions (Afar, Benishangul-Gumuz, Gambella, Harari, and Somali). The chartered cities of Addis Ababa and Dire Dawa have different structures but are considered equivalent to regions. The region of Harari has different characteristics than the other regions since it is largely urban.

The first phase of decentralization took place in 1995 with some of the central government powers devolved to regional states. In 2003, the GoE mandated a second wave of decentralization to woredas. Woredas, of which there are now over 800, are Ethiopia's key unit of local government. They have service delivery departments, including for water, health, education, and agriculture extension. Kebeles sit under woredas in the hierarchy and have an average population of about 5,000. In the most populous regions, zones were introduced as an intermediary administrative area above woredas, though their oversight over woredas varies among regions. The decentralization process stimulated a series of legal, fiscal, and administrative reforms, which began with four of the largest regions. The reforms have resulted in significant responsibilities for the provision of basic services being placed on woredas.

In parallel with fiscal decentralization, regions and woredas have significant service delivery roles. Regional and woreda governments have their own means of raising finance through local taxes. However, the percentage of regional budgets derived from internal revenue is still relatively small (the highest share was 20 percent in 2009/10), and the rate of growth in the share of budget derived from internal revenue has been low (Assefa 2015). The revenue generating capacity of the woreda level is even more constrained due both to the woreda's limited tax assignments and to their limited institutional capacity (Snyder et al. 2014).

To compensate for the imbalance in revenue and expenditure assignments, regions rely on a system of intergovernmental transfers between federal, regional, and woreda levels. There are two main types of intergovernmental transfer instruments in Ethiopia: the unconditional, or General Purpose Grant (GPG); and conditional, or Specific Purpose Grant (SPG). The block grant transfer scheme is based on equity in service delivery for all Ethiopians, and respective allocations are determined by a set of criteria that include population, expenditure needs, and revenue-raising capacities of each region. This approach seeks to smooth out the disparities in revenue-raising capacity across different levels of government (vertical imbalance) and equity between different jurisdictions (horizontal imbalance) (Assefa 2015).

Regions determine formulas to distribute block grant resources to woredas as long as resources are allocated in a rule-based manner following a predetermined and objective criteria (Garcia and Rajkumar 2008). Some regions, such as Amhara and Tigray, follow the same budget allocation criteria to distribute resources downward to woredas, whereas others, such as SNNPR, use uniform distribution to all woredas irrespective of any weighting criteria. Together, the two tiers of regional and woreda government and the intergovernmental transfer mechanisms form the backbone for all serivce delivery in Ethiopia, including for water supply and sanitation.

The evolution of Ethiopia's formal water sector began in 1995 with the establishment of the Ministry of Water Resources, which happened in parallel with political, fiscal, and administrative decentralization, and which created the core systems for service delivery. The first water resource management policy was passed in 1999 to promote equitable and efficient use of water resources for water supply, sanitation, irrigation, and hydropower. The policy was shortly followed by a Water Sector Strategy (2001) and Water Sector Development Programme (2002) to set out a more comprehensive institutional and financial framework to achieve the water policy objectives.

The 2005 Universal Access Plan (UAP) for water supply and sanitation consolidated the link between Ethiopia's decentralized institutions with the policy direction for expanding services. The UAP became the nationwide delivery mechanism; it set out explicit national targets for water supply and sanitation with the aim of reaching 98 percent, 100 percent, and 98.5 percent for rural, urban, and combined rural and urban settings, respectively, with access by 2012 (later revised to 2015). In rural areas access was to 15 liters per capita per day within 1.5 kilometers, and in urban areas, 20 liters per capita per day within 0.5 kilometers. The plan endorsed low-cost technologies and empowered woredas to deliver basic services and individual households to build self-supply sources. The UAP was key in galvanizing political and financial support for water supply and sanitation as a means of alleviating poverty.

The integration of sanitation and hygiene promotion with water supply has been an important step taken by the GoE. The National Hygiene and Sanitation Strategy (NHSS) was developed by the Ministry of Health (MoH) and published in 2005; it complements the existing Health Policy and Water Sector Strategy.

The government's strong commitment to decentralization and a clear sector policy framework have provided a solid basis to guide service delivery. For the most part, the GoE has clearly set out functions, coordination mechanisms, and guidance for implementation within the water supply, sanitation, and hygiene (WASH) sector. However, the strength of the sector policy framework and clarity of strategy varies among the four WASH subsectors. The rural subsectors are more mature than the urban subsectors, and water subsectors are more developed than sanitation (see box 3.1 on the roles and responsibilities for rural water supply). In urban areas, autonomous utilities were established and over the last 10 years the MoWIE has introduced further legislation to strengthen these, including a moving toward full cost recovery for urban water schemes. There is also a wide range in the capacity to implement these policies and across regions and woredas.

Since the late 1990s Ethiopia has been a country at the forefront of managing the interface between public finance and development assistance. Though programmatic approaches were adopted earlier in other sectors such as health and education, development assistance to water supply and sanitation has steadily shifted from project to programmatic approaches over the past decade. The ambitious targets set out in the UAP and the Growth and Transformation

Box 3.1: De Jure Assignment of Functions in Ethiopia's Rural Water Subsector

Ethiopia's institutional arrangement for WASH is clearly articulated on paper, with roles distributed across federal and regional levels, woredas, and communities (table B3.1.1). Since the inception of the OWNP, the government has introduced WASH coordination, management, and guidance bodies at the federal and regional tiers of government to manage Consolidated WASH Account (CWA) investments. These institutions are less developed, and recent research suggests that understanding of their role is limited at regional and woreda levels.

Table B3.1.1: Responsibilities of WASH sectors institutions

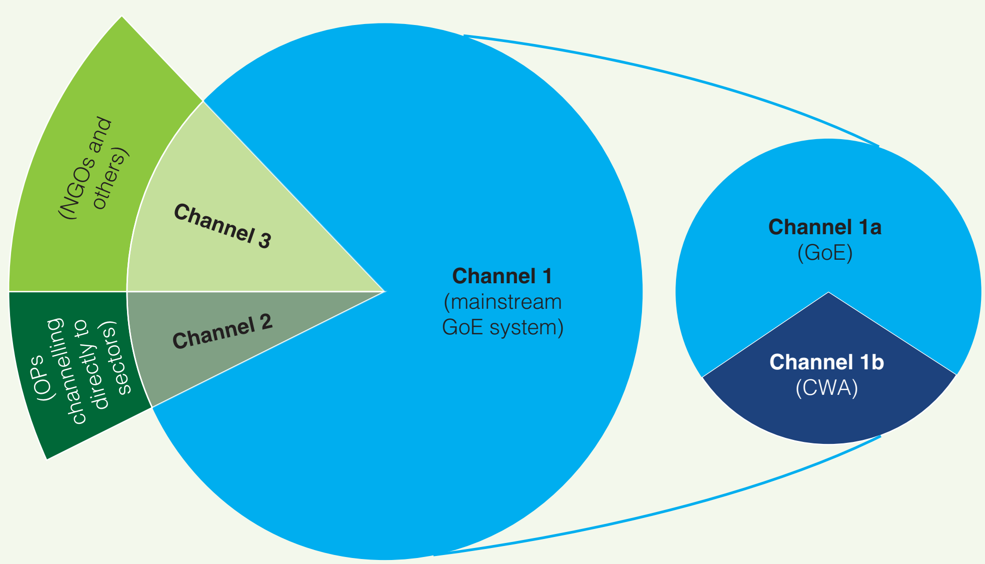
Level	Body	Responsibilities
Federal	Ministry of Water, Irrigation and Energy (MoWIE)	• Planning, development, and management of resources • Development of guidelines, strategies, policies, programs • Development and implementation of sectoral laws and regulations • Chairing the national WASH committee
Regional	Zonal Water Resources Development Office	• Supporting water bureaus in giving technical support to woreda water offices and town water supply offices • Coordinate activities, plans, and reports, and liaise between water bureaus and woreda water offices
	Bureau of Water Resources Department	• Implementing federal policies and adapting them to conditions of the region • Chairing the regional WASH steering committee
	Regional WASH team	• Providing support to woreda-level authorities • May directly support WASHCOs when breakdowns exceed local capacity
Woreda	Woreda Water Resources Development Office	• Responsible for investigation, design, and implementation of small-scale water supply schemes • Provide technical support to town water supply offices in towns without municipalities
	Woreda WASH Team	• Cross-sectoral team responsible for all aspects of water supply and sanitation development • Provide support to kebeles and WASHCOs directly for monitoring and technical support
Woreda / kebele	WASHCO	• Community-level WASH committee established to manage a specific WASH facility (there may be multiple WASHCOs in a kebele, depending on the number of facilities) • WASHCOs are accountable to woreda water team

Box 3.2: Integrating Public Finance with Development Assistance

There are three channels established for WASH sector funding, but these are complex and overlapping (see figures B3.2.1 and B3.2.2):

- **Channel 1** is on-budget and is managed by the MoFEC, regional Bureaus of Finance and Economic Development (BoFEDs), and woreda finance offices. "On-budget" means included in the national annual budget description. Channel 1 is further divided into the following:
    - Channel 1a: funds are transferred through the MoFEC to regional BoFEDs, and then to WASH sector bureaus and offices.
    - Channel 1b: funds are transferred through the MoFEC, but funds go directly to WASH sector bureaus and offices.
- **Channel 2** funds are made available directly to the WASH sector ministries (MoWIE, the Ministry of Health [MoH], MoE) and then to their respective bureaus and offices at lower levels. Bilateral assistance and most United Nations agency investments flow through channel 2, and are also on-budget.
- **Channel 3** funds are directly transferred by donors and aid agencies to service providers, and the donor retains financial control. Channel 3 funds are off-budget, meaning they are outside the control of government and are not included in the national annual budget.

Figure B3.2.1: Financial Channels in Ethiopia



Note: CWA = Consolidated WASH Account; DP = development program; GoE = Government of Ethiopia; NGO = nongovernmental organization.

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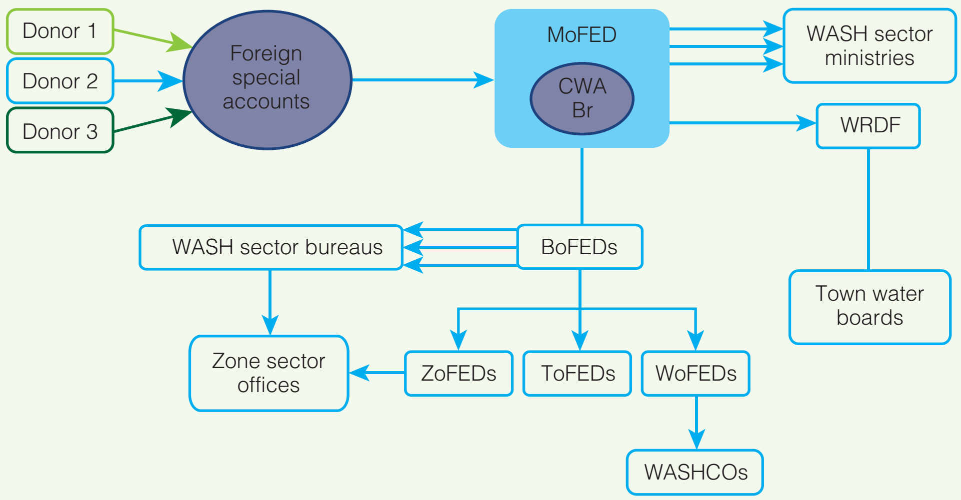
Box 3.2: Continued

Figure B3.2.2: Sectoral Financial Flows in Ethiopia



Note: BoFED = Bureau of Finance and Economic Development; CWA = Consolidated WASH Account; DP = development program; MoFED = Ministry of Finance and Economic Development (MoFED); ToFED = Town Administration Office of Finance and Economic Development; WASH = water supply, sanitation, and hygiene; WASHCOs = water supply, sanitation, and hygiene committees; WoFED = Woreda Office of Finance and Economic Development; ZoFED = Zonal Administration Office of Finance and Economic Development.

Plan (GTP) were a major driver for the GoE and development partners to reorganize and streamline investment in water supply, sanitation, and hygiene (WASH). (See box 3.2.)

The resulting ONE WASH National Programme (OWNP) is, since 2011, the GoE's main vehicle for achieving its ambitious WASH goals. The institutional arrangements for the first national WASH Program were set out in the 2011 Memorandum of Understanding and WASH Implementation Framework (WIF), signed by the Ministry of Finance and Economic Cooperation (MoFEC), the Ministry of Water, Irrigation and Electricity (then Water Resource and Energy) (MoWIE), the Ministry of Health (MoH), and the Ministry of Education (MoE). The objective of the OWNP is to extend and sustain access to water supply and sanitation services in rural and urban areas, while moving away from discrete WASH projects and toward a programmatic, sectorwide approach based on four key principles:

- Integration of water, health, education and finance sectors
- Alignment of partner activities (donors, nongovernmental organizations [NGOs], private sector agents) with those of the GoE
- Harmonization of partner approaches and activities
- Strengthened partnerships between WASH stakeholders at all levels, from federal to woreda

However, though good progress has been made in interfacing public and donor resources, there will be a large annual financing gap as Ethiopia adopts the Sustainable Development

Goals (SDGs). According to a World Bank study (World Bank 2016) on the costs of meeting the SDGs for WASH, it is estimated that Ethiopia would need to invest US$2.5 billion a year to extend basic services and over US$5 billion a year extend safely managed services (Hutton and Varughese 2016). The funding gap of US$2 billion a year for basic or US$4.5 billion a year for safely managed services will not be met by public and donor resources alone. Ethiopia and its development partners will need to leverage far greater levels household and private finance.

GTP II places emphasis on building the capacity of the domestic private sector. To meet the high demands of the OWNP, the private sector is a potential source of additional capacity for the WASH sector. There is a clear need for private contractors, consultants, and suppliers' engagement to support the designing, building, and rehabilitating of water supply and sanitation schemes. MoWIE carried out an assessment of supply chains in 2010, and the study shows that supply chains for hand pumps and spare parts, largely driven by market forces, were still in their infancy in Ethiopia. The World Bank's own assessment of the sanitation supply chain further confirmed it is fragmented and weak. However, both studies confirm that there is a significant market for WASH products and services, such as well drilling, household water treatment, on-site sanitation products, and fecal sludge management.

To maximize the private sector contribution, there is a need for more supportive sector policies and strategies to create a conducive enabling environment to facilitate their engagement. Basic challenges such as lack of clear regulatory frameworks, unskilled labor, high transport costs, limited availability of financial services, and land tenure insecurity are barriers to more meaningful engagement of the private sector in the WASH sector. In addition, questions still remain over whether economic conditions are such that financially sustainable private sector involvement in the construction, operation, and management of WASH infrastructure are possible in the near term without carefully planned programs of support.

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Collecting water from a community water point in Mareko Word, SNNPR.

Chapter 4
Rural WASH Sector Analysis

Rural Water Supply Subsector Analysis

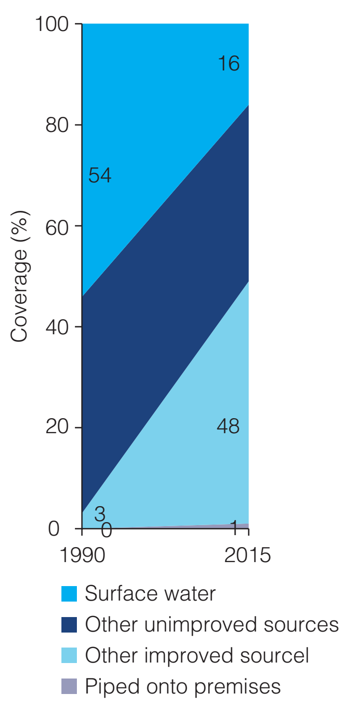
National Status and Trends

In 2015 Ethiopia met its Millennium Development Goal (MDG) for water supply. This significant achievement was largely driven by the very rapid increase to improved access to rural water: one of the top five fastest rates of change in the world. Nearly half of all rural Ethiopians had access to an improved water source in 2015 (see figure 4.1), up from just 15 percent in 1994 (UNICEF/WHO 2015).[1] Over the period around 35 million people made the shift from using unprotected wells, springs, and surface sources to an improved water source. Two-thirds of this access is provided from protected wells and springs and one-third from communal piped systems.

Evolution of Funding and Capacity for Delivering Rural Water Supply

In the 1990s donor-funded programs were central to progress. Initially the Ministry of Water, Irrigation and Electricity (MOWIE) worked with programs such as the World Bank–funded

Figure 4.1: Rural Drinking Water Trends in Ethiopia, 1990–2015



Source: WHO/UNICEF 2015.

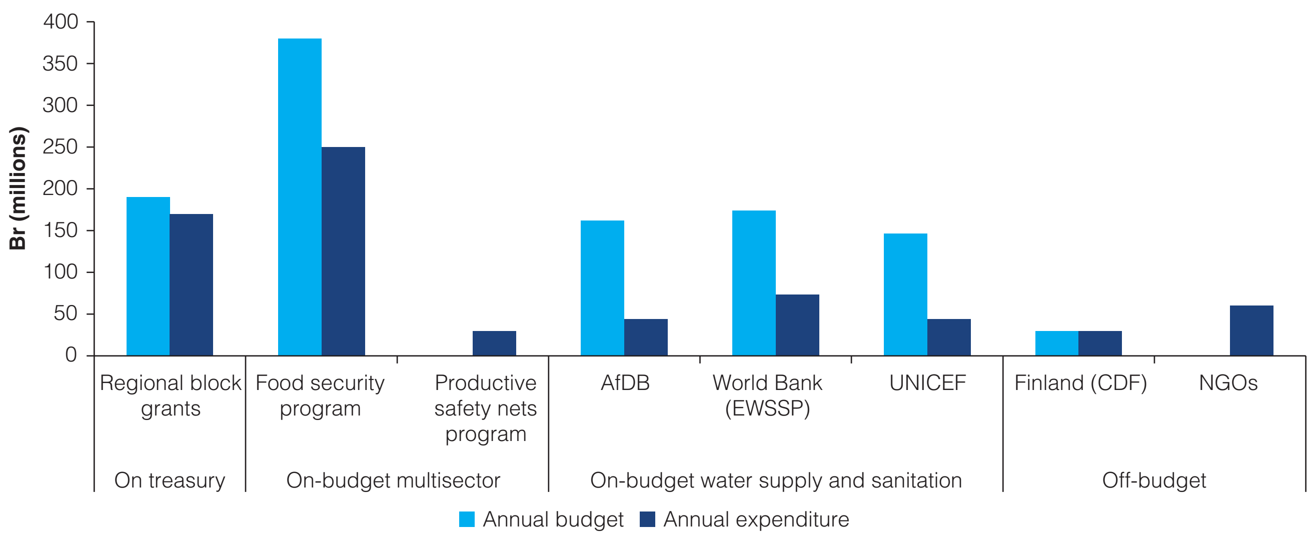
Ethiopia Social Rehabilitation and Development Fund (ESRDF) to deliver services nationwide. By the late 1990s programs such as the ESRDF were also being used to build up capacity in regional offices. Through the ESRDF alone, 3 million people in rural areas gained access to improved water at a cost of just under US$30 million, or US$3 million a year from 1995–2005. Other bilateral donors and nongovernmental organizations (NGOs) delivered services through area-based projects.

During the early 2000s, as decentralization took root, the rollout of rural water schemes through government systems grew rapidly. By 2006–08 around US$40 million a year was being spent on rural water supply, 65 percent of which was funded through Government of Ethiopia (GoE) block and special purpose grants, and 35 percent from, mainly, multilateral development partners. Though most of the sector finance (60 percent to 70 percent) was being managed by regional bureaus, after the second wave of decentralization, woredas were managing 10 percent of capital expenditure.

By the mid-2000s rates of execution through government channels were higher than through development partner channels (see figure 4.2). From 2006–08 only 60 percent of what was budgeted for annually (US$65 million) was actually being spent. In response to these low rates of execution, both the World Bank and the African Development Bank (AfDB) changed their funding modalities by integrating them into the more streamlined channel. Over the 2008–12 period this shift to funding modalities, aligned with country systems, translated into better overall budget execution rates (80 percent) though still lower in some regions and lower than this average for capital expenditure at the woreda level. With additional commitments over this 2009–12 period annual expenditures on rural water supply rose above US$50 million a year, peaking at US$60 million in 2009/10. This was managed mainly by regions (43 percent) but with a sizable share managed by woredas (37 percent) and a minority share managed at the federal level (20 percent) (World Bank 2015b).

Expenditure by NGOs also increased. From 2006–08 NGO expenditure on WASH was estimated at US$5 million a year, while from 2009–12 period the NGO Supply and Sanitation Forum reports annual expenditures of US$18 million a year.

Figure 4.2: Budgets and Expenditure for Main Rural Water Supply Financing Modalities in Ethiopia, 2006–08



Source: IBEX.

Note: Amounts are three-year average for 2006, 2007, and 2008. AfDB = African Development Bank; CDF = Community Development Foundation; EWSSP = Ethiopian Water Supply and Sanitation Project; NGO = nongovernmental organization.

While investments from donors have not been the main financing source, donor projects have, and will continue to be, instrumental in building capacity at regional and woreda levels. From the mid-1990s donors supported policy and institutional development, including the formation of the Federal Ministry of Water Resources. As service delivery was decentralized, donor projects shaped the formation and capacity building of regional water bureaus and woreda water desks. Administrative and technical capacity building benefitted from a learning-by-doing approach through the rigorous design, procurement, contract management, and reporting required by donors. Good practices included (a) the use of woreda support groups (WSGs) to help woredas develop strategic plans and identify and design projects; (b) the development of project implementation manuals; and (c) annual work planning.

By 2008 capacity for planning and supervising development of rural water supplies at the regional level was well established across most regions. This included skills in sector planning, scheme design, procurement, contract supervision, scheme management training, and postconstruction support. The allocation to salaries at regional level increased threefold in nominal terms from 2005–08, and operational costs increased fivefold, enabling regional level staff to manage projects. This regional capacity was greater in the large regions than in the emerging regions, which is reflected in the progress made across regions. The larger regions were able to implement capacity through state-owned drilling and dam construction companies and had better access to private sector contractors than emerging regions.

Unlike capacity at the regional level, capacity and funding at the woreda level has been less well developed. The 2009 PER (World Bank 2009) reports that as result of increasing the number of woredas and the number of staff deployed on the water desks in the second wave of decentralization, the allocation to salaries at woreda level increased tenfold in nominal terms between 2005–08. During the same period, operational costs increased sixfold in nominal terms, but dropped as a percentage of water desk spending (33 percent to 22 percent of the recurrent budget). The average number of woreda water desk staff in 2008 was 7.5, with an operational budget averaging Br 2,000 (US$200) per staff member per year. The 2015 PER (World Bank 2015b) similarly notes that the low level of recurrent budget remains a constraint to the quality and adequacy of supervision and support to the water sector. The amount of recurrent budget allocated at the woreda level in 2009–12 rose from Br. 141.5 million to Br 622.5 million. However, when divided among the large number of woredas in the country, the operational budget left after paying salaries averaged only Br 5,287 per woreda per year (around US$300 in 2015).

Operational budgets at these levels do not enable staff members to carry out their basic duties of data collection and backstopping support to rural schemes. During interviews held at the woreda level for the 2009 PER (World Bank 2009), it was evident that coupled with the absence of vehicles, equipment, and office space, this environment was leading to low morale and ultimately high staff turnover. The result has been that woredas are understaffed and staff members lack key skills. Even in Amhara region, a favored region in which to work, only 30 percent of posts were filled (World Bank 2014).

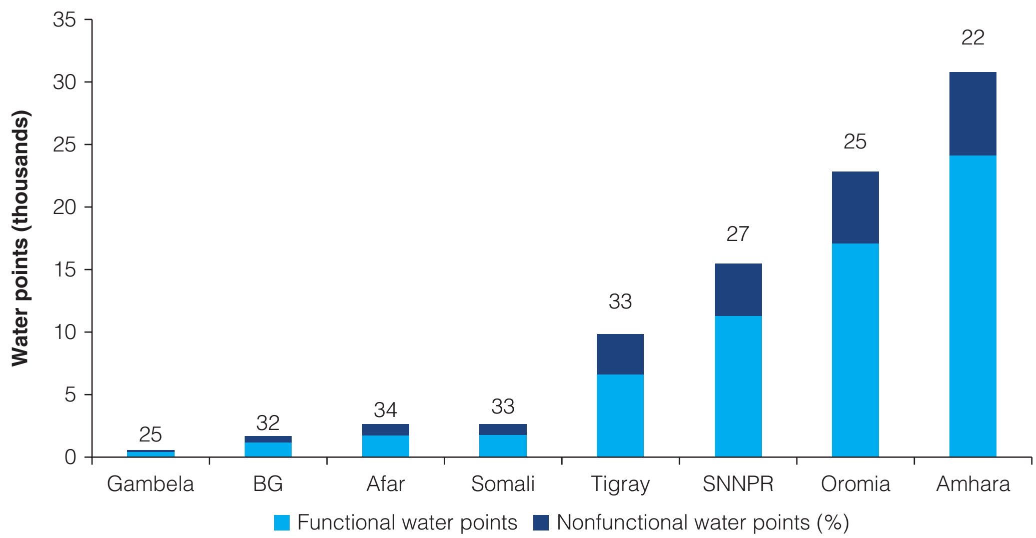
The Expansion of Rural Water Supply Infrastructure and its Sustainability

From 2006 to 2012 the construction of water points and schemes has been at an industrial scale across Ethiopia. The backbone of generic service delivery machinery that GoE has put in place through the two-tier decentralization process, coupled with strong sector policy direction and consistent sector funding (from government and donors), have enabled between 6,000 and 10,000 water points a year to be constructed from 2006 to 2012.

However, only around 75 percent of the 85,000 rural water schemes captured by the 2011 National WASH Inventory were reported as functional (NWI 2011). [2] Though this is a higher level of functionality than in many other countries in the Africa region (70 percent or lower is common [Carter and Ross 2016]), the role and capacity of woredas to sustain access remain questions among policy makers, particularly as the stock of infrastructure grows Tincani et al. 2015).

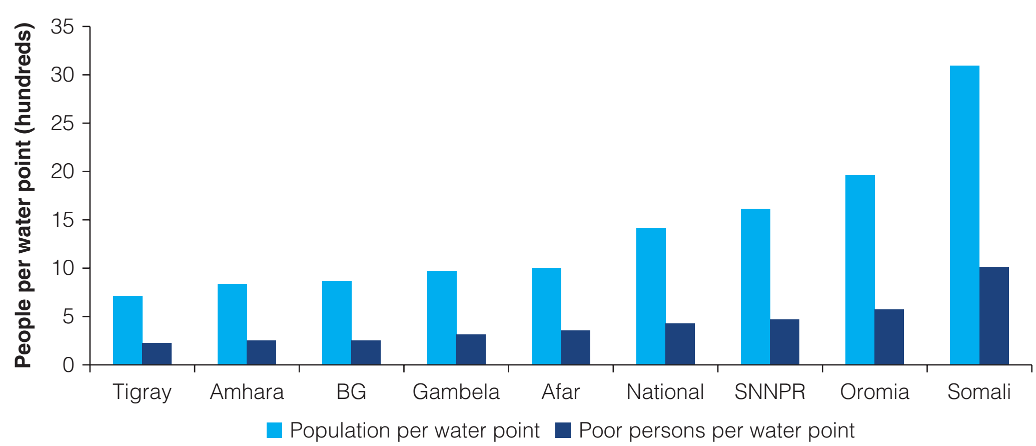
More detailed studies of water point operation reveal deeper problems of nonfunctionality (see figures 4.3 and 4.4). A 2016 detailed survey of 171 community shallow (tube wells equipped with hand pumps), chosen to be representative of woredas in the Ethiopian Highlands, finds that 82 percent were working at the time of the survey, which is similar to data from the National Well Inventory survey. However, extending the definition of functionality to exclude low yielding (less than 10 liters per minute) and unreliable boreholes (down time of more than one month per year), functionality dropped to 45 percent (Kebede et al. 2017).

Figure 4.3: Regional Variation in Water Point Functionality in Ethiopia, 2012



Source: National WASH Inventory, 2012.
Note: SNNPR = Southern Nations, Nationalities and People Region; BG = Benishangul Gumuz.

Figure 4.4: People per Water Point by Region in Ethiopia 2012



Source: National WASH Inventory, 2012.
Note: SNNPR = Southern Nations, Nationalities and People Region.

A key finding from the Overseas Development Institute (ODI) RiPPLE program in Ethiopia is that woreda and regional government staff are often unaware of the problems village water committees have with repair and maintenance. Research conducted by the RiPPLE program in SNNPR, for example, indicates that 43 percent to 65 percent of water points or schemes were nonfunctional. Moreover, problems are not restricted to more complex schemes with deep boreholes and motorized pumps. In Mirab Abaya woreda, for example, nearly 50 percent of off-plot, communal water points equipped with hand pumps were not working at the time of survey (Calow et al. 2013).

Improving on this level of functionality depends in part on whether woreda water desks will backstop community-level water management committees. Backstopping involves periodically checking whether cost recovery mechanisms are working and facilitating the sourcing and fitting of spare parts when water committees need help in keeping systems running. These activities require recurrent operational costs (see box 4.1).

However, poor siting, design, and construction expose weaknesses at regional and woreda levels. Postconstruction sustainability audits of water point infrastructure examine siting, design, and construction standards. Recent studies conducted for the World Bank (Calow et al. 2013) and the CMP (Calow et al. 2016) point to upstream implementation issues, for example, water point type and design were not well matched with hydrological or hydrogeological conditions, which is a regional planning function. A poorly sited and constructed dug well (woreda responsibility) or shallow well (regionally commissioned, but subcontracted to a drilling company) are more likely to have a low or intermittent water supplies, more likely to be contaminated by pathogens, and more likely to suffer flood damage. These upstream weaknesses greatly constrain what village water committees are able to do to keep water points functioning.

Box 4.1: Maintenance of Water Points in Lodi Etosa Woreda, Arsi Zone, and Oromia Region

In 2011 the Woreda Water Office built a spring protection with government funding for Tuma Wolkitei and Meda Gefersa villages in Lodi Etosa Woreda. A WASH committee was formed to oversee the scheme, but the committee received no training. Except for the poorest of the poor households, households pay Br 30 a year to collect water from the spring.

Since the spring was located in a streambed, a hand pump was used to lift water into a spring box. In 2015 the hand pump broke. In this case the provision of the spare part was assumed to be the Woreda Water Office’s responsibility both by the Woreda Water Office and user community. The Woreda Water Office was informed of the broken pump by the WASH committee, but neither the woreda nor the committee had funds to purchase the spare part, since the WASH committee had not collected funds for the repair. Households went back to fetching water from traditional surface and unprotected sources. After 10 months the Woreda Water Office fixed the hand pump by replacing the broken part with a part taken from another new pump within their store. Yet, the pump was vandalized shortly afterward with essential screws stolen from the pump. Villagers and leaders recognized the need to strengthen the WASH committee; fence the scheme; and collect the nominal fee to cover maintenance cost; however, none of this happened.

box continues next page

Box 4.1: Continued

Broken water point in Arsi Woreda Oromia.

Like most government-financed schemes in the woreda, the focus during the implementation period was on the hardware provision alone with no consideration of sustainability. No budget was allocated for training the WASH committee for follow-up after the construction of the spring protection. Though at the zonal and woreda level, technical staff are employed to provide technical support to sustain the schemes yet they have no budget. Staff at Lodi Etosa Woreda found this lack of budget demotivating, pointing out that paying their salaries without an operations budget was a waste of money.

box continues next page

Box 4.1: Continued

Discussions at the woreda and zonal levels revealed that the same trend is being adopted in the implementation of government-financed schemes at present, and that it is common that designs are compromised during implementation to reduce construction costs. Unless the water policy is reviewed to give clear direction on roles and responsibilities and on postconstruction support, this trend of focusing on the infrastructure development and poor sustainability will continue.

Both government- and donor-financed projects need to budget for the hardware and software. Budgets are needed for community mobilization and sensitization, the preliminary studies, design studies, capacity strengthening component, and postconstruction support. This may mean higher per capita costs but this would be preferable to the wasted sunk costs of abandoning existing schemes.

Source: Yemane and Defere n.d.

Access Disparities by Wealth and Consumption

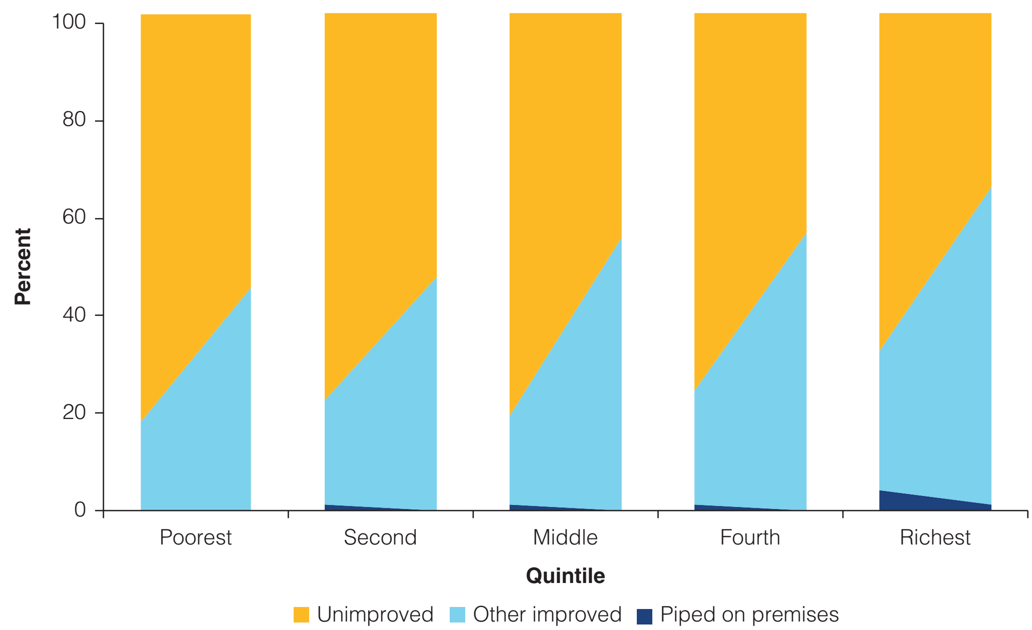
With 35 million people gaining access to improved sources but still 40 million rural Ethiopians without access to improved service, was it predominantly wealthier or poorer people who captured this gain? Ethiopia's progress in providing access to improved water supply in rural areas is relatively equitable. Estimating the progress across different consumption and wealth quintiles, it is clear that, regardless of the metric, people across all quintiles have experienced a significant jump in access. Using wealth quintiles derived from an asset index, the poorest quintile saw a 27 percent increase in access compared to 36 percent by the wealthiest quintile between 1995 and 2012. Using the consumption-based method, the difference in access rates is even less with only a 7 percentage points difference between the lowest and highest consumption quintiles in 2011 (figure 4.5 and figure 4.6).

Compared to the evenly spread access to improved sources, access to piped water from stand posts in rural areas—representing around one-third of improved water access—is more skewed across quintiles. Based on consumption quintiles, the distribution of piped water access is only marginally tilted toward those with greater purchasing power (figure 4.7). However, based on wealth quintiles this distribution is more skewed toward wealthier populations with a 33 percentage points difference between the poorest and the wealthiest (figure 4.8). Though part of this greater skew towards wealthier populations is due to the inclusion of water supply and sanitation in the asset index used to calculate wealth (a problem of endogeneity), it may also point to affordability of piped water compared to other improved sources.

Access Disparities by Geography

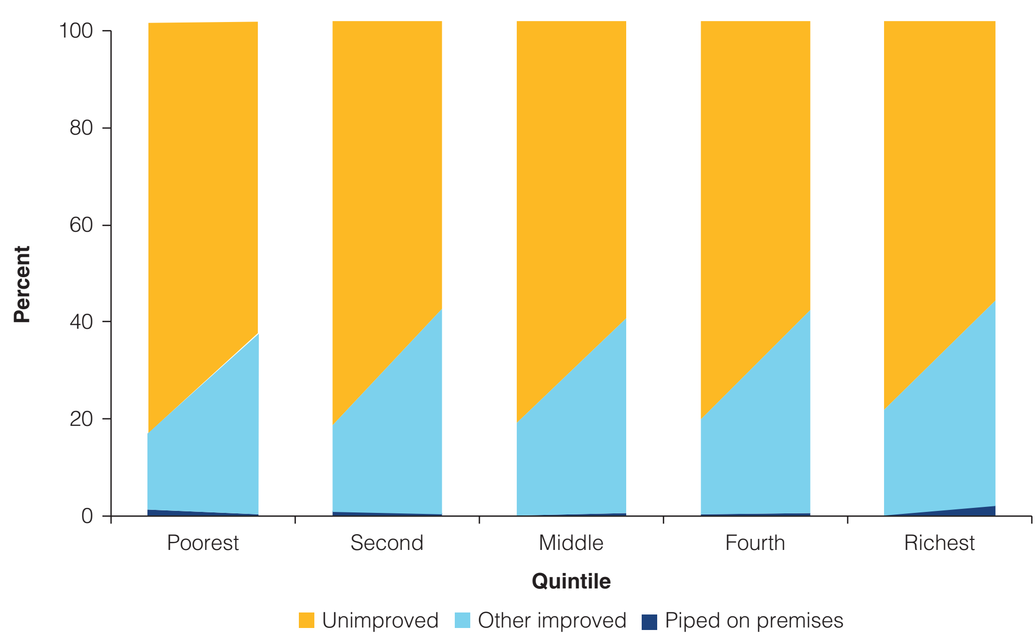
Though the progress was even across categories of wealth and consumption, there are clear disparities across Ethiopia's regions (see map 4.1). Between 2000 and 2016, access to improved water supply more than doubled in percentage terms from just under 20 percent to just under 50 percent. Progress across Ethiopia's five large regions has been strong.

Figure 4.5: Rural Drinking Water Coverage by Wealth Quintile in Ethiopia, 1995–2011



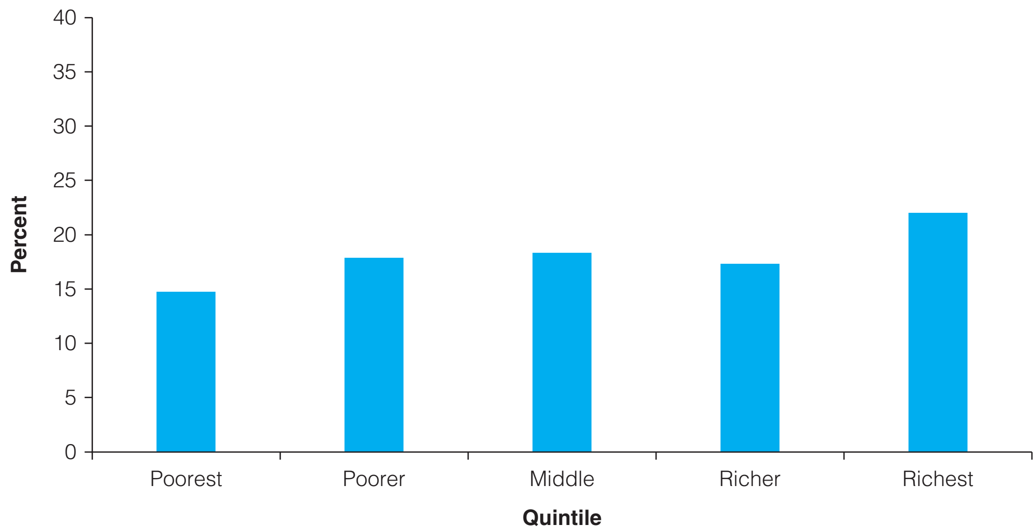
Source: DHS, 2017.
Note: Wealth quintile trend is based on subset of surveys (DHS) leading to steeper slope than JMP trend data. Water supply and sanitation variables removed from DHS asset index.

Figure 4.6: Rural Drinking Water Coverage by Consumption Quintile in Ethiopia, 1995–2011



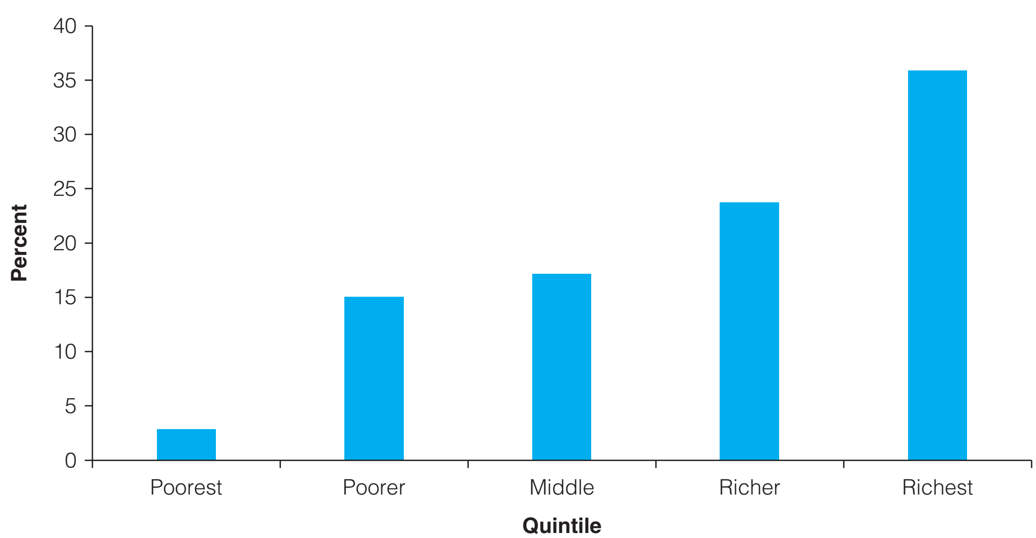
Source: WMS/HICES, 2011.
Note: Wealth quintile trend is based on subset of surveys (DHS) leading to steeper slope than JMP trend data. Water supply and sanitation variables removed from DHS asset index.

Figure 4.7: Access to Rural Piped Water from Public Stand Posts by Consumption Quintile in Ethiopia, 2011



Source: World Bank calculations based on WMS/HICES 2011.

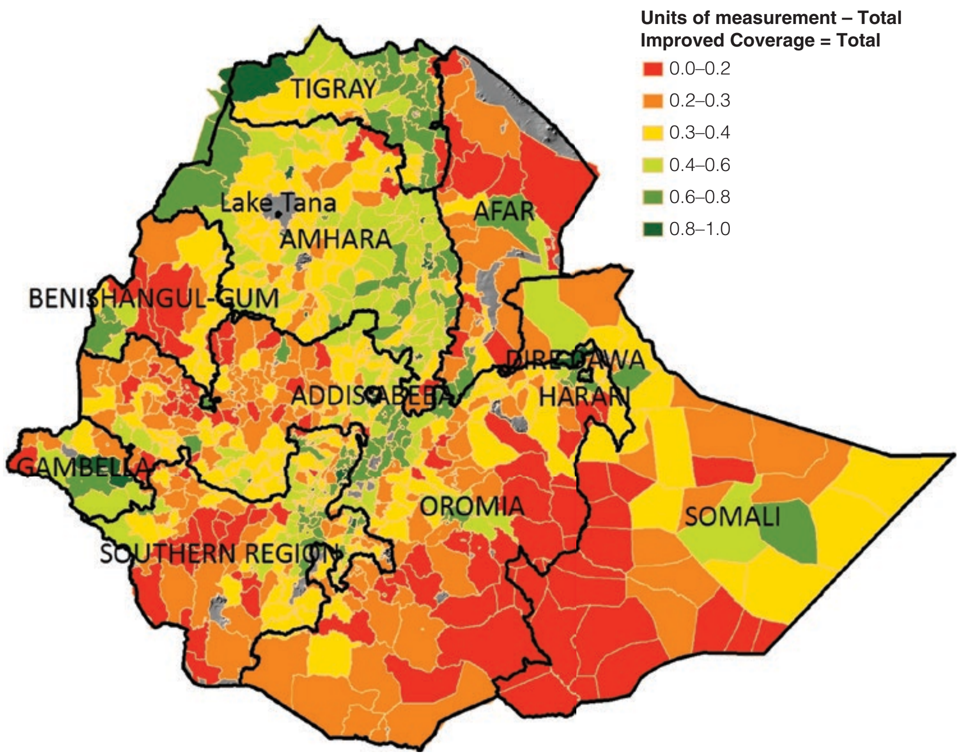
Figure 4.8: Access to Rural Piped Water from Public Stand Posts by Wealth Quintile in Ethiopia, 2011



Source: World Bank calculations based on DHS 2011.

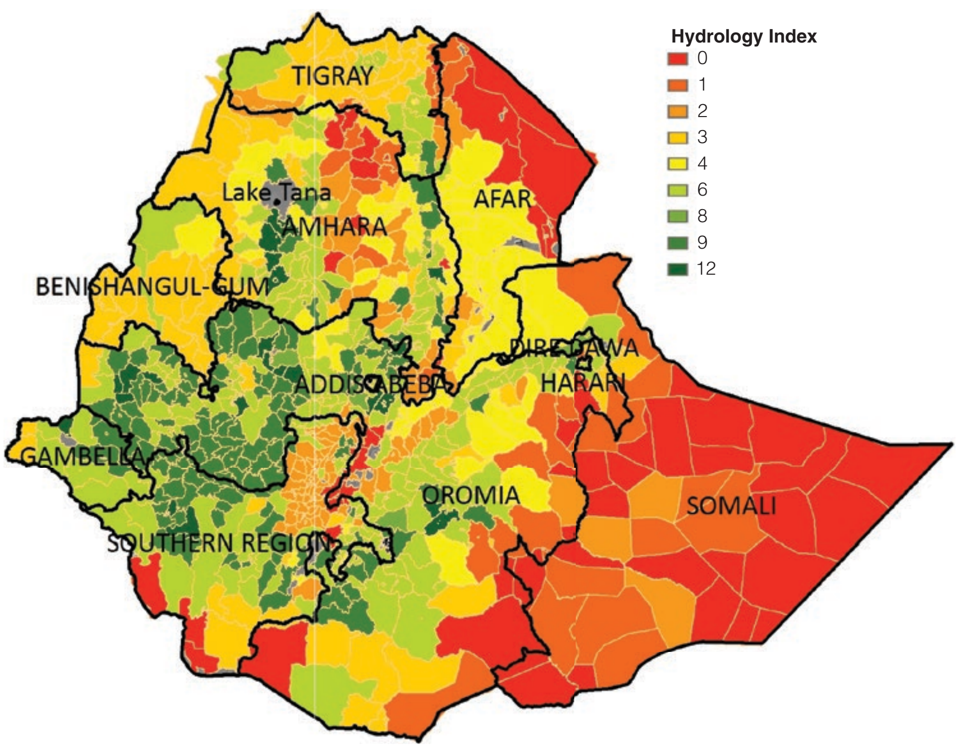
Access in two emerging regions, Gambela and Benishangul-Gumuz, has also increased rapidly. However, progress in Afar and Somali regions, which started from a low base, stand out as having fallen further behind other regional states (figure 4.9). There are multiple reasons why they have fallen behind, including that: they receive less rainfall than other regions, have more complex hydrogeology (see map 4.2), have weaker regional and woreda administrations, and, are sparsely populated by people practicing agropastoralist and pastoralist livelihoods.

Map 4.1: Coverage of Improved Water Supply across Woredas in Ethiopia, 2007



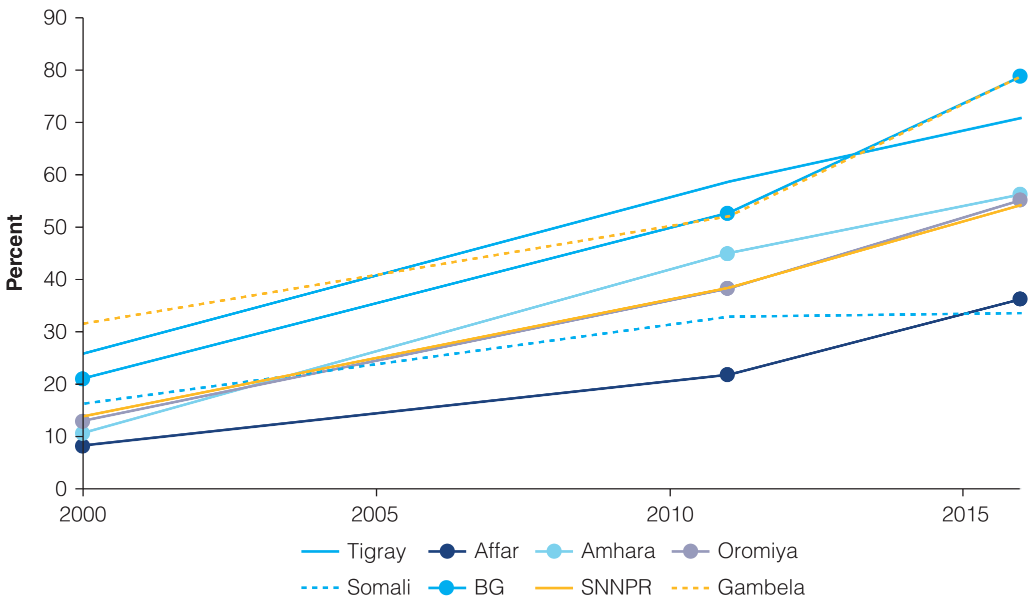
Source: Housing and Population Census 2007.

Map 4.2: Hydrogeology Index in Ethiopia, 2016



Sources: ODI and BGS, 2016.
Note: See Appendix C: Hydrogeological for more details.

Figure 4.9: Access to Improved Sources of Water in Rural Areas by Region in Ethiopia, 2000–16



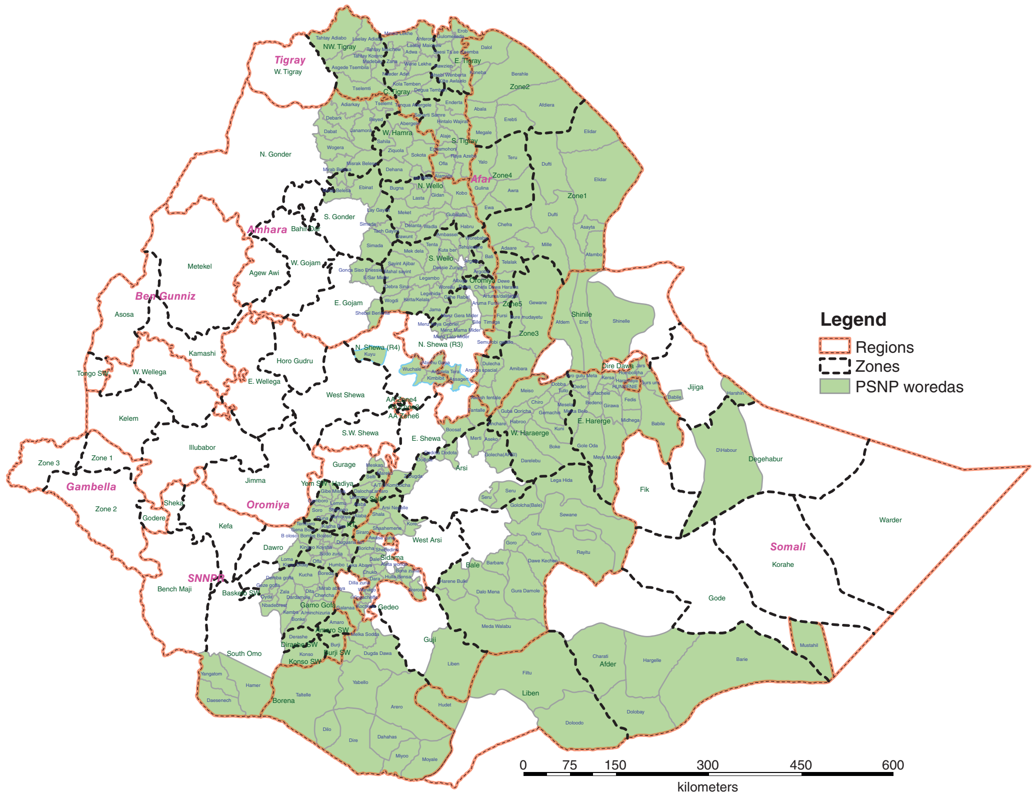
Sources: DHS 2000, 2011, and 2016.
Note: BG = Benishangul-Gumuz; SNNPR = Southern Nations, Nationalities, and People Region.

It is clear that variation in disparities within regions is even greater than that across regions.[3] While annual rainfall,[4] and to a lesser extent hydrogeology, explain the interregional variance—particularly the difficulty of providing improved water supply in Afar and Somali—they do not adequately explain the variation in access rates within regions. Exploring a further layer of positive and negative factors helps explain the differential progress within regions. On the negative side, areas dominated by agropastoralist and pastoralist livelihoods within otherwise large regions had particularly low access. On the positive side, areas with higher levels of access were in areas dominated by agrarian livelihoods targeted by the PSNP (see appendix B for an explanation of data sources, supporting analysis, and regression model) (see map 4.3).

Woredas dominated by agropastoralist and pastoralist livelihoods were just over half as likely to have access to improved water as agrarian woredas (see figure 4.10). This includes regions that have significant numbers of agropastoralist and pastoralist woredas, such as Oromia and SNNPR (see figure 4.11). This data suggests a systemic failure to deliver improved water supplies to pastoralist and agropastoralist areas even in regions where access levels were higher than in the pastoralist regions of Afar and Somali (appendix B).

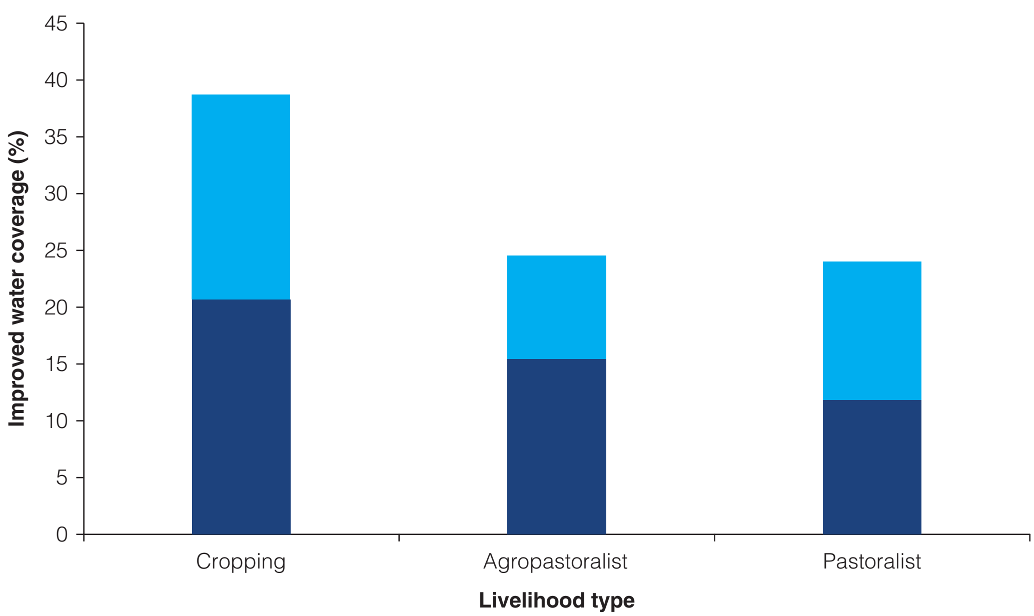
These broad patterns of failing to deliver to pastoralist and agropastoralist areas are supported by a more detailed analysis comparing access to improved water with rates of poverty across woredas. Just under 80 percent of woredas with both a high proportion of poor households and the lowest levels of improved water coverage[5] were dominated by pastoralist and agropastoralist livelihood types whose households live in remote, low population density areas (less than 50 people per square kilometer). In contrast, over 80 percent of the woredas with both a high proportion of poor and high improved water coverage were agrarian woredas targeted by the PSNP (see figure 4.12). For example, one group is in the Wolayita Maize and Root Crop livelihood zone in SNNPR. These are very high

Map 4.3: Productive Safety Nets Program in Woredas and Responsible Agency in Ethiopia, 2010



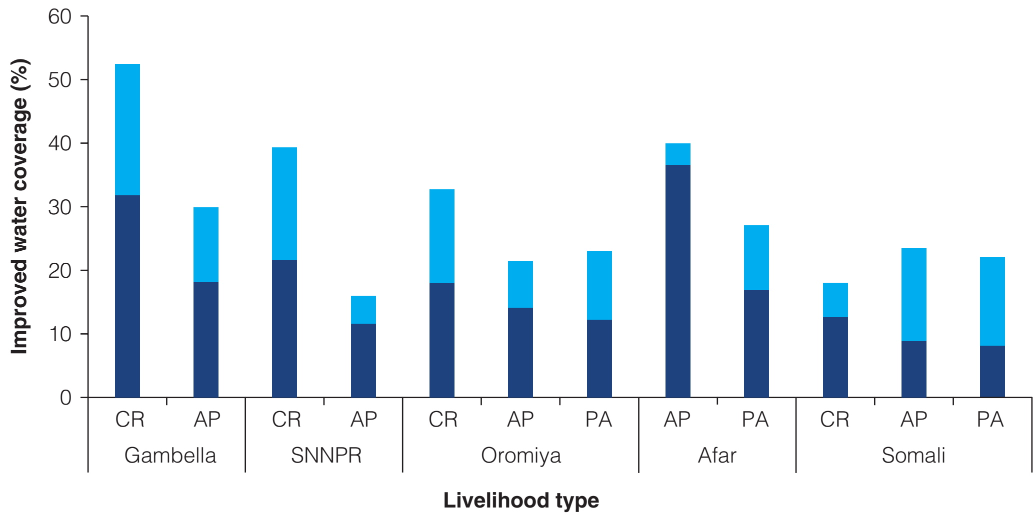
Source: FAO.

Figure 4.10: Improved Water Coverage by Dominant Livelihood Type in Ethiopia, 2007 and 2010



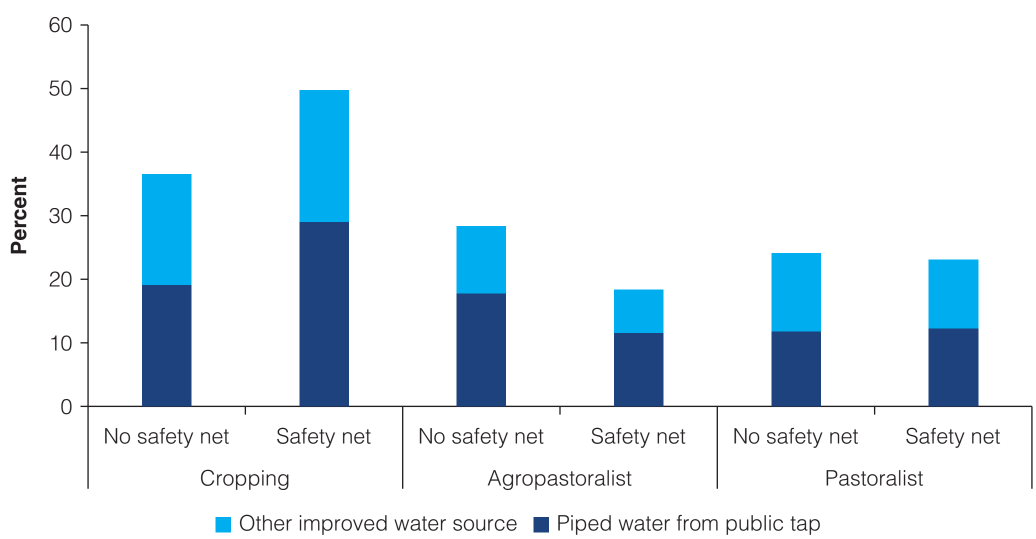
Source: World Bank calculations based on the merged 2010 LIU livelihoods database with 2007 Census.

Figure 4.11: Improved Water Coverage with Regions, by Livelihood Type



Source: World Bank calculations based on the merged 2010 LIU livelihoods database with 2007 Census.
Note: AP = agropastoralist; CR = cropping; PA = pastoralist; SNNPR = Southern Nations, Nationalities, and People Region.

Figure 4.12: Improved Water Coverage by Woreda's Dominant Livelihood Type and whether the Woreda is a Recipient of the PSNP Safety Net



Source: World Bank calculations based on the merged 2010 LIU livelihoods database with 2007 Census - http://foodeconomy .com/wp-content/uploads/2016/02/Atlas-Final-Web-Version-6_14.pdf.
Note: Data in figure show that PSNP-targeted woredas have higher coverage than non-PSNP woredas in agrarian areas but not pastoralist areas. PSNP = Productive Safety Nets Program.

population density woredas (>300 people per square kilometer). Although these areas have difficult hydrology (HI=2), they are served by relatively high levels of piped water schemes (41 percent piped of 61 percent improved), indicating that they have received attention from the regional water bureaus (Oromia and SNNPR) and their development partners to overcome the difficult hydrogeology through multi-village piped schemes.

While the PSNP is associated with higher rates of access to improved water supply in agrarian cropping woredas, this is not the case in pastoralist and agropastoralist woredas. Across Ethiopia, woredas targeted by the PSNP reported significantly higher levels of access to improved water than those not targeted. However, further analysis reveal that these differences are only significant across agrarian cropping woredas but *not* across pastoralist and agropastoralist woredas. Pastoralist and agropastoralist woredas targeted by the PSNP do not have better access to improved water, quite possibly because compex hydrogeology is a barrier not overcome with the funding available through the program. Yet, even where hydrogeology is complex in agrarian woredas, GoE and development partners manage to overcome these difficulties through the design and implementation of piped schemes, but this is less evident in pastoralist and agropastoralist areas.[6]

Within agrarian areas local variations in access to improved water supplies may reflect interactions between topography, hydrogeology, and accessibility. Some less poor rural areas with low improved water coverage have invested in self-supply. These are remote, low population density areas with agrarian production systems that generate a surplus, such as the western enset growing areas of SNNPR or lower density sorghum growing areas of Amhara. In these areas where the hydrogeology is relatively easy, large numbers of households have hand-dug their own unimproved wells.

Many areas worst affected by the El Niño triggered drought of 2015-16 were already known as seasonally vulnerable because of a combination of technical and physical constraints. They are areas with few springs and little or no shallow groundwater for dug wells, and they are difficult or impossible to reach with truck-mounted drilling rigs for accessing deeper groundwater. Such areas fall between the cracks of service delivery modalities: they are unsuitable for basic spring development and dug wells, and too difficult and expensive to reach with drilled shallow wells and deeper boreholes.

Access Disparities by Service Qualities along the Service Delivery and Results Chain

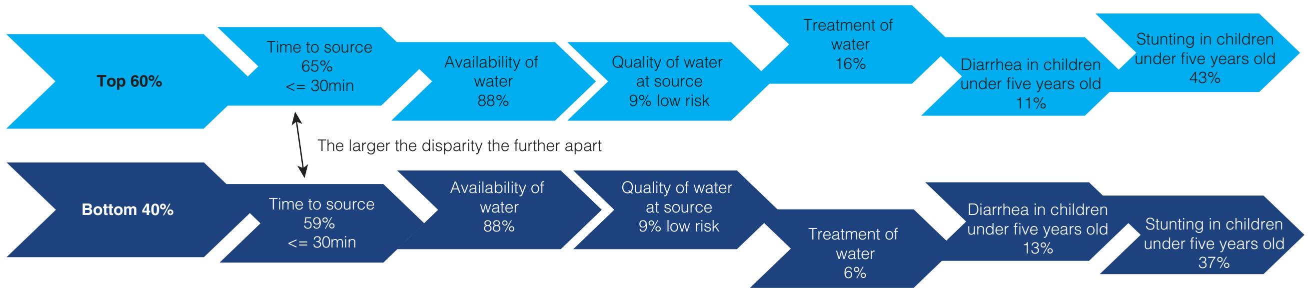
Sustainable Development Goal (SDG) Target 6.1 relates to drinking water: *"By 2030, achieve universal and equitable access to safe and affordable drinking water for all."* It aims to achieve universal access, rather than just halving the proportion of the population without access. Next, it calls for equitable access, which implies reducing inequalities in service levels between population subgroups. Finally, it specifies that drinking water should be safe, affordable, and accessible to all. To meet the threshold for a safely managed service, the improved source must meet three conditions:

- Accessibility: the source should be located on premises (within the dwelling, yard, or plot).
- Availability: water should be available when needed.
- Quality: water supplied should be free from fecal and priority chemical contamination.

If any of the three conditions are not met, but the improved source is within 30 minutes of the home, it will continue to be categorized as a basic service.

This section examines these service qualities along the service delivery and results chain: (a) time to source; (b) water availability; (c) quality of water; and (d) diarrhea and

Figure 4.13: Service Quality along Results Chain between T60 and B40 Households in Ethiopia, 2016



Sources: Time to source, DHS 2016; availability of water, ESS 2016; quality of water, ESS 2016; water treatment, DHS 2016; diarrhea and stunting, DHS 2016.
Note: B40 = bottom 40 percent of the wealth index; T60 = top 60 percent of the wealth index.

malnutrition outcomes. This is done for both the top 60 percent (T60) and the bottom 40 percent (B40) of the wealth distribution (figure 4.13). The section then presents what this means for the SDG baseline for the rural water supply subsector.

Accessibility is a criterion for both basic and safely managed drinking water services using the indicator of time to fetch water (go, queue, collect, and return). The Joint Monitoring Programme (JMP) uses a travel time indicator for accessibility.[7] Households reporting collection of water from an improved source that is not on premises but takes 30 minutes or less (for round-trip travel, collection, and queuing) are classified as having *basic services*, while those using improved sources that take over 30 minutes are classified as having *limited services*.

Between 2000 and 2011 the proportion of households collecting water within 30 minutes dropped from 65 percent to 57 percent. This is because in 2011 a greater proportion of households collected water from more distant improved sources than from closer unprotected sources (see figure 4.14). Only by 2016 did the proportion of people able to fetch water within half an hour return to the 2000 level (figure 4.14). So while 35 million people gained access to improved water sources from 2000–16, the number of people able to collect water in less than 30 minutes increased only by around 15 million people.

Though women-headed households (47 percent) have slightly better access to water than male-headed (44 percent) households in rural areas, women (71 percent) and female children (15 percent) bear the burden of fetching water. The only exception to this is in the Somali region where in 30 percent of households men were the primary fetchers of water. This is maybe attributable to the median time to source being two hours compared to 30 minutes or less in other regions. However in Afar, which had a median time of two hours to fetch water, the burden fell to women in 80 percent of households.

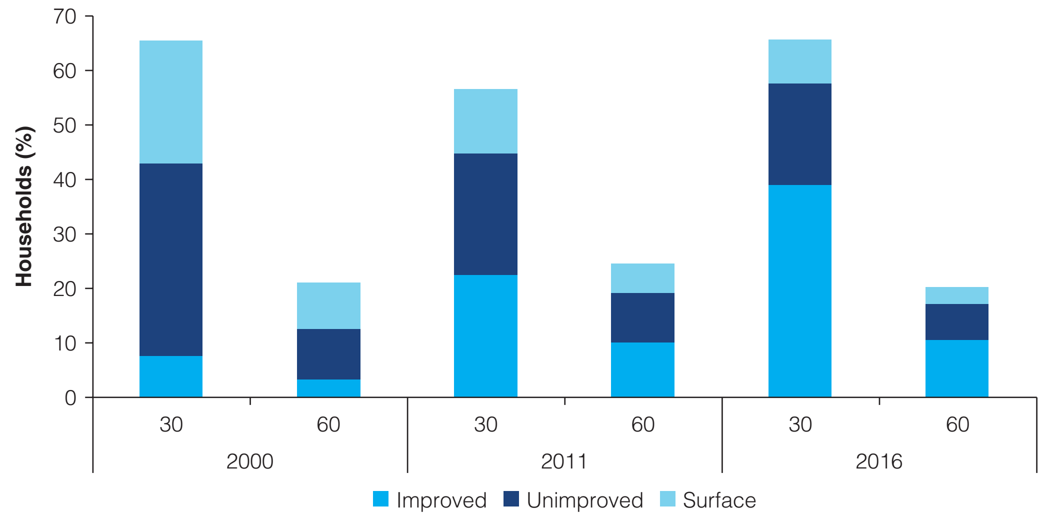
Availability and sufficiency of water. Availability is an important criterion for assessing drinking water service levels.[8] In the Ethiopia Socioeconomic Survey-Water Quality Testing Component (ESS-WQT 2016) water quality module, two questions were asked about availability and sufficiency of water:

1. In the past two weeks, was the water from this source not available for at least one full day?

2. Has there been any time in the last month when you did not have water in sufficient quantities?

If the answer to the second question was yes, the respondent was asked the main reason that he or she did not have water in sufficient quantities.

Figure 4.14: Households Able to Fetch Water within 30 Minutes in Ethiopia, 2000–16



Sources: DHS 2000, 2011, and 2016.
Note: Data show changing composition of sources over time.

Across all rural areas, at the time of this survey, households reported that water was available (88 percent) and sufficient (83 percent) most of the time. There was variation across source types: piped water from stand posts (66 percent) was less frequently available than that from protected wells (93 percent) or protected springs (96 percent). Rainwater collection systems used almost exclusively in Somali region—cisterns or berkhads—were the least reliable with nearly 60 percent of households using them reporting that water in the past two weeks had not been available from these sources.

However, in rural areas, availability and sufficiency become critical in seasonal or chronic drought. Detailed water audits conducted along a highland–lowland transect in eastern Oromia highlighted the problem of seasonality, very low levels of water use, and the importance of wealth in shaping service levels (Coulter et al, 2010; Tucker et al. 2014). Very few households in any livelihood zone exceeded the domestic (drinking, cooking, personal hygiene, laundry) water requirements recommended by the Sphere project (Sphere Project, 2011) for humanitarian emergency situations (7.5–15 liters per capita per day), let alone reached the levels recommended for nonemergency situations. The majority of households used 8–12 liters per capita per day, levels that present a high level of health concern (Howard and Bartram 2003). Moreover, poorer households consistently used less water than their better-off counterparts, particularly for hygiene, and especially in the dry season.

The drought associated with the current El Niño cycle has also raised questions around the resilience of services and their underlying functionality. By April 2016, the peak of the El Niño drought, the GoE reported that around 10 million people across six regions were in need of emergency assistance; of these around 6 million (in over 160 priority woredas) were affected by acute water shortages (Howard et al 2016). Real-time monitoring of water access conducted by World Vision and Oxfam from January to March 2016 revealed that in January, at the start of monitoring, 85 percent of hand-dug wells had failed completely (box 4.2). A key response has been water point rehabilitation, suggesting that the drought exacerbated—or drew attention to—long standing problems of repair and maintenance (UNICEF 2016).

Box 4.2: Lessons from the El Niño Drought

The El Niño–triggered drought of 2015–16 was one of the worst in decades. In June 2015, the GoE declared the failure of the spring (belg) rains. This affected smallholder farmers and pastoralists in the northeastern rangelands of Afar and northern Somali region. Weak and erratic summer (meher) rains then tipped many pastoralists and meher-dependent farmers into crisis. By April 2016, the GoE reported that 10.2 million people in six regions needed

Hand pump water supply point for Aboakokit School and local community, Aboakokit Kebele, Fogera Woreda, Amhara Region.

box continues next page

Box 4.2: Continued

emergency assistance, from which 5.8 million people were affected by acute water shortages in 166 woredas. Following a WASH Gap Analysis led by the United Nations Children's Fund (UNICEF) and the Ministry of Water, Irrigation and Electricity (MoWIE), the population in need of emergency water supply, sanitation, and hygiene (WASH) interventions quickly rose to 8.9 million people across 223 woredas.

Piecing together WASH impacts and responses is difficult. Assessments have been periodically updated, but the criteria and methods used to assess WASH-related problems have evolved over time. What seems clear is the scale of the drought-related WASH problem took government and its development partners by surprise, and major arguments broke out about data on the number of water points that were drying out and about how best to respond.

In January 2015, the GoE sanctioned a real-time monitoring program designed to improve the timeliness and accuracy of WASH reporting across six drought-affected regions: Afar, Amhara, Oromia, Southern Nations, Nationalities, and People Region, Somali, and Tigray. Supported by UNICEF, Oxfam, and World Vision, teams of enumerators collected data on the functionality of water points, consumption levels, and the time and distance for water collection. Results for phase 1 (January to March 2015) indicated that 40 percent of improved sources had failed completely; 85 percent of dug wells had failed; 45 percent of respondents were using less than 5 liters per capita per day; and 66 percent of households were spending over one hour per day collecting water—in some cases walking up to 10 hours per day. A planned phase 2 of the monitoring work was cancelled by the GoE.

Data have not been officially published but are widely reported in summary form. What they reveal is, first, there were major problems with the underlying functionality and performance of systems, predrought. Second, they appear to show that dug wells were particularly vulnerable. However, the widespread failure of wells could be attributed, in part, to underlying problems of poor siting, construction, and maintenance. Following the El Niño drought, below average rains in the south and east of the country caused by the negative Indian Ocean Dipole have now left 5.6 million people in need of emergency humanitarian assistance.

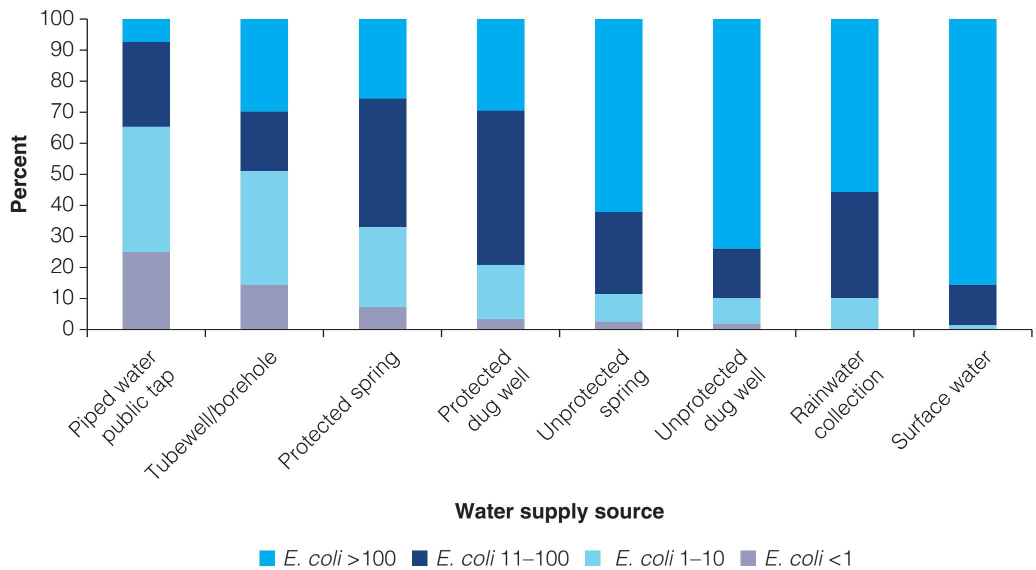
Sources: UNICEF 2016; key informant interviews 2016.

Quality of water at source. To be considered safe, drinking water must be free from pathogens and elevated levels of harmful substances at all times. The highest priority water quality parameter globally, and in most countries, is contamination of drinking water with fecal matter.[9] The ESS-WQT 2016 is the first large-scale water quality testing to have been carried out in Ethiopia. The survey tested two samples for *E. coli*: one at the point of collection, and one directly from a glass used for drinking. At point of source 4,513 valid tests were conducted (see appendix D for methods and more detailed results).

Though there was little variation across wealth or geography over nine out 10 rural samples tested positive for *E. coli*, and nearly seven out of 10 samples were classified as high (11–100 colony-forming units per 100 milliliters) or very high risk (>100 colony-forming units per

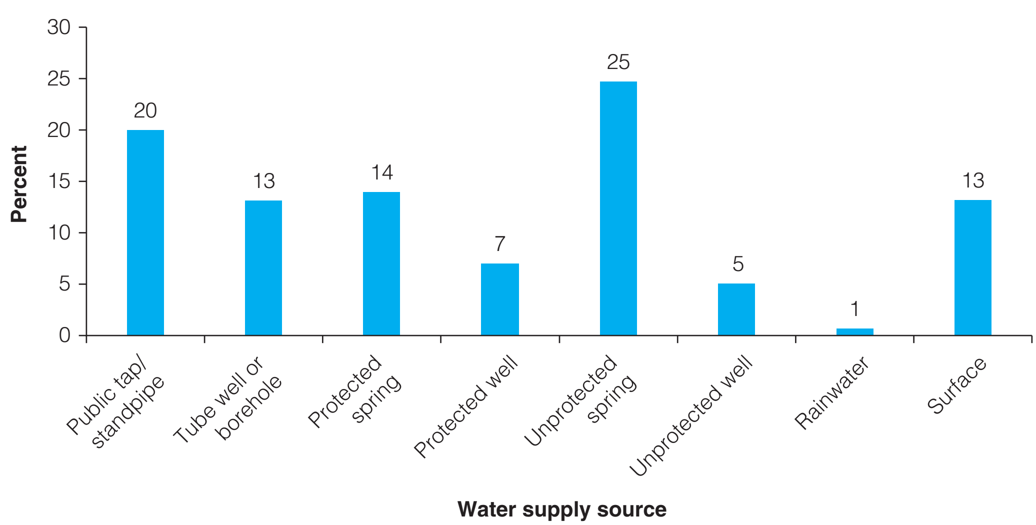
100 milliliters). *E. coli* was detected across all source types in rural areas. Protected wells (99 percent) and springs (93 percent) were equally at risk of fecal contamination as unprotected sources (95 percent). Only boreholes (87 percent) and stand posts (80 percent) were marginally lower in the proportion of sources in which *E. coli* was detected and in the overall level of risk from fecal contamination (see figure 4.15 and figure 4.16).

Figure 4.15: *E. Coli* Risk Levels at Point of Collection by Rural Water Supply Type in Ethiopia, 2016



Sources: ESS 2016 Water Quality Survey.

Figure 4.16: Main Source of Household Drinking Water by Type in Ethiopia, 2016



Sources: DHS 2016.

Previous, smaller water quality surveys reported lower levels of contamination but lacked the scale and representativeness of the ESS. There have been a number of small-scale water quality surveys (e.g., Kebede et al. 2017) but only one other water quality survey carried out at any scale across Ethiopia (WHO 2010). This survey, called the Rapid Assessment of Drinking-Water Quality (RADWQ) was carried out in 2004–05 across 1,602 households. Though it is representative of improved types of water supply used in the country, it does *not* report separately on urban and rural areas. The RADWQ survey reports lower average levels of microbiological contamination than the ESS survey. Thermotolerant coliforms were detected in 32 percent of borehole samples, 45 percent of protected dug wells, and 56 percent of protected springs. For some regions and types of source, however, such as protected springs in SNNPR, thermotolerant coliforms were detected in 79 percent of the samples. The ESS's larger scale, enabling a greater reach into rural areas, and its stratified sample design, enabling disaggregated reporting for urban and rural areas, may account for the higher levels of microbiological contamination reported.

Treatment of water. Though the ESS-WQT 2016 reports some improvement to water quality at point of use when treated, only 5 percent of rural households treated water. The DHS 2011 and 2016 report slightly higher rates of treatment in rural areas at around 8 percent. The main methods households used were chlorinating (5 percent) and boiling water (2 percent).

Households that reported treated water at the household level were more likely to see a decrease in *E. coli* levels (19 percent) than households that did not report treatment (10 percent). Water treatment is one of the few variables in the service delivery chain that shows variation across wealth quintiles with households in the T60 (16 percent) more likely to treat water than households in the B40 (6 percent). However, given the very low levels of water treatment in rural areas, this does not appear to be a significant contributor to a divide in health outcomes.

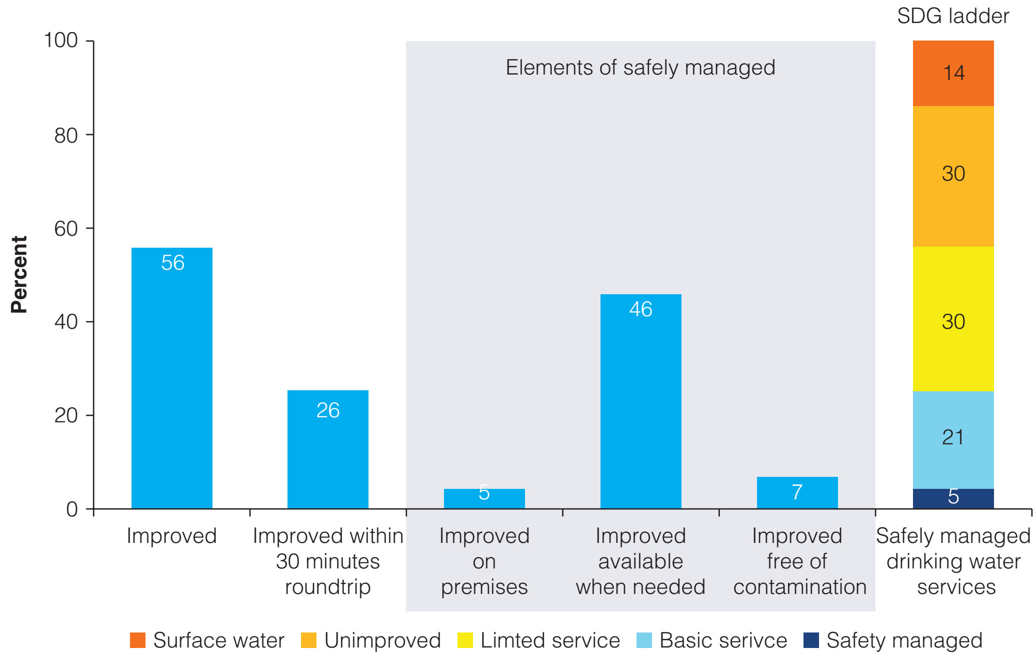
Implications of Service Quality on the SDG Baseline

Though there is little differentiation by wealth the level of service available to Ethiopia's rural population is very low: an SDG baseline of just 5 percent of people having access to safely managed drinking water. Across the service delivery and results chain, the main finding relating to wealth is that there is very little differentiation whether by (a) time to source; (b) water availability; (c) quality of water at source; (d) diarrhea; or (e) malnutrition. The only small difference is in water treatment, but the overall levels of treatment are so low that these are unlikely to influence outcomes. Rather, the analysis of links along the chain highlights that both poorer and wealthier households face an equally low level of service with (a) limited time saving being realized; (b) seasonal and drought risks to availability and sufficiency; (c) poor water quality; and (d) very low levels of point of use treatment. With failures throughout the service delivery chain, current rural service levels are unlikely to deliver on the health, let alone the putative economic benefits, of rural water supply interventions.

The SDG baseline for *safely managed* rural drinking water is just 5 percent determined by the lowest element of the three conditions of (a) accessibility (the source should be located on premises within the dwelling, yard or plot); (b) availability (water from an improved source should be available when needed); and (c) quality (water supplied should be free from fecal and priority chemical contamination). Even if there were higher levels of water on premises, the quality of water would be the next element to determine the baseline.

The SDG baseline for a *basic service* of rural water supply is 26 percent (see figure 4.17). This is where the three conditions of safely managed are not met, but the improved source is within 30 minutes of the home.

Figure 4.17: Estimates of Safely Managed Rural Drinking Water in Rural Ethiopia, 2016—SDG Methodology



Source: ESS-WQT 2016.
Note: SDG = Sustainable Development Goal.

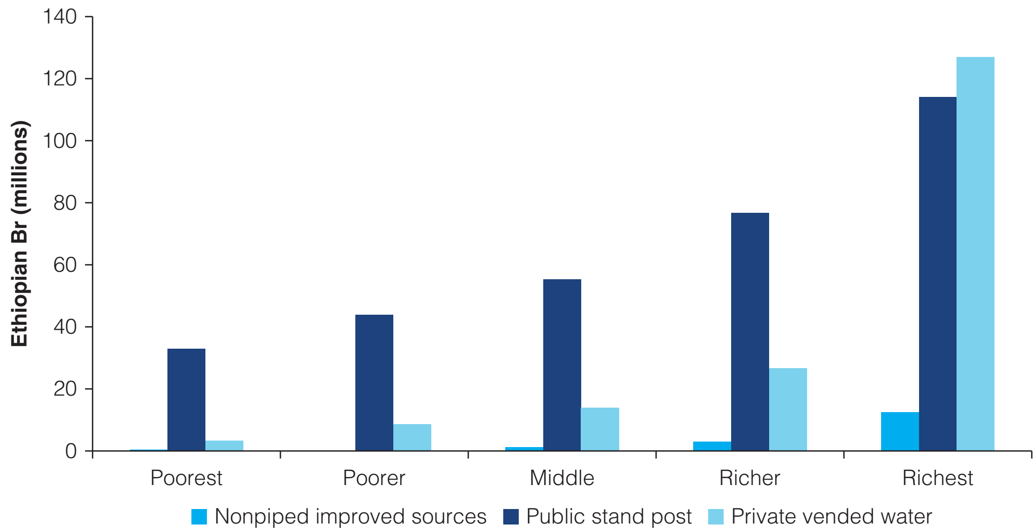
However, neither of these definitions for safely managed or basic services deal with a final condition of the SDG: affordability. The following section examines affordability exploring some of challenges that there would be in expanding access to piped water.

Implications of a Shift Toward Piped Water Supply on Affordability

While expenditure on nonpiped sources is very low the expenditure on piped water and water from vendors rises sharply across consumption quintiles (see figure 4.18). The 2011 Household Income and Consumption Economic Survey (HICES) collected expenditure data on both food and essential nonfood items, including water. In rural areas the survey reports average actual expenditure on water to be Br 62 per person per year (US$3.7), equating to an implied subsector turnover of US$230 million in 2011.

This pattern of expenditure is reflected in a much smaller survey of tariffs across 100 schemes in Ethiopia conducted for the 2009 Ethiopia PER. The results of this small survey help explain this pattern. First, only 55 of the schemes have instituted a regular tariff (i.e., a user payment per bucket, monthly, or annual), 45 of which also have a maintenance fund. Water tariffs are extremely low except for motorized piped schemes in which tariffs average just under Br 0.5 per 20 liters. Motorized piped schemes use diesel engines to pump water from boreholes, usually to an overhead tank, from which water is distributed to stand posts. These schemes have high operational costs since they have to buy diesel regularly for water pumping.

Figure 4.18: Average Total Consumption per Person per Year in Ethiopia, 2011



Source: HICES 2011.
Note: "Consumption per person" refers to adult equivalent.

Table 4.1: Average Tariff by Scheme Type and Payment Method

	Tariff (Br)		
Source/scheme type	Pay annually	Pay monthly	Pay per bucket
Protected spring	n.a.	0.71	n.a.
Hand-dug well	11.00	1.15	n.a.
Shallow borehole	6.00	1.31	0.07
Spring with piped distribution	n.a.	10.00	0.10
Motorized deep borehole with piped distribution	n.a.	n.a.	0.47

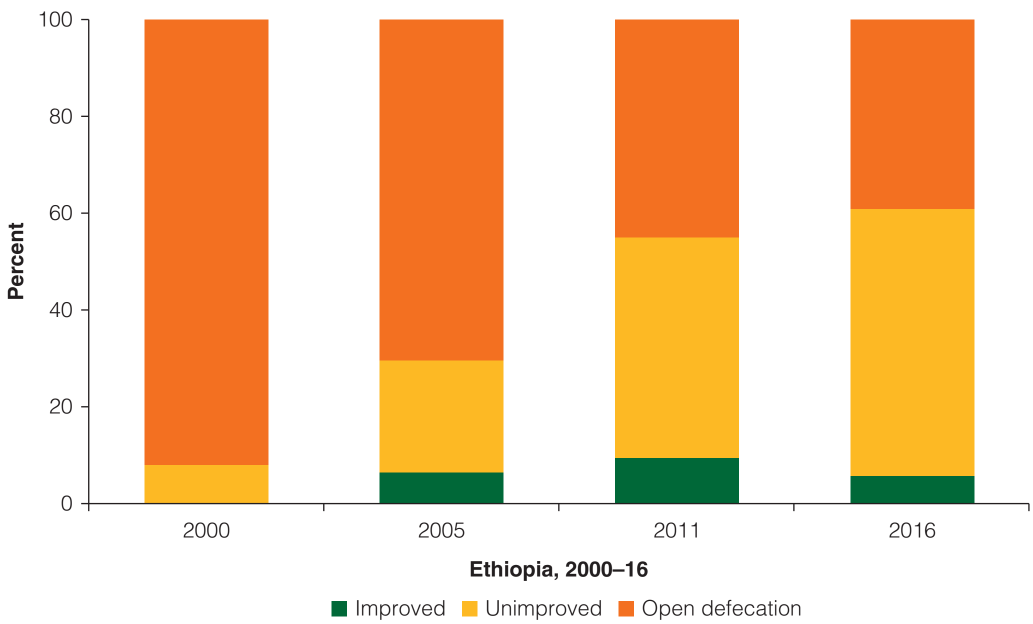
Source: PER 2009.
Note: n.a. = not applicable.

At the equivalent of Br 25 per cubic meter, the tariff for these rural motorized schemes is over five times the average urban tariff per cubic meter and 25 times the lowest urban tariff bands (see figure 4.19). Consuming just 20 liters per person per day would be equivalent to just under Br 200 per person per year, which is more than the 5 percent affordability threshold commonly used to gauge affordability. Many of these motorized piped schemes are in pastoralist and ago-pastoralist lowland areas.

Another small-scale study of water use conducted in Shinile woreda in Somali region and Konso woreda in SNNPR (Dessalegn et al. 2013) reports that the poorest households are most severely affected by the high costs of rural water. They have the least labor to release, the fewest assets to collect and store water, and the least cash to pay for it. They are also more likely to forego income-generating activities in favor of water collection, and more likely to see the condition of their livestock deteriorate because of constrained water access. The study reveals that water fees also affect access, particularly for poorer households.

In view of the shift envisaged to more complex piped schemes under GTP II, the *affordability* of water services and cost-sharing arrangements will need to be examined carefully. Evidence from national surveys, smaller studies, and the case study (box 4.3) suggest that affordability of rural water from piped schemes, particularly motorized piped schemes, can be a real barrier for poorer households to access and explains the skewed distribution of access to piped water in rural areas. In circumstances of shocks such as the poor harvests from recent drought events, the cost of water can have a profound effect on availability of cash income and on rural indebtedness.[10]

Figure 4.19: Trends in Access to Rural Sanitation



Source: DHS, 200, 2005, 2011 & 2016.

Box 4.3: Poor Households Receiving Safety-Net Funding from PSNP Excluded from Access to Improved Piped Water

Mareko is a food insecure woreda in the Gurage zone of SNNPR that benefits from the PSNP. Ilala Gebiba Kebele in Mareko woreda has a motorized scheme that lifts water from a well at a depth of 270 meters. About six years ago the diesel generator used drive the water pump was replaced with electric- powered engine to reduce the cost of water production. Water is sold at Br 0.25 for a jerry can. Households also contribute Br 100 annually to cover maintenance costs. Households that cannot pay are excluded from accessing the piped water scheme.

box continues next page

Box 4.3: Continued

Ansade Seid, Ilala Gebiba Kebele in Mareko Woreda, SNNPR.
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While the borehole and one of its distribution points is within 200-meter distance to Ansade Seid, a mother of five, and to Shumba Bukeri a mother of three, both families cannot afford to use water from this source. Until last year Ansade bought water from the piped scheme at Br 0.15 per jerry can, but both Ansade and Shumba now collect water from a muddy pond close to their house, which is also used for animal watering. They use this water for both cooking and drinking purposes. At times they boil the water and filter it through a cloth for drinking. Ansade adds cement powder, which she takes form her workplace, to help settle the sediment in the water.

box continues next page

Box 4.3: Continued

Shumba Bukeri, Ilala Gebiba Kebele in Mareko Woreda, SNNPR.
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Both families are beneficiaries of the PSNP, receiving Br 710 per month for four months of the year, until the beginning of the rainy season. The children of both families also benefit from feeding program at the local school. During the rainy seasons, the husbands are able to get work laboring on other peoples' farms while both Ansade and Shambu look after cattle for payment of basic needs (feeding, watering, and provision of shelter). Their income barely meets the family's monthly need for food, and even though they receive the PSNP support they are unable to buy water from the improved piped water source. It is not due to lack of awareness about the benefits of clean water. It is simply that buying food is prioritized over buying water.

WASH committee members evaluating Asnade's and Shambu's situation agreed to consider their case with some agreeing to enable them to receive one jerry can of water for each household per day free of charge. But since water sold is metered, providing water free of charge requires a special arrangement.

Source: Yemane and Defere n.d.

Model latrine of Asersash Melese, 1-5 Leader, Ayjaseta Kebele in Fegeta Lakoma Woreda, Amhara Region.
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Rural Sanitation Subsector Analysis

National Status and Trends

Improvements in access to sanitation in rural Ethiopia has benefited from the transformative approach to the delivery of basic health care services implemented by the government. MoH's flagship Health Extension Program (HEP) operates with the premise that access and quality of primary health care for communities can be improved through the transfer of health knowledge and skills to households. This focused approach based on behaviorial change aligns with emerging thinking within the rural sanitation subsector and with the government's policy of zero hardware subsidies for household latrines.

The training and deployment of health extension workers (HEWs) at the kebele level through the HEP has provided a mechanism to promote sanitation and hygiene behaviors and adoption of low-cost latrine technologies at scale. The HEP is structured around packages of health messages delivered by around 38,000 HEWs. These packages are organized around 16 thematic areas, of which seven relate to sanitation and hygiene behaviors. Despite the financing challenges of the HEP and scale of the tasks expected from the HEWs, including modules in the HEP packages on ways to change sanitation and hygiene behaviors have provided the basis for notable progress in latrine coverage. Regional health bureaus and woreda health offices have harnessed the HEP and outreach of the HEWs to significantly improve the sanitation situation in rural areas after 2000.

Clear GoE strategies, high level of political commitments for improving sanitation, and the empowerment of regional bodies through an ongoing decentralization process have created a conducive enabling environment for sanitation and hygiene promotion and service delivery. In 2005 the MoH's National Hygiene and Sanitation Strategy (NHSS) focused on three main areas: (a) safely manage excreta; (b) safe water chain from a source to point of use; and (c) hand washing with soap after defecation. This was followed in 2006 by the Universal Access Plan (UAP), which targeted 100 percent sanitation coverage.[11] The development of the NHSS Strategic Action Plan (2011), supported by the National Community-Led Total Sanitation and Hygiene (CLTSH) Guideline, the National Sanitation Marketing Guidelines, and other protocols, belatedly provided the tools and methodologies to guide implementation.

Ethiopia was recognized in the 2015 JMP report (UNICEF/WHO 2015) as having achieved the largest global decrease in the proportion of the population practicing open defecation.[12] In 2000, the DHS recorded that open defecation[13] rate (those households without access to a latrine) in rural areas was at 92 percent. By 2016 Ethiopia reduced the proportion of the population practicing open defecation to 39.1 percent, which is an average reduction of over 3.5 percent per year since 2000. It should however be noted that progress has slowed in recent years, with a reduction of only just over 1 percent per year between 2012 and 2016.

While the reduction in open defecation has resulted in the uptake of latrines, most latrines built in rural areas are unimproved.[14] The 2016 DHS reports access to unimproved latrines in rural areas was 52.5 percent, compared to just 5.7 percent of households with improved latrines[15]. The progress in reducing open defecation is commendable; however, the significant number of unimproved latrines raises questions over the public health impact of this change. While unimproved latrines can increase convenience and dignity for individuals, they are less likely to safely remove feces from the environment and not result in the expected health benefits. While data on latrine use remain limited, studies show that behavior change is less likely to be sustained by users of unimproved latrine due to the less pleasurable experience and the cost of maintaining less robust infrastructure. In part this slippage could explain the slowdown in reduction of open defecation in recent years, as household return to open defecation practices.

Box 4.4: Health Extension Workers Support Improvement in Sanitation

Abakokit Keble (Faguta woreda in South Gonder zone) is an example of success in the woreda. After following the initial engagement of the HEWs on sanitation and hygiene promotion, it achieved 100 percent latrine coverage. However, the communities' initial response to CLTSH was latrinization, with little focus to quality and sustained use. The poor quality latrines and person behavior have been test by annual rain that bring flooding to the areas. Most latrines are destroyed each year, and residents are now fed up with annually rebuilding their latrines, resulting in latrine coverage of only 5.2 percent.

The HEWs engaged the communities in the kebele to achieve open-defecation-free status, and provided some technical support on how to build traditional pit latrines. However, the HEWs' capacity to provide technical support was inadequate when it came to building improved pit latrines with a cleanable floor and wall ensuring privacy. In fact, in the case of Abakokit, the demand is beyond just improved latrine but for more sustainable latrine technologies suitable for areas prone to water-logging. The HEWs struggled to meet the community's needs, and are in a vicious circle in which they continue to promote the same hygiene and sanitation messages with decreasing success. As a result, the HEWs, who have many other tasks assigned to them, shift their focus to other areas in which progress is more realistic. As a result, Abakokit's family and other families have returned to open defecation.

Although this is a single case, in general, HEWs have focused on promoting latrine construction and have done less to promote safe excreta disposal and sustained use of latrines. Unless a clear strategy for hygiene promotion focuses on sustained use of latrines, along with means to support households to climb up the sanitation ladder, the trend of communities reverting back to open defecation will continue.

Source: Yemane and Defere n.d.

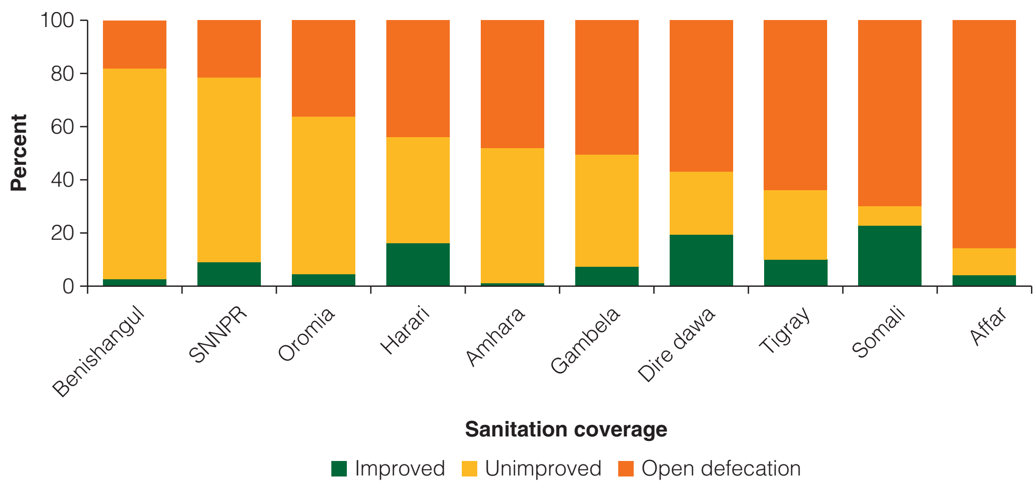
The low uptake of improved latrines in rural areas are driven by both demand and supply factors. From the demand side, there is a strong emphasis on households stopping open defecation and building basic latrines. HEWs often lack knowledge of the importance of building a hygienic latrine, and therefore provide communities with limited information on why they should invest in an improved latrine or how to build one. This is compounded by supply-side factors: most communities lack someone with the knowledge and skills to construct an improved latrine, and products to support this construction are not available in the local market. Where products and services are available they are often not affordable or above a price households are willing to pay, due to individuals' lack of knowledge of the importance of investing in a latrine. There are also limited microfinance products available to support households build latrines.

Access Disparities by Geography and Livelihoods

Significant variation in the sanitation coverage can be observed among rural populations in different regions (figure 4.20). The most significant disparity is in open defecation rates, which range from 18 percent to 85 percent. The regional variation between improved sanitation rates are less significant, ranging from 1.2 percent to 22.7 percent.

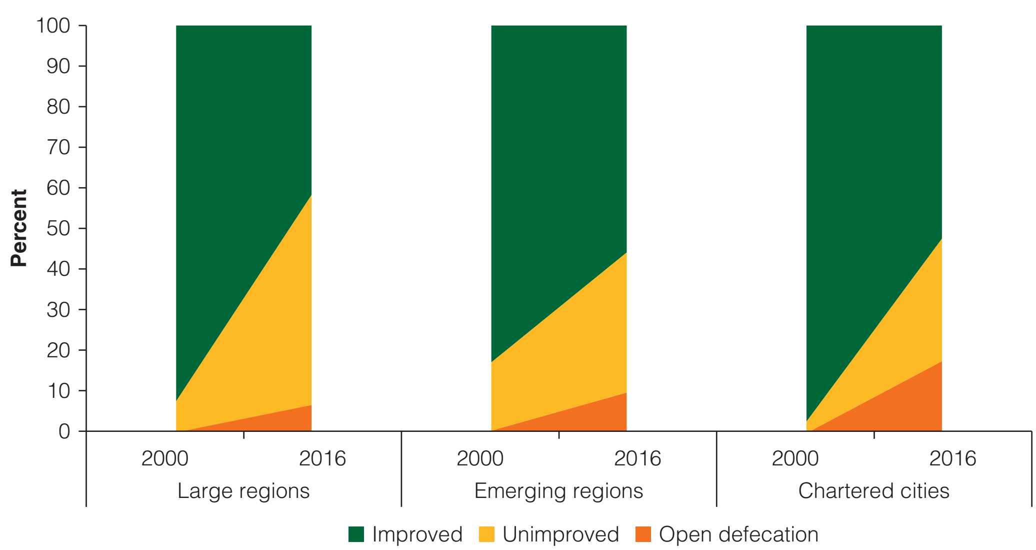
The four large (and predominately agrarian) regions have achieved the most significant reduction in open defection, dropping from 94 percent to 42 percent between 2000 and 2016 (figure 4.21). The open defecation reduced by 48 percent in the chartered cities, similar to the large regions during the same period. Despite open defecation in the emerging regions being lower in 2000 than the other regions, progress has been slowest during the period, reducing from 82 percent to 56 percent.

Figure 4.20: Rural Sanitation Coverage by Region in Ethiopia, 2016



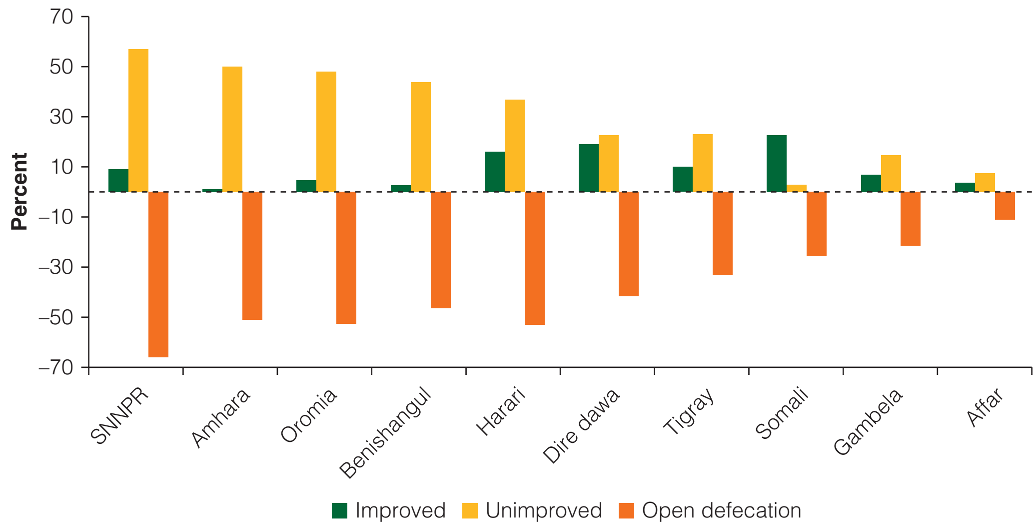
Source: DHS 2016.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Figure 4.21: Rural Sanitation Coverage Trends in Large Regions, Emerging Regions, and Chartered Cities in Ethiopia, 2000 and 2016



Source: DHS, 2016.

Figure 4.22: Rural Sanitation Coverage Trends by Regions in Ethiopia, 2000–16



Note: SNNPR = Southern Nations, Nationalities, and People Region.

While Afar has the lowest percentage of improved latrine, emerging regions (such as Somali and Gambella) and the chartered cities have some of the highest percentages of improved latrines. When regional trends in sanitation coverage are analyzed (see figure 4.22) the large regions (except for Tigray) have achieved the largest percentage growth in unimproved latrines. Emerging regions, on the other hand, have translated more modest reductions in open defecation into greater proportionate increases in improved latrines.

These regional trends can be best explained by the effectiveness of HEP in the regions and the different approaches that have been promoted. It is clear that HEP has been most effectively delivered in the large regions and Benishangul-Gumuz. This is because of the greater capacity of the local government structures and the increased level of financial and technical support provided by development partners in these regions. The fact that SNNPR has the lowest levels of open defecation among its rural population can be primarily attributed to the strong political leadership of Dr. Shiferaw Teklemariam.[16] Dr. Teklemariam placed sanitation high up on his agenda for change, and as a result woreda and kebele health offices and HEWs dedicated significant time to promoting improvement in sanitation, over and above other interventions.

The predominant approach promoted by HEWs and development partners in the large regions has been the CLTSH approach, which emphasizes collective community action to eradicate open defecation. Because the approach does not provide subsidies for hardware construction (in line with the national policy), less focus has been placed on the construction of higher quality (improved) latrines. Poor access to sanitation products in rural areas, due to weak supply chains, has further compounded the challenge of constructing an improved latrine, with most rural communities relying on local materials.

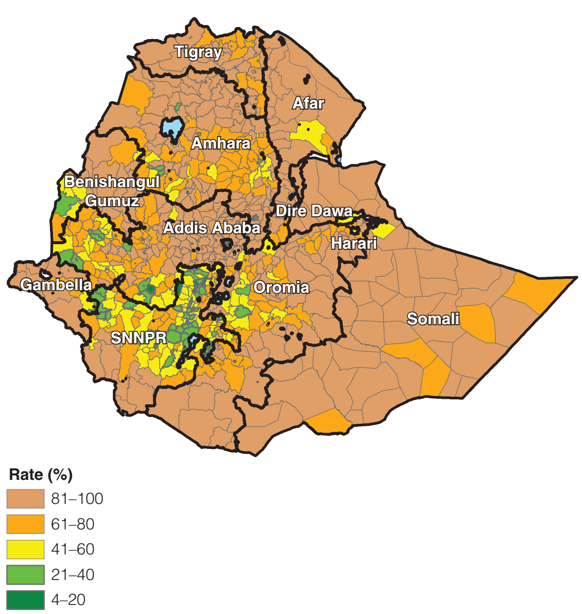
There are several explanations for the higher levels of improved latrines in the emerging regions. The first is that the promotion of the CLTSH approach has not been prevalent in the emerging regions. While Gambella, Afar, and Somali have high levels of open defecation, the distribution of subsidized hardware through humanitarian programs have resulted in some of the highest rates of improved latrines. In addition, the rural populations of the city states of Dire Dawa and Harari reside close to these large urban centers, providing them increased access to local markets and affordable sanitation products, which has enabled the construction of improved latrines.

These differences in coverage and characteristics of coverage also play out within regions. The 2007 Housing and Population Census data have been used to undertake woreda-level intraregional analysis, while this data are slightly outdated, they provide0 a good indication of some intraregional trends (see maps 4.4 and 4.5). Woredas with higher level of improved sanitation coverage tend to also have lower levels of open defecation. The woreda analysis further confirms the report of the higher coverage in SNNPR, but highlights that there are number of woredas in southwest SNNPR (Bench Maji and South Omo Zones) that have not made the progress shown in other areas. In addition, the progress in northern SNNPR is part of a band of progress from east to west: from Central Oromia (Arsi Zone), northern SNNPR, western Oromia, and southern Benishangul.

Maps 4.4 and 4.5 clearly show woredas in southern Amhara and eastern and southern Tigray (Misraqawi and Debubawi Tigray Zones) have higher coverage rates compared to other woredas in the region. This is in part due to the higher level of external financial and technical support in these areas, and additional donor support in these areas since the 2007 census has further been exaggerated this trend. In Tigray, these zones have benefitted from their proximity to regional capital city of Mekelle, which has resulted in increased donor financing, access to markets, and political attention. Islands of success in Benishangul-Gumuz and Afar also exist, which warrants further investigation.

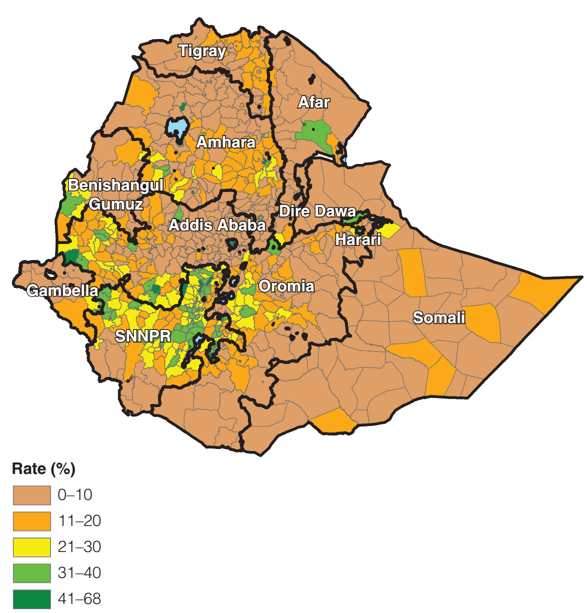
Intraregional variations in sanitation coverage can to some degree be explained by livelihood types (cropping, agropastoralist, and pastoralist) (figure 4.23a), and production systems (cash crops, food crop, crop sales, and livestock) (figure 4.23b). There is significantly higher rates of open defecation in woredas with livelihood types classified as mostly pastoralist and agropastoralist, compared to those classified as cropping. There appears to be a systematic failure to improve sanitation coverage in pastrolist communities, as with the issues regarding improved water supply.

Map 4.4: Open Defecation Rates in Ethiopia, 2007



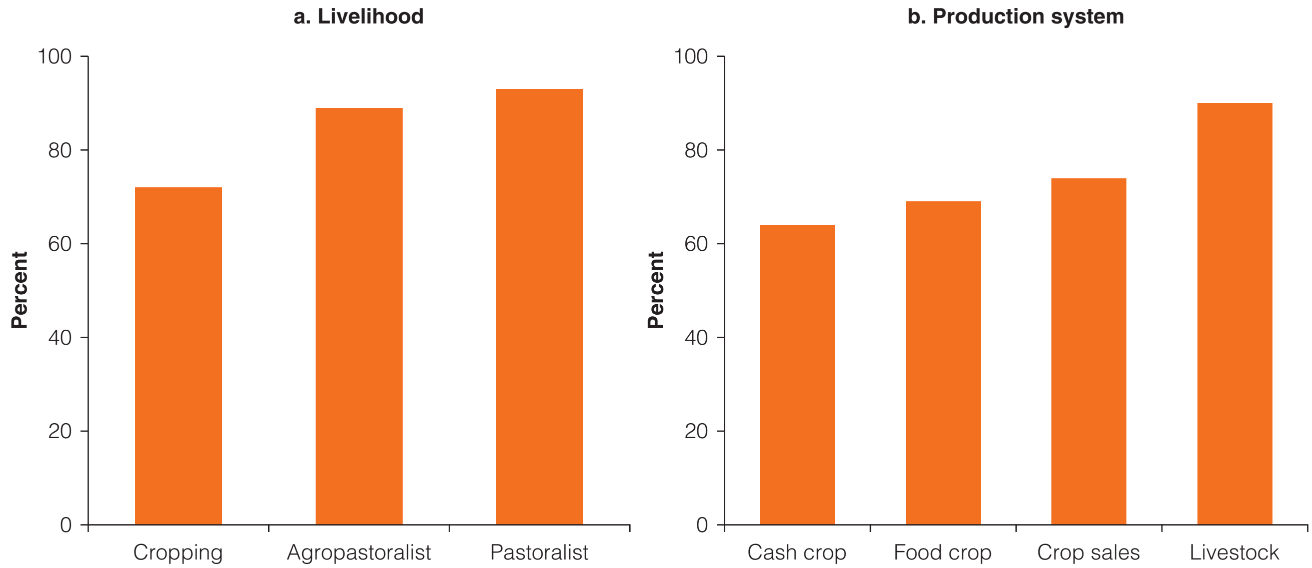
Source: Housing and Population Census, 2007.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Map 4.5: Improved Sanitation Coverage in Ethiopia, 2007



Source: Housing and Population Census 2007.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Figure 4.23: Open Defecation Rates in Ethiopia, by Livelihood Type and Production System, 2007



Source: Population and Housing Census 2007.

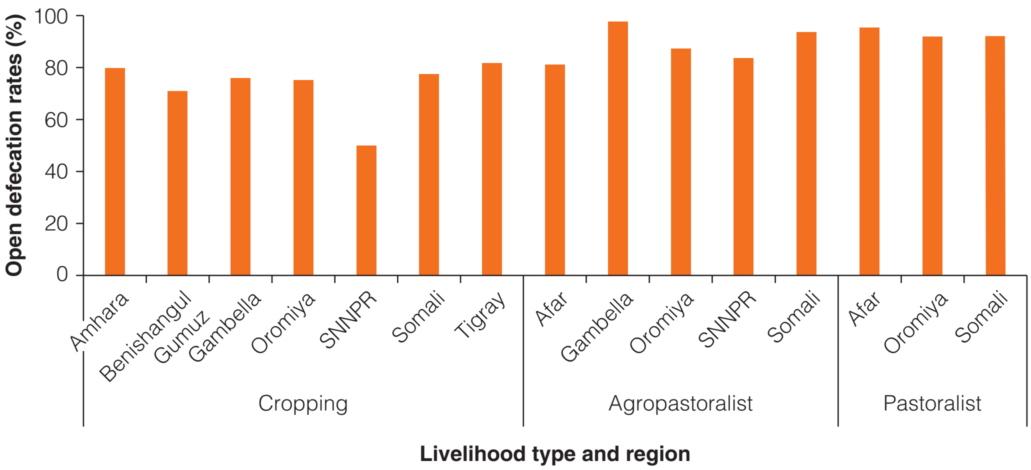
Those living in woredas in which cropping, specifically cash cropping, is most prevelant have the lowest levels of open defecation. However, there appears to be lower open defecation rates in areas where households consume over half the food they produce, so-called "food crop" woredas, compared to areas of crop sales. This seems counterintuitive, and unlike water supply, cannot be explained by the safety nets program (PSNP), since open defecation is 11 percentage points higher in PSNP woredas on average.

Differences in open defecation rates can be observed between pastoralist and cropping woredas, which further confirms the systematic challenges of addressing sanitation coverage among these groups even within the regions. Fewer differences are observed between pastoralist and agropastoralist woredas in Somali and Oromia; however, there is a significant gap between pastoralist and agropastoralist woredas in Afar (figure 4.24). The most striking difference is in SNNPR and Gambella where agropastoralist woredas have a significantly higher level of open defecation than cropping woredas (see box 4.5).

Despite emerging regions' coverage lagging behind that of the large regions, most people who lack access to adequate sanitation reside in the large regions (see figure B4.5.1a). Of the total number of people who still defecate in the open in rural areas 86 percent are in Oromia, SNNPR, and Amhara; those areas are also home to 94 percent of households with unimproved latrines. Oromia contains 45 percent of the rural population still practicing open defecation, many of whom live within pastoralist communities (see figure B4.5.1b).

To bring all the regions to a similar proportionate level of coverage, there is a clear argument to focus investment in the emerging regions to address the gaps in coverage they are experiencing compared to the large regions. However, there are just over 2 million people who openly defecate in the emerging regions, compared to over 25 million in the large regions. To achieve universal access to sanitation facilities, considerable focus needs to be made on the large regions. The following section looks at the relationship between poverty and sanitation coverage in rural areas, and identifies coverage levels among the poorest woreda to further guide choices concerning the targeting of investment.

Figure 4.24: Open Defecation Rates by Livelihood Type and Region in Ethiopia, 2007



Source: Population and Housing Census 2007.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Box 4.5: Challenge of Sustaining Sanitation Improvements in SNNPR

Digna Koisha Humbo kebeles in Digna Fango woredas (Wolaita Zone, SNNPRO) is one of the poorest woredas in the area with most of its residents benefiting from the PSNP. While the kebele once reported 100 percent latrine coverage, most latrines are now dysfunctional, requiring maintenance and renovation. Muntashe Chinkla is a 70-year-old mother of five daughters and a son, whose once functional latrine now requires rebuilding and sits unused. She lives with three of her school-aged daughters, and the household's only source of income is the agricultural product they sell from their smallholding.

Chinkla buys one jerry can of water per week for drinking purpose at a rate of Br 2.50 per can, and collects water for other domestic use from traditional sources. Her now dysfunctional latrine, which her son helped her build, is shared with his family, which places an increased burden on this failing facility. She realizes her need to improve her latrine but lacks the resources to hire someone to build a stronger, more permanent structure.

Martha Mathewos has been a HEW for the last nine years, and sees the challenge faced by many households as their latrines run into despair. As the initial community enthusiasm for collective action on sanitation wanes, the honeymoon period ends and households return to open defecation. Mathewos, like other HEWs, lacks the interest and time to continue hygiene promotion, and although one to five groups were formed as a support system for hygienic behavior, in practice they have little ability or motivation to improve the situation. Even those who can afford to improve their latrine are now discouraged to do so, since the collective

box continues next page

Box 4.5: Continued

Muntashe Chinkla, 70 years old. Digna Koisha Humbo Kabele, Digana Fango Woreda, SNNPR.

decisions made in the past are no longer enforced with the same accountability. The prevalent poor economic situation and the lack of construction material and skilled labor are other challenges the households in this kebele must face to either rebuild or improve their latrine. The dysfunctional and unused latrines scattered across the kebele are a stark reminder to the community of the once good progress they made in improving the environment of the village.

box continues next page

Box 4.5: Continued

Marta Matthews, Health Extension Worker. Digna Koisha Humbo Kabele, Digana Fango Woreda, SNNPR.

Source: Yemane and Defere n.d.

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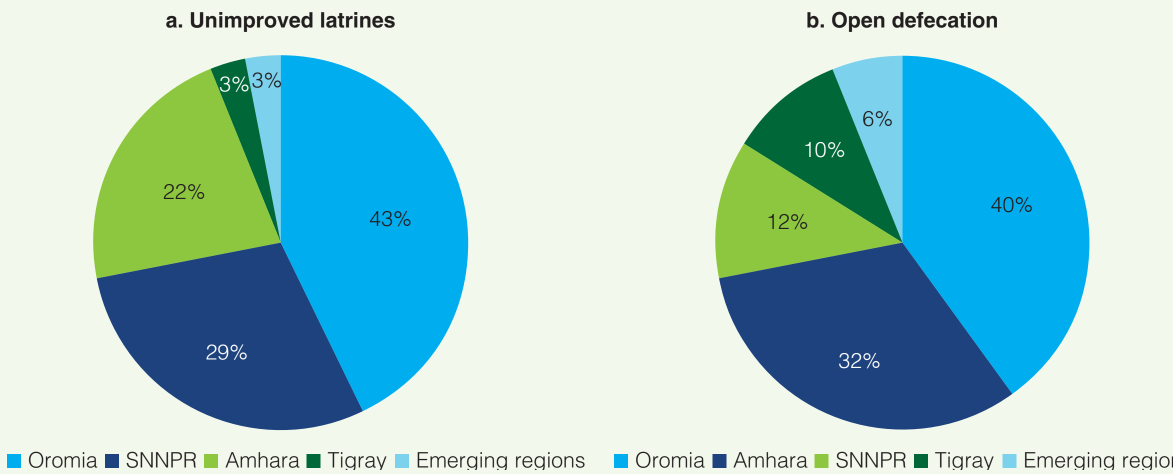
Box 4.5: Continued

Figure B4.5.1: Rural Populations in Ethiopia with Unimproved Latrines and Practicing Open Defecation, by Region, 2016



Source: DHS 2016.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

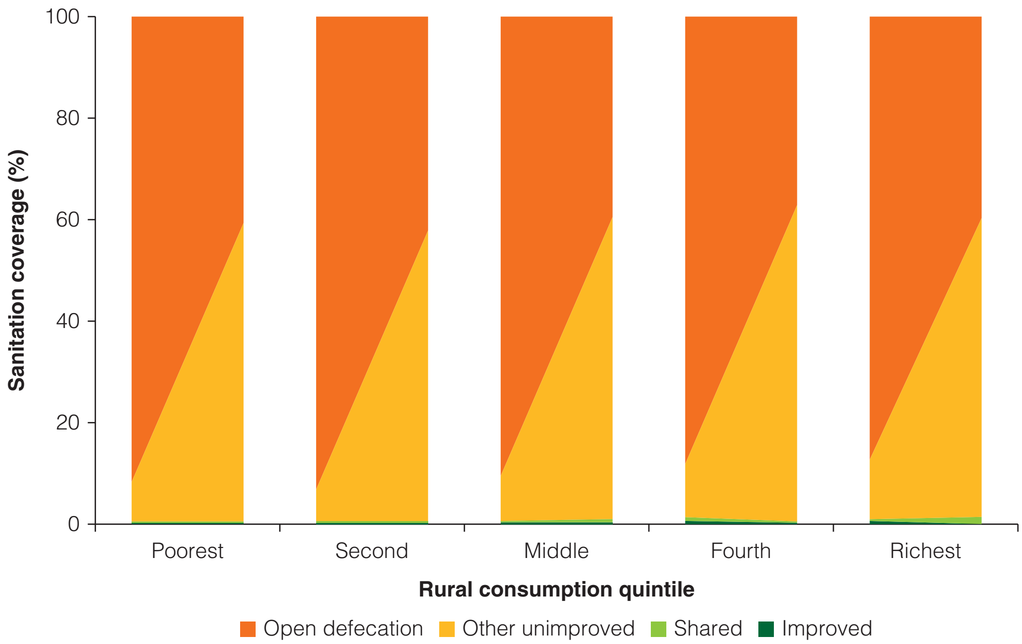
Access Disparities by Wealth and Consumption

Analysis of poverty quintiles using the Welfare Monitoring Survey (WMS), based on consumption, shows that poverty makes no difference to access to sanitation in rural areas (see figure 4.25). This data would suggest that the HEP and other strategies used to create demand for sanitation seems to have been effective for all households irrespective of poverty levels. However, analysis of DHS data of poverty quintiles, using a wealth index, shows a difference between rich and poor households in terms of access to sanitation (see figure 4.26). In the richest quintile open defecation is nearly half that of the poorest quintile. While the DHS data show inequality of coverage between rich and poor households, over one-third of the richest 40 percent living in rural areas still defecate in the open and only 10 percent the richest 40 percent have access to an improved latrine.

The poorest households have the lowest levels of adoption of the three key hygiene behaviors highlighted in the GoE's policies and strategies; safe child stool disposal, safe water treatment, and improved hand washing. There was almost no improved hand washing reported in rural areas, and low levels of improved child stool disposal (approximately 5 percent for the top 20 percent of the wealth index [T20] and 2 percent for the bottom 20 percent of the wealth index [B20]) and safe water treatment (approximately 10 percent for the T20 and 2 percent for the B20; see figure 4.27)

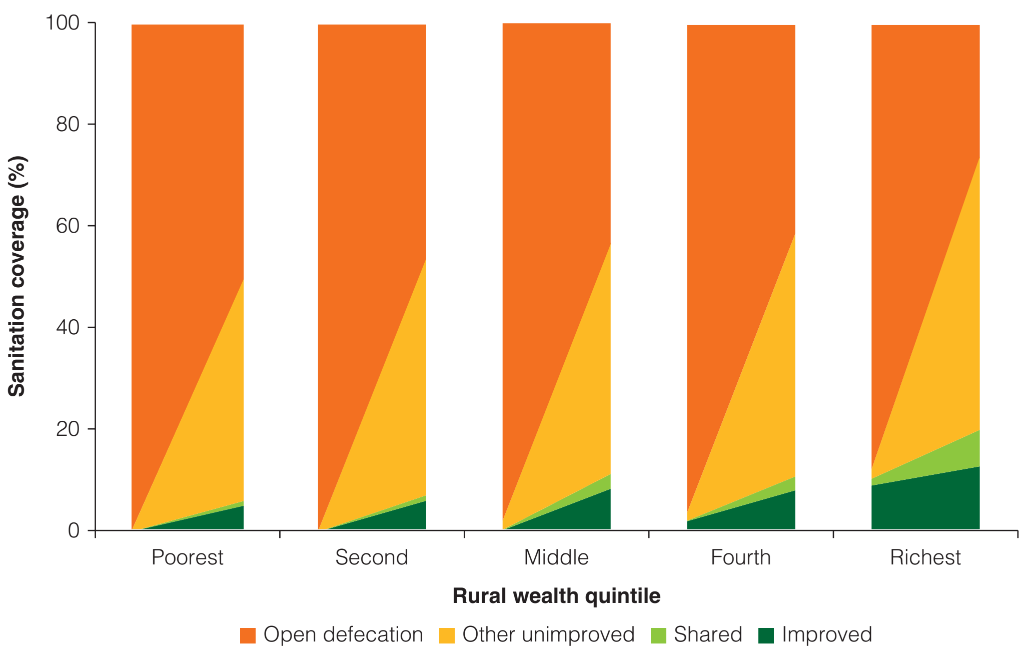
While the association is not that strong, female-headed households have higher rates of open defecation and lower rates of improved latrines than male-headed households (figure 4.28). Several factors drive this including access to land, access to skilled labor, and income levels. However, the data confirm that even if women would prioritize sanitation over and above male counterparts in decisions on how income were prioritized, other factors constrain them from implementing this.

Figure 4.25: Sanitation Coverage by Rural Consumption Quintile in Ethiopia, 2000–11



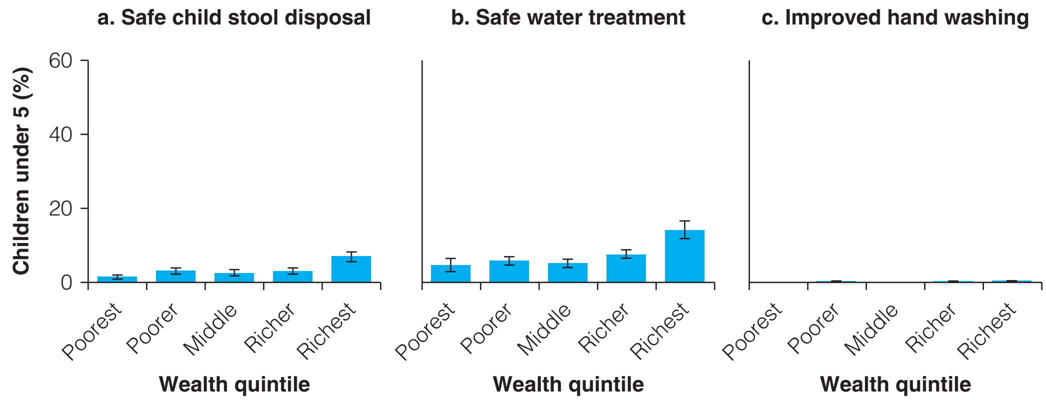
Source: WMS 2000–11.

Figure 4.26: Sanitation Coverage by Rural Wealth Quintile in Ethiopia, 2000–11



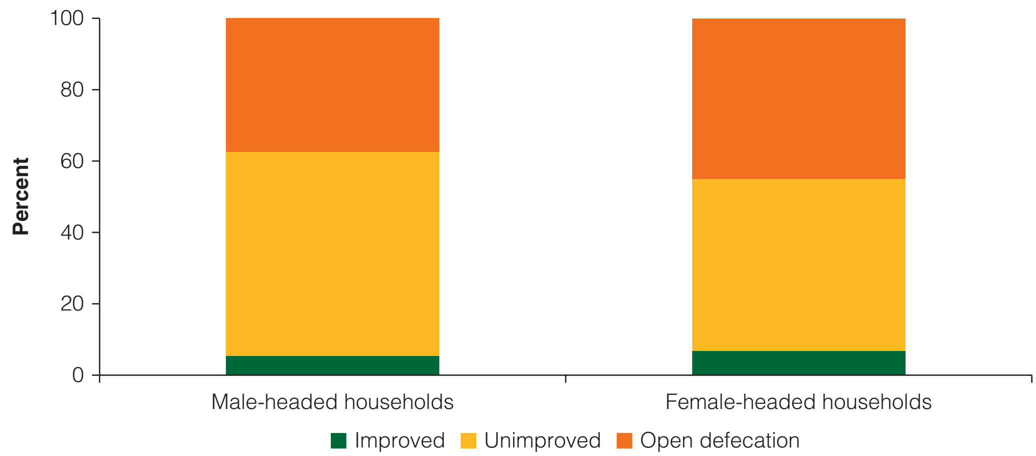
Source: JMP calculations of DHS 2000–11.

Figure 4.27: Exposure Variables by Economic Level for Rural Populations of Children under 5 in Ethiopia, 2011



Source: DHS 2011.

Figure 4.28: Rural Sanitation Coverage–Gender Analysis



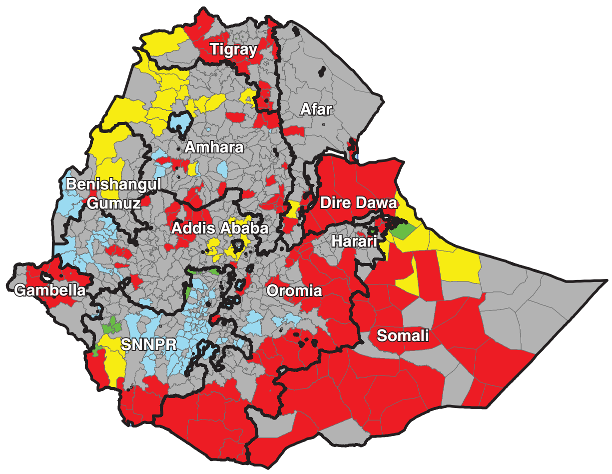
Source: DHS 2016.

Access Disparities by Geography and Poverty

At the national level, there does not appear to be a relationship between relative wealth and sanitation coverage, however to gain a more detailed insight the maps 4.6 and 4.7 present the relationship between poverty and open defecation and access to improved latrines at the woreda level. What is most reveling in this analysis are the extremes, in which there is low poverty and low coverage or high poverty and high coverage.

Less than 5 percent of people live in an area of low levels of poverty and high levels of open defecation, and 6 percent with low levels of improved latrine coverage. However, these woredas fall into three distinct geographic areas (yellow on the map): (a) surrounding Addis Ababa in the Oromia region; (b) in northern Amhara (North Gondar Zone) and northern Benishangul-Gumuz (Mektekel Zone); and (c) eastern Somali. The low coverage in the woredas in northern Amhara and northern Benishangul-Gumuz could partially be explained

Map 4.6: Poverty Relationship to Open Defecation in Ethiopia, 2007

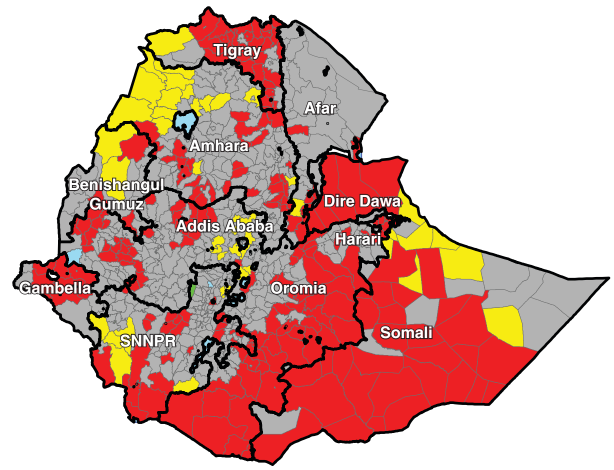


Open defecation vs poverty rate

- Low poverty, low open defecation
- Low poverty, high open defecation
- High poverty, low open defecation
- High poverty, high open defecation
- Medium to either of indicators

	Woreda open defecation levels		
Poverty level	<60	60–80	>80
<15	2.8		4.7
15–30		64.7	
>30	13		14.8

Map 4.7: Poverty Relationship to Improved Latrines in Ethiopia, 2007



Improved sanitation vs poverty rate

- Low poverty, low improved sanitation
- Low poverty, high improved sanitation
- High poverty, high improved sanitation
- High poverty, low improved sanitation
- Medium to either of indicators

	Woreda access to improved sanitation		
Poverty level	<20	20–40	>40
<15	6		1
15–30		64	
>30	26		2

Source: World Bank calculations based on Housing and Population Census 2007.
Note: SNNPR = Southern Nations, Nationalities and People Region.

by the poor connectivity in the transportation infrastructure and their distance from major cities. Cultural issues could also play a part in the poor uptake of sanitation facilities. The woredas in eastern Somali are mostly home to pastoralists with relatively good economic opportunities. However, their nomadic lifestyle makes it socially and technically challenging to provide sanitation solutions.

The reasons behind the low sanitation coverage around Addis Ababa are less clear, considering the relatively high level of road accessibility and proximity to a large urban center, which offers access to the good and services. This could be explained by the fact that these areas have more transient populations who move from other regions into the proximity of Addis Ababa to access employment, and the lack of community felt in these areas. The low sanitation coverage could be further compounded by the fact that many of the HEWs who work in these areas are based in Addis Ababa and have less connection with the communities they serve. It could be concluded that targeting these Oromia woredas might provide an opportunity for quick results.

As would be expected, there are a very limited number of woredas with high levels of poverty and high improved sanitation coverage or low open defecation. However, there are two groups of woredas that fall into this category (blue on the map): (a) central SNNPR; and (b) southern Benishangul-Gumuz and western Oromia. The woredas in central SNNPR appear to have benefited from the sustained campaign from the political leaders in SNNPR, which is a positive message that change can be achieved in a poor area with sustained political commitment. Southern Benishangul-Gumuz and western Oromia have a long history of external engagement from civil society and religious groups, which has complemented the government's effort to provide services.

There are a substantial percentage of the rural population living in areas of high levels of poverty and open defecation (14.8 percent) and low coverage of improved latrines (26 percent), and from an equity perspective those areas should be targeted most urgently. The largest area that falls into this group is a belt of woredas that cover the south of Ethiopia across Somali, Oromia, and SNNPR. The high percentage of pastoralists and the remote location of these woredas contribute to their high poverty levels and the poor sanitation coverage.

Livelihood type has a larger impact on sanitation coverage than population density. Figure 4.29 suggests a correlation between population density and open defecation, in which areas with lower population density experience higher rates of open defecation. However, when the woredas are split by both population density and by livelihood group (as in figure 4.30), while that association between high open defecation and low population density remains, there is a stronger correlation between the different livelihood groups and open defecation rates.

Overlapping Deprivation and Rural Sanitation Access

Improvements in sanitation, poverty, health, education and water in rural areas have considerably reduced the proportion of individuals deprived in multiple dimensions. Figure 4.31 depicts the degree to which those deprived from sanitation and with monetary poverty overlap with deprivation from access to the key services of health, education, and water. The number of individuals experiencing more than one out of any three deprivations has been reduced considerably. This is highest among individuals experiencing deprivation across sanitation,

Figure 4.29: Open Defecation Rates by Woreda Population Density in Ethiopia, 2007

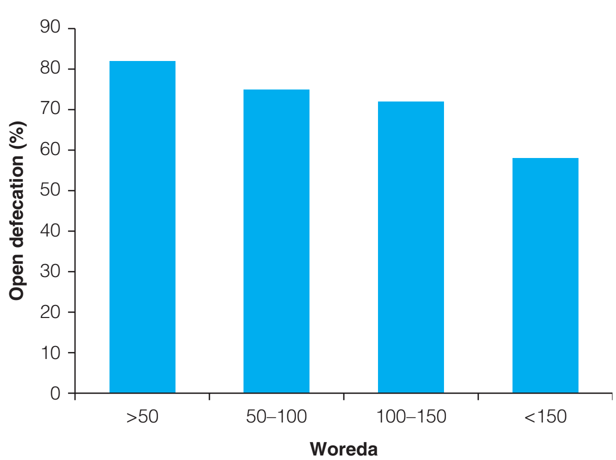
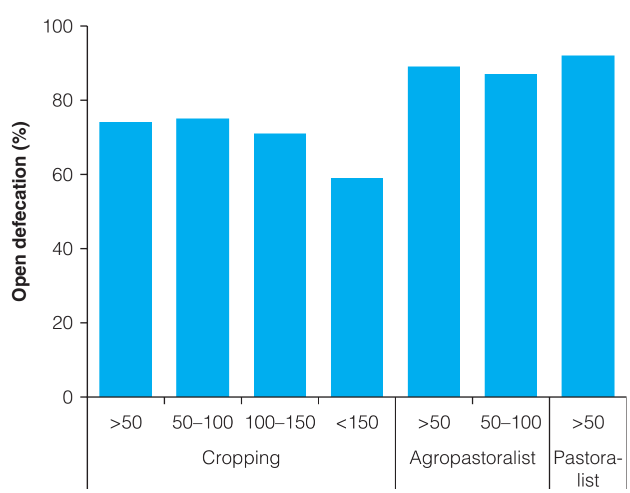


Figure 4.30: Open Defecation Rates by Livelihood Type and Population Density in Ethiopia, 2007

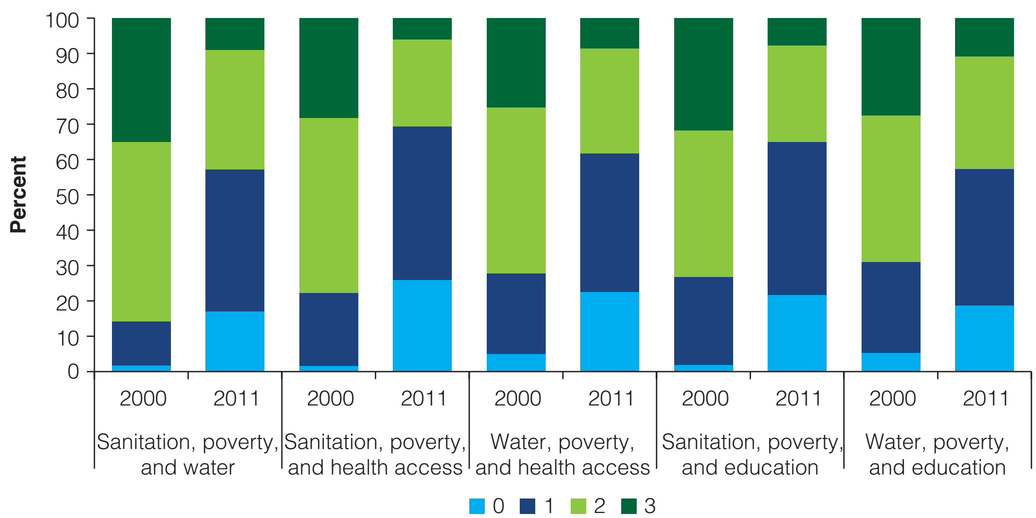


Source: Housing and Population Census 2007.

poverty, and health access, in which there has been a 47.2 percent reduction in those experiencing two or three of these deprivations. This further confirms the significant gains made in both access to sanitation and healthcare services in rural areas during period. Experiencing deprivation in many dimensions at once makes it difficult to escape poverty; thus, the overall progress is a positive indication that poor households with access to sanitation may now be in a better position to see improvements in welfare.

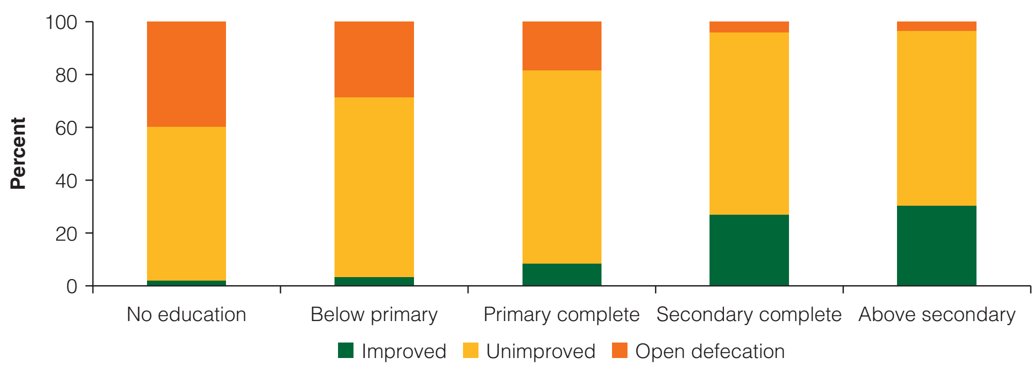
This analysis confirms the positive relationship between access to sanitation and education, with significant reductions seen in those experiencing overlapping deprivation for sanitation, poverty, and education. This trend is reaffirmed by national statistics that show a direct correlation between education levels and access to sanitation. Households with members who have completed secondary education and beyond are significantly more likely to have an improve latrine and not practice open defecation, even when one controls for wealth (figure 4.32).

Figure 4.31: Overlapping Deprivation Trends in Rural Areas in Ethiopia, 2001–11



Sources: World Bank calculations using HICES 2000 and HCES 2011.

Figure 4.32: Access to Sanitation by Education Level of Head of the Household in Ethiopia, 2011



Sources: HICES and WMS 2011.

Barriers to Rural Sanitation Access

While Ethiopia has a clear strategy and approach for moving rural households away from open defecation, policy makers must analyze ways to support the government in the next stage of transformative change in rural sanitation barriers and drivers to improve sanitation. A number of factors have driven the high percentage of unimproved latrines and in the inability of people to constructed improved latrines.

HEWs have focused more on stopping open defecation, rather than the promotion and adoption of technology solutions that qualify as improved. The CLTSH behavior change approach has harnessed a community response through individuals' emotions such as shame, pride, and collective responsibility, which when implemented effectively has been very powerful. However, where HEWs have not been provided adequate training and lacked the necessary skills, this approach risks households being forced to build latrines due to social pressure or even coercion, and not through a real desire to improve their sanitation situation. Hence poor quality latrines with minimal investment are built just to meet community requirement, not for personal use.

While evidence on latrine usage in Ethiopia is still limited, global evidence shows that there is a link between the quality of the latrine and the regularity of use. Latrines that don't provide a positive experience for their users (i.e., they smell, are dark, don't offer privacy, are unstable, and risk collapse) are not used as much as when a positive experience is had. In addition, poor quality latrines are more likely to become dysfunctional more quickly than latrines constructed robustly. This includes using wood and earth for a slab instead of using concrete shallow pits that fill up more easily, or unlined pits in soil conditions that risk collapse. Hence, moving people away from practicing open defecation into using poor quality latrines has proven to support only temporary behavior change.

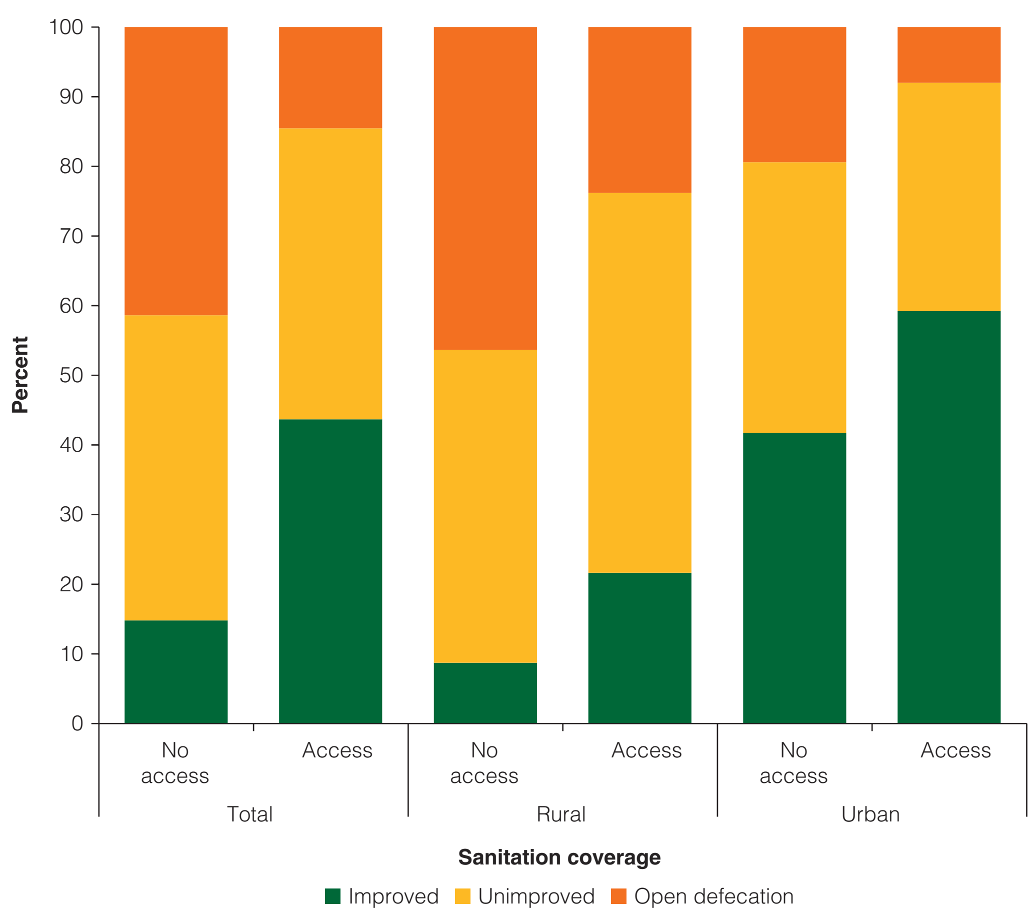
A new generation of behavior change strategies and messages are required to provide HEWs with the tools to reinforce the message of collective action and to encourage the construction of higher quality latrines. A more balanced mix of messages is required. Messages that trigger key behavior changes, such as stopping of open defecation and creating demand for latrine use, need to be continued. However, these need to be complemented with more informative communication, which increases household knowledge of what constitutes a hygienic and sustainable latrine, the benefits of additional investment, and where to access product and services to build improved latrines.

The current dearth of sanitation products and services in rural areas is another critical barrier to people constructing improved latrines. Appropriate products are often not available in local markets, and when available are often too expensive for most consumers or poorly marketed to reach the demand for latrines created by HEWs. If over the next decade, Ethiopia is to replicate the successful transition from open defecation to unimproved latrine with a move to improved latrine, innovative and low-cost products need to penetrate rural market. Greater product availability needs to be complemented with appropriate skills, both in construction of improved latrines and in business expertise to enable enterprises to be established, be made profitable, and create jobs. The Ministry of Health (MoH) partnership with other government agencies (such as the Technical and Vocational Education and Training Agency [TVET] and micro- and small business development agencies) with skills and experience in these areas will provide a strong foundation for this transition.

The availability of products and services will not have the desired impact on sanitation uptake if consumers don't have the necessary finance to purchase them. The government's policy of providing to rural areas no hardware subsidies and limited access to finance (such as microcredit) has hampered households' ability to invest in their sanitation facilities. This is a key contributor to latrines being constructed with less durable materials and to lower standards, as well as the perception from businesses that there is limited demand for sanitation products and services. However, analysis shows that those households that have access to credit are more likely to invest in improved latrines (see figure 4.33). While this is true for all poverty quintiles except the poorest, the richest quintile has benefited most from access to credit. It is also clear that access to credit has a bigger impact in urban areas where more products and services are available(see figure 4.34).

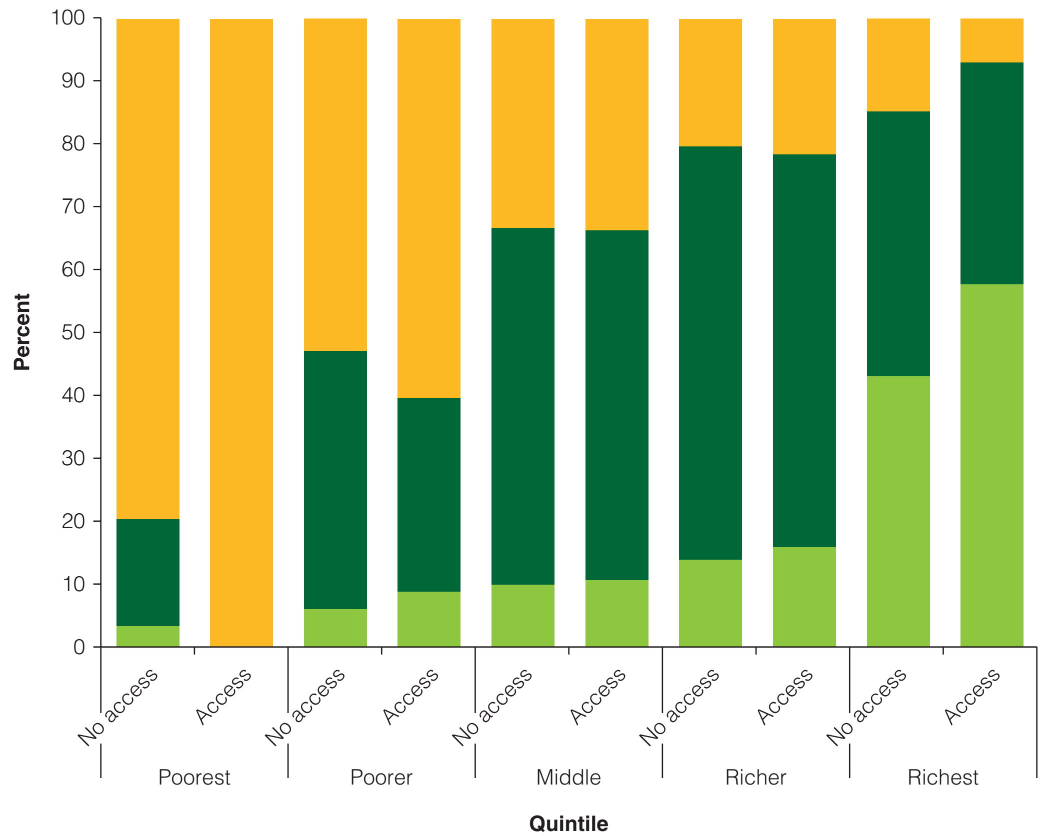
Limited data are available on the financing of businesses, but it is clear that in addition to making credit available for households to purchase sanitation products, businesses also need finance to engage in sanitation-based activities. The engagement of TVET and business development agencies have facilitated credit to new sanitation enterprises through the provision of training, accreditation, and development of financeable business models. However, further efforts are needed to engage microfinance institutions and the Development Bank of Ethiopia to enable sufficient finance to be targeted at businesses of varying sizes seeking to enter the sanitation market. The Ethiopia Chamber of Commerce and Sectoral Association can help facilitate market development and linkages to improve the supply chain.

Figure 4.33: Sanitation Coverage Compared to Access to Credit in Rural and Urban Regions in Ethiopia, 2011



Source: WMS 2011.

Figure 4.34: Sanitation Coverage Compared with Access to Credit in Poverty Quintiles in Ethiopia, 2011



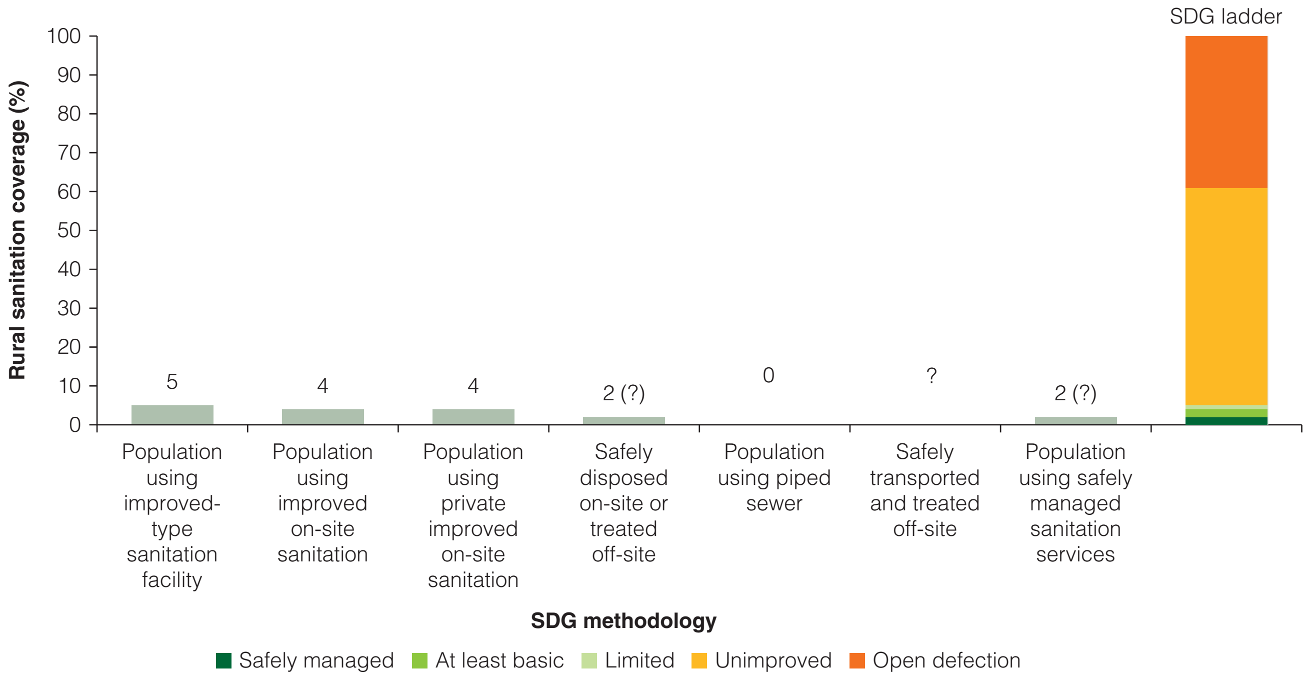
Implication of Achieving the SDG Targets

The higher sanitation service levels that the SDG targets demand are more applicable in urban context than in rural settings. However, the key difference for the rural setting is that safely containing fecal waste in a private improved onsite facility will now only qualify as basic sanitation access. If the improved latrine is shared, the household will be counted as having limited sanitation access. To qualify for safely managed access, households will need to safely contain fecal waste in a private improved latrine, and once full there will need to be evidence that this waste is safely managed. For onsite facilities there are two modalities for achieving this: emptying or sealing the pit. There is very limited prospect of off-site sanitation infrastructures being developed in rural Ethiopia soon, although pit emptying and disposal services may well become more common.

With such low improved sanitation coverage in rural areas, even reaching basic sanitation access will require a huge effort. There will also need to be an increased focus on the sustainability of infrastructure, since the new system will place increased focus on the effective use and whole life cycle of sanitation infrastructure, not simply its construction.

To accurately monitor progress using the SDG indicators, new data will need to be generated by the GoE's sector monitoring systems and national surveys. For example, in the data presented in figure 4.35, an assumption has been made that half of improved latrines are safely sealed once full. This data are currently not available, nor are data available on whether pits are safely

Figure 4.35: Rural Sanitation Coverage in Ethiopia, 2016—SDG Methodology



Source: World Bank calculation based on DHS 2016.
Note: SDG = Sustainable Development Goal; ? = figure based on best estimate using existing data.

emptied and treated off-site. The current sector monitoring system for rural sanitation needs strengthening (as documented in a World Bank report [Jones 2015]). This will require additional investments in capacity and system development.

Capacity Constraints across Rural WASH

Institutional and human resource capacity remains one of the biggest barriers to progress at all levels of government. Tracking the evolving capacity at different levels of government is difficult but provides an important variable in the effectiveness of service delivery, as well as the sustainability of services. As more power has been devolved downward and the number of administrative units have increased, the capacity and maturity of institutions delegated to deliver basic services have varied considerably across the country.

An internal World Bank study in 2014 estimates that at the federal level within the water sector, 63 percent of staff positions were filled and 79 percent filled in the health sector, compared to the average of 62 percent across the six sectors reviewed (see table 4.2). Regions and woredas were operating with even lower levels of required staff. In 2013, the ONE WASH National Programme (OWNP) cite a shortfall of about 40 percent across all technical cadres from artisans and water technicians to professional engineers, equating to some 47,000 people. It is difficult to see how the mandates of government institutions can be delivered with this extensive underdeployment of professionals.

Even where staff have been recruited and deployed, there is an ongoing challenge of retaining personnel, with high turnover of both administrative and technical staff. The gross turnover rate (voluntary and involuntary) in the water sector was 7.6 percent and 6.3 percent in health in

Table 4.2: Involuntary Turnover by Sector and Professional Level in Ethiopia, Fiscal Year 2013
Percent

Sector	Professional	Support	Manager	Total
Water	9.3	2.1	4.7	4.5
Health	6.6	5.1	8.4	6
Six sector average	5.7	2.9	3.9	4.6

Source: World Bank calculation based on available government data.

fiscal 2013, compared to the average across the sectors reviewed of 6.3 percent. Low government salaries and working in far-flung rural areas are disincentives, with staff preferring better terms and conditions in towns and cities.

Evidence shows that the most significant turnover type is internal voluntary turnover (transfers and moves) to other positions within the public sector, which is in principle under the control of government. The health sector has had one of the highest total involuntary turnover rates, primarily due to high turnover at managerial level. In the water sector, total turnover was in line with the average across the six sectors reviewed; however, the involuntary turnover in professional staff was significantly higher.

Men dominate staff positions in the water sector, while women make up most staff in the health sector. Data support the perception that in the water sectors there is a higher prevalence of males in professional positions, such as water engineering, with men making up 71 percent of the workforce. In contrast, in the health sector, women make up 53 percent of the workforce, including the roles of HEWs (filled almost exclusively by women). However, this data also indicates a lack of women further up the health system.

The OWNP and the WIF emphasize the need to improve capacity, and a National Capacity Building Unit has been established to coordinate efforts. However, the capacity of government institutions to provide systematic and regular support is limited by staffing constraints, and by differing interpretations of what support is needed and how best it should be delivered. The lack of ongoing targeted and tailored training—as well as the lack of other capacity development tools, such as supportive supervision and mentoring—hamper effective delivery in the WASH sector. Poor mechanisms to transfer knowledge between staff when turnover occurs further undermines the limited capacity building efforts.

The vision of the integrated delivery of WASH services is undermined by the low awareness of the principles, institutional arrangement, and working modalities of OWNP. The potential to decentralized management of WASH service delivery is immense given the availability of woreda WASH teams, HEWs, and teachers. However, poor coordination and weak planning systems between the different institutions at all levels mean that these resources have still not been maximized.

Notes

1. See the 1994 Ethiopia Housing and Population Census, WHO/UNICEF JMP database.
2. Completed in 2011 and based on a census of households and water points (users and systems). The census covered 92,000 rural water supply schemes, over 1,600 small towns and 50,000 schools and health institutions (Butterworth et al. 2013). There are plans to repeat and improve the exercise: one national census every two years beginning 2017.
3. Based on the highest resolution data available, the levels of variation among woredas within each region (standard deviation plus or minus 12 percentage points to 22 percentage points) is greater than that among regions (standard deviation plus or minus 9 percentage points). (Central Statistics Agency, Housing and Population Census 2007.

4. Though annual rainfall is the basic indicator analyzed here, other related factors, particularly altitude and evapotranspiration rates, exacerbate the water stress experienced in low rainfall regions.
5. Poverty headcount ratio and water coverage are one standard deviation below the woreda mean.
6. Datturi et al. (2015) conclude that multivillage reticulated schemes can achieve impact at scale, serving a population of over 15 million people with safe water. However, they note that the costs of repairs associated with frequent breakdowns, power outages, and pretreatment (e.g., of low fluoride river water) are largely borne by regional bureaus, not users.
7. Typically surveys ask respondents to estimate the amount of time required to travel to the water source, queue if necessary, fill containers, and return to the household. While self-reported journey times are not always precise, they nevertheless provide a useful indicator of the relative time burden of water collection.
8. The human right to water specifies that water should be "*available continuously and in a sufficient quantity to meet the requirements of drinking and personal hygiene, as well as of further personal and domestic uses, such as cooking and food preparation, dish and laundry washing and cleaning. Supply needs to be continuous enough to allow for the collection of sufficient amounts to satisfy all needs, without compromising the quality of water.*"
9. Fecal contamination of drinking water is usually identified through the detection of indicator bacteria such as Escherichia coli (*E. coli*) in a 100 milliliter sample. Contamination can be highly variable in time, and brief contamination events can escape detection with routine surveillance but still have serious public health outcomes. Ethiopia's standards are aligned with WHO Guidelines for Drinking Water Quality.
10. Surveys conducted during the El Niño drought in Oromia and Amhara highlight growing levels or rural indebtedness associated with reduced off-farm seasonal employment (vital for poorer households with smaller land holdings) and migration opportunities (see AKLDP field notes at the website http://www.agri-learning-ethiopia.org/).
11. The UAP's target was more ambitious than the MDG target, in both aiming for universal access and setting a deadline of 2012.
12. The JMP relies on a number of government data points and applies some assumption to reach their coverage figures. The analysis in this report has used the original government data (DHS, WMS, and the National Census) and not applied any assumptions.
13. Open defecation is the practice of people defecating outside and not into a designated latrine.
14. Unimproved latrine is a sanitary facility that does not ensure hygienic separation of human excreta from human contact. Unimproved facilities include pit latrines without a slab or platform, hanging latrines, and bucket latrines.
15. Improved latrine is a sanitary facility that ensure hygienic separation of human excreta from human contact. They include flush or pour-flush toilet or latrine to piped sewer system, septic tank, or pit latrine; ventilated improved pit (VIP) latrine; pit latrine with slab; and composting toilet.
16. Dr. Shiferaw Teklemariam was the head of the Health Bureau in SNNPR, served as the Minister of Health, and is now the Minister for the Environment.

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Community water point in Harar City.
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Chapter 5
Urban WASH Sector Analysis

Urban Growth and Institutions

The overarching trends in the urban water supply, sanitation, and hygiene (WASH) sector are best understood from three perspectives: (a) rapid urbanization; (b) as a result, a large-scale infrastructure investment and service delivery improvement requirement; and (c) a need for systematic policy and institutional transformation in urban and water sector governance.

Ethiopia's urban infrastructure and institutions are facing increased stress due to a rapidly increasing urbanization. In 2012, roughly 17 percent of Ethiopia's population lived in urban areas, which is well below the Sub-Saharan Africa average of 37 percent.[1] As of 2015, urbanization rates were around 3.4 percent per year, some estimates anticipate this rate could soon exceed 5 percent a year. Such an increase would result in 30 percent of the population living in urban areas by 2028 and tripling of the urban population by 2034.

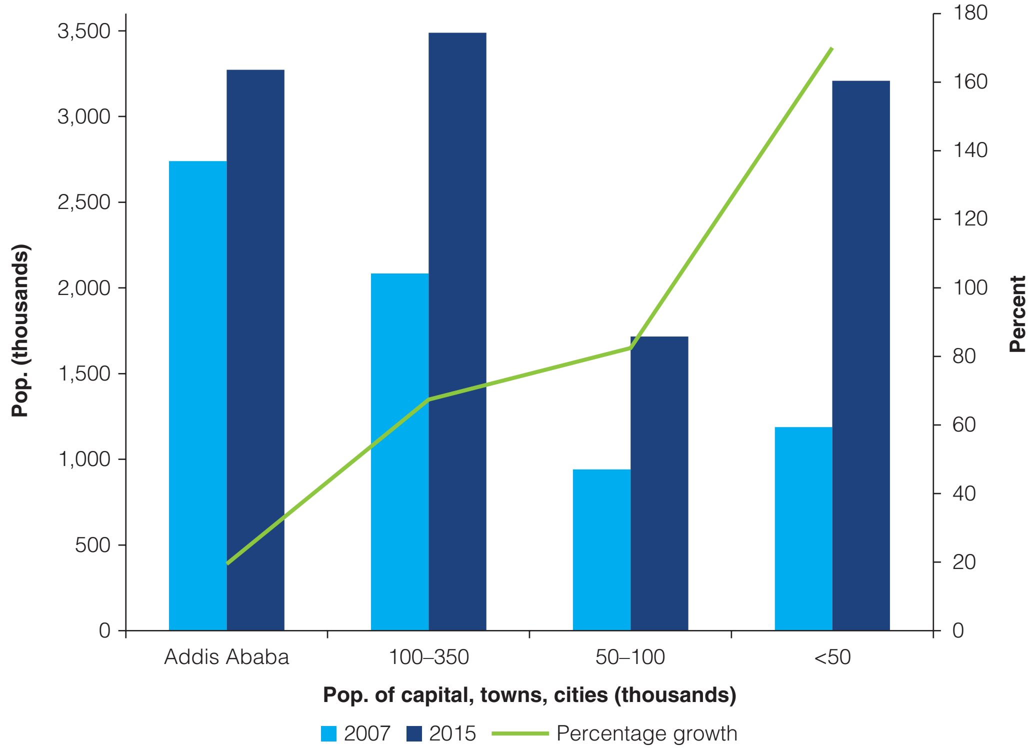
Urban growth is recognized in the Growth and Transformation Plan (GTP) II as an opportunity for sustained economic growth and structural transformation. However, if not well managed, rapid urban growth could present less of a demographic dividend and more of a demographic problem as cities struggle to provide jobs, infrastructure and services, and housing to more people. Infrastructure and service delivery are already undermined by the growing urban population and by stretched municipal budgets.

The urban demographic across the country has shifted with many smaller cities and towns holding an increasing share of the urban population (see figure 5.1). Addis Ababa is by far the most populous city, with twice the population of the next five largest towns. However, Addis Ababa grew at significantly slower rate than other urban areas, at just under 20 percent, between 2007 and 2015 (see figure 5.2). As a result, while in 2007 Addis Ababa accounted for 39 percent of the urban population, by 2015 this had reduced to 28 percent. The 16 secondary towns[2] grew by 67 percent during the same period, and now have a combined total population that is greater than Addis Ababa's.

The largest percentage growth in population is in existing and new urban centers with populations below 50,000. This has resulted in them accounting for just over one-fourth of the urban population by 2015 (similar to Addis Ababa's share), compared to just 17 percent of the urban population in 2007. This shift has been driven in part by the reclassification of large rural settlements as urban centers, but this does not distract from the trends for significant growth in smaller urban areas.

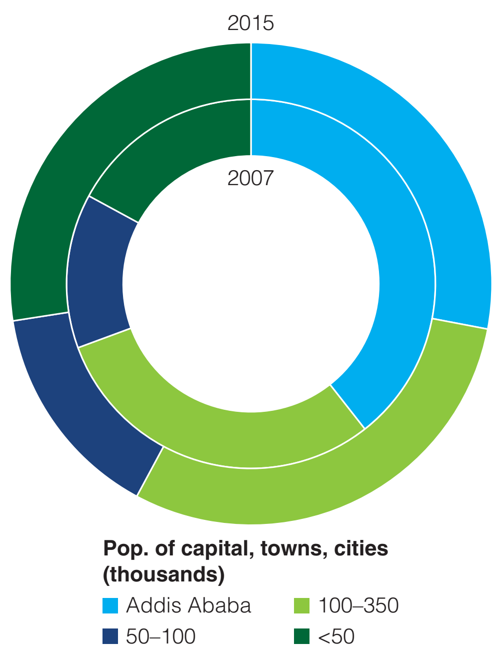
The Ministry of Water, Irrigation and Electricity (MoWIE) is the responsible federal institution for provision of water supply in urban centers. MoWIE's main responsibility is formulating the national urban water supply development and management policies, strategies, and programs, as well as monitoring and evaluating urban water supply development. The Water Resource Development Fund (WRDF) is a federal organization that facilitates the development of urban water supplies on a cost recovery basis, providing on-lending facilities to medium and large towns for water supply expansion works. WRDF appraises loan applications by town water utilities, provides on-lending facilities and ensures that loans are paid back and used as revolving funds.

Figure 5.1: Population Growth by Population Size of Towns and Cities in Ethiopia, 2007–15



Source: World Bank calculations based on World Bank 2015c and Housing and Population Census 2007.

Figure 5.2: Share of Population by Population Size of Towns and Cities in Ethiopia, 2007 and 2015



Regional water bureaus develop regional water sector development programs and strategies, manage water supply projects, and provide support to town water supply utilities. The regional bureaus develop regional proclamations to establish water utilities and town water boards. The Bureau of Finance and Economic Development (BoFED) allocates, channels, administers, and controls financial grants for urban water supply utilities in the region. Loans are directly channeled from WRDF to town water utilities.

Ethiopia has no stand-alone sanitation policy, but sanitation development strategies are captured in the health, environment, water, and urban development sector policies. Institutional arrangements for urban sanitation are complex, with MoWIE, the Ministry of Health (MoH), and the Ministry of Works, Urban Development and Housing Construction (MoWUDC) sharing responsibilities for monitoring and oversight of hygiene and sanitation services at the federal level. This institutional fragmentation and unclear responsibilities have led to gaps in service provision and challenges in holding utilities accountable for improvements in service quality and coverage. Each ministry has focused on its own mandate, as well as internal planning and management systems. Hence, inadequate coordination of planning, design, implementation, and supervision has resulted in poor quality construction and weak asset management.

At the regional level several bureaus are involved in capacity building, funding, and monitoring of urban sanitation activities. Regional bureaus with an urban sanitation role resemble the institutional arrangements at the federal level, and there is generally an office responsible for sanitation, beautification, and greenery in the regional Urban Development Bureau. Regional Water Bureaus in some regions are now starting to explore sewered systems, especially if they are part of the MoWIE's proposed wastewater interventions in six cities earmarked for sewerage. Liquid waste management is further supported by the regional health bureau, which focuses mainly on promoting hygiene and sanitation at household level.

Despite a new policy direction, due to the number of institutions involved in urban sanitation service delivery and management, it will take some time for the respective institutions to come to terms with the evolving environment of urban sanitation challenges. In 2017 the relevant ministries endorsed a cross-sectoral Integrated Urban Sanitation and Hygiene Strategy, with the aim of aligning relevant strands of existing policies in different sector policy documents. The integrated strategy takes forward mandates of various ministries in light of new insights and aligns institutional arrangements for greater effectiveness.

Urban water utilities in Ethiopia are formed from two entities, town water supply and sewerage enterprises, which hold the function of operator, and town water boards, which are the oversight body. The town water supply and sewerage enterprises are responsible for the planning, development, and provision of water supply services in urban areas. As part of their control and supervisory function, the town water boards are responsible for approving town water supply and sewerage enterprises' annual plans and programs, monitoring activities of the enterprises, and assigning the manager of the enterprise.

Unlike in the telecom and power sector, there is no independent regulatory agency for provision of urban water supply services in the country. The regional water bureaus, town health offices, city councils, and town water boards share the burden of different regulatory activity. The MoWUDC also plays a part in monitoring the standard of municipal services, including water supply and solid waste.

Water and sewerage entities in each municipality are legally mandated to provide wastewater services in the larger cities, but municipalities are responsible for solid waste and storm water management. In most cases municipalities have not been able to coordinate sanitation services (wastewater, solid waste, and stormwater) effectively. The lack of coordination between solid waste and liquid waste services, as well as drainage, is a problem since these waste streams are often mixed together; for example, drainage channels are contaminated with fecal waste, and are blocked by solid waste.

Elaine Gelan, 23 years old. Water supply connected August 2016, 9 months after application. Kebele 12, Harar, Harari Region.

Mechanisms and institutional capacity to enforce public health proclamations and pollution control regulation are weak, even though "polluter pays" principles have been adopted formally. The existing regulations do not clearly define the minimum standards for services, and are mostly silent on the urban sanitation delivery chain of collection, transportation, treatment, and disposal. In addition, town and city leaders currently give very little attention to managing and mitigating potential pollution impacts of existing and new industries. Coordination between the industrial, water, and other sectors is currently too weak to manage the impacts of the envisaged growth in pollution from expanding population and industry. Unchecked and persistent industrial pollution (tannery, food processing, and textiles sectors) can cause significant long-term contamination to water bodies and other environmental and health impacts. Current weak monitoring systems mean detection will take many years, making cleanup very expensive or impossible.

Capacity building and institutional development is needed across urban utilities and boards including clearer performance incentives and a more business-oriented approach driven by a clear business plan with measurable targets. This applies to all functions and roles: supporting senior strategic leadership approaches and skills; updating technical skills at the operational level; and developing greater ownership of the institutional development agenda. More transparent HR systems and databases will enable utilities to hold staff members accountable for their performance on clearly assigned responsibilities.

The necessary technical and financial resources to adequately support rural administration transition to urban centers have not been sufficiently acknowledged. As a result, many young urban municipalities and utilities lack the skills to effectively take up the mandates expected of them. The strengthening of relevant institutions through the provision of increased levels of funding, guidance, and up-skilling sector staff is essential to meet the growing water supply and sanitation challenges faced in urban areas.

Urban Water Subsector Analysis

National Status and Trends

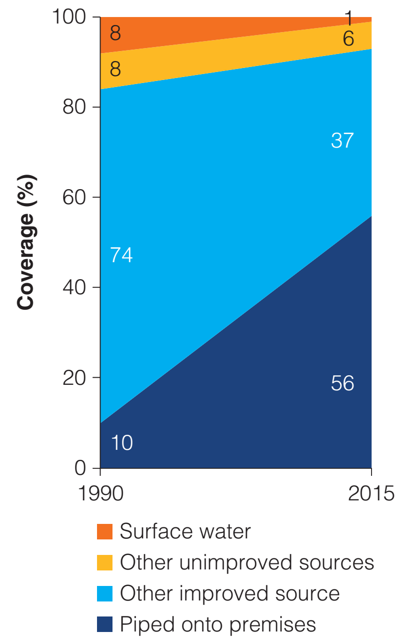
The big shift over the past 20 years is that nearly 10 million people have been added to the group of people who get their water from a tap in the yard just outside their house (figure 5.3). By 2015, over half of urban households in Ethiopia got their water from a tap in the yard just outside their house. Just under another 40 percent fetched water from a neighbor or standpipe outside their compound. However, less than one in 20 of Ethiopia's urban dwellers had a tap inside their house as their main source of drinking water. Over the same period those fetching water from standpipes outside their compound has remained fairly constant, rising from over 5 million to just over 7 million people.[3]

For around 60 percent of women and girls living in urban areas, this big shift toward using a more convenient source of water has avoided a significant economic loss in time used to fetch water.[4] The rest of this section examines how this big shift to piped water in peoples' yards has been achieved and why this benefit has fallen disproportionately to wealthier women and their families.

Evolution of Funding for Urban Water Supply

The progress in urban water supply has been driven by a more diverse set of funding sources than that for rural water supply. The composition of funding sources changes from (a) when piped networks emerge in small towns within a woreda to (b) when small towns are recognized as urban local governments (ULGs) and (c) to when ULGs split off their water supply departments to form utilities. In 2007 there were already over 200 locations with over 1,000 household

Figure 5.3: Urban Drinking Water Trends in Ethiopia, 1990–2015



Source: WHO/UNICEF 2016.

connections. By 2015, 140 of these locations were granted ULG status, of which just under 100 of which had ring-fenced their water supply operations (see figure 5.4).

As piped networks first emerge in small towns, an initial critical source of capital investment is the woreda block grant. In these small towns, from 2008–12, an average of US$30,000 to US$40,000 per year from woreda block grants went toward the capital costs of establishing piped networks.

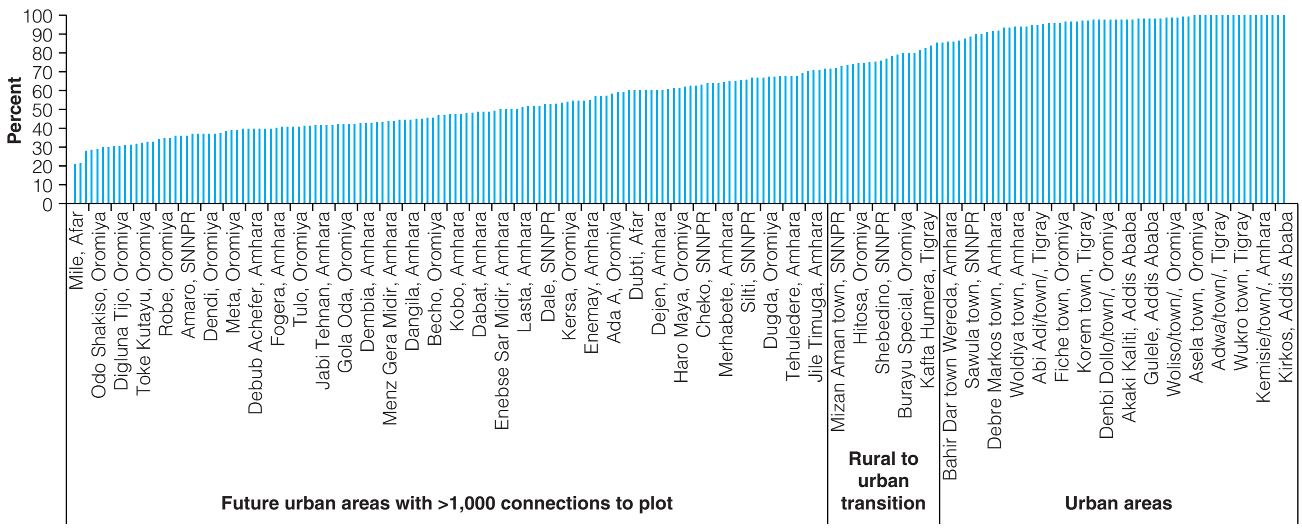
As towns graduated to becoming ULGs, they no longer qualify for woreda block grants and have to fund capital investment from their own revenues (municipal fees and charges). At these initial stages of transition, the taxes assigned to ULGs raise only a limited amount of revenue, which is too little to cover expenditure assignments given to ULGs. Nationwide, municipal revenues account for just 3 percent of the national tax effort (World Bank 2015c). For smaller towns this is a critical constraint in growing their water supply operations and means that they are heavily dependent on regional state and donor investment.

Smaller ULGs have to compete with larger ULGs and utilities for funding from regions and donors. The allocation of both regional and donor funding is subject to the discretion of regional state or donor decisions, which makes them, from the ULG perspective, less predictable investment flows than woreda block grants or municipal revenues.

The regional state funding to urban water supply is drawn from the regional block grants, and since 2011, the Millennium Development Goal (MDG) special purpose grant has focused on capital expenditure. From 2008–12, An average of US$44 million per year from these sources was channeled to ULGs for capital investments in water.

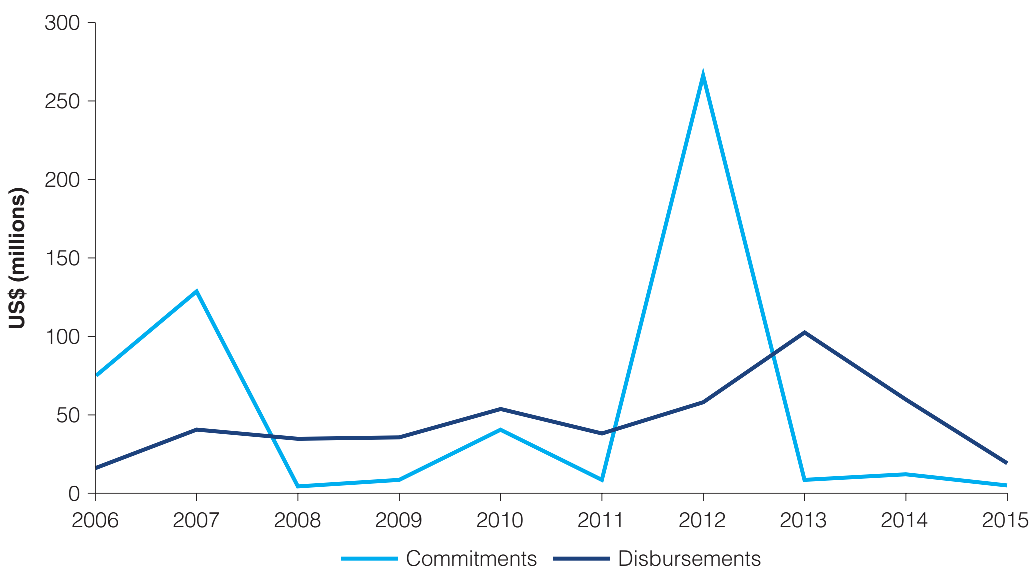
Donor funding is often negotiated directly with specific towns, cities, or utilities, which results in it being skewed toward larger cities and utilities, particularly Addis Ababa, which received nearly 40 percent of donor funding (loans and grants) but accounts for only a quarter of

Figure 5.4: Towns Transitioning from Rural to Urban Local Governance, Ranked by Access to Improved Source of Drinking Water, 2007



Source: Population and Housing Census 2007.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Figure 5.5: Donor Aid to Urban Water Supply and Sanitation in Ethiopia, 2006–15



Source: OECD DAC CRS database.

Ethiopia's urban population (see figure 5.5 and table 5.1). The larger utilities also have greater revenue flows from which they can finance critical small infrastructure investments and household connections.

Addis Ababa has been the only city allocating substantial own source revenue (> Br 1 billion) per year to improving water supply. Secondary towns, such as regional capitals, provided some matching funds to financing from bilateral sources.

Table 5.1: Main Urban Water Supply and Sanitation Donors by Commitments in Ethiopia, 2006–15

Donor	US$, millions		
	Addis Ababa	Other urban	Total
World Bank (IDA)	99	289	388
China Exim Bank	148	n.a.	148
African Development Bank	n.a.	64	64
United States	2	47	49
France	10	1	10
Italy	n.a.	10	10
Japan	n.a.	8	8
Other donors	n.a.	5	5
Total	**258**	**423**	**681**

Source: OECD DAC CRS database.
Note: n.a. = not applicable.

Recognizing the constraint that smaller ULGs face, and as an instrument for implementing its cost recovery policy, the GoE established a Water Resource Development Fund (WRDF) under MoWIE in 2002. The WRDF is a revolving fund that can loan funds from government and donors to expanding utilities. Since its inception, WRDF has received more than 144 applications for loans from town utilities all over the country, but has extended loans only to 34 towns with a value of Br 1.7 billion (US$80 million in 2017 prices). Utilities that have completed their grace period have started repaying their loans.

Although more than 100 towns are on the waiting list to take up loans, WRDF has not yet started disbursing from the finance repaid (World Bank 2014a). There is, therefore, still a particular bottleneck in the funding or financing of water supply and sanitation infrastructure in towns that graduate to being ULGs after they lose their woreda block grant allocations and are outcompeted by larger towns and utilities, particularly for donor investment.

Improving the performance and reach of the WRDF would help these new ULGs with their water supply investment needs. The WRDF has received additional funding to on-lend to utilities, and the management of the WRDFs is working to streamline its lending and implementation procedures, increase staffing levels, and address the reluctance by regional water bureaus to guarantee loans for utilities (reforms that could help small towns with their investments needs).

Cost recovery from tariff holds the potential to generate internal revenue for expansion, but policy and practice are at odds. The Sector Policy (1999) and Strategy (2001) envisioned a move toward full cost recovery for urban water supply. However, the success in implementing full cost recovery policies for town and urban water supplies has been limited. Tariffs established in most water utilities cover at best operations and some maintenance, which leaves investments for major rehabilitation and expansion of the systems to be financed by government or donors. Underpricing and high nonrevenue water (NRW) undermine higher levels of cost recovery.

In 2011 and 2012 the benchmarking of 76 utilities across the country reported average revenue per cubic meter sold as just US$0.32 against costs of US$0.29 per cubic meter sold.[5] Even the largest utility, Addis Ababa Water and Sewerage Authority (AAWSA), covers only its operating costs (table 5.2). This narrow margin is in part due to NRW reported as 25 percent for smaller utilities and over 40 percent for larger utilities.

Table 5.2: Operational Costs and Revenues for AAWSA in Ethiopia, 2011–16
Br, millions

Cost and revenue items	2011	2012	2013	2014	2015	2016
Operating cost	**280.2**	**332.5**	**519.9**	**544.8**	**560.9**	**665**
Salaries and related benefits	106	130.4	138.1	213.8	202.4	240
Electricity	31.3	42.3	53.1	40.6	52.5	62.2
Chemical	45.3	7.3	64.2	84.5	72.1	85.5
Repair and maintenance	18.6	20.8	68.9	35.5	45.2	53.6
Fuel and lubricants	23.6	26.5	25.2	34.8	36.5	43.3
Other operating expenses	55.5	105.4	170.5	135.7	152.1	180.4
Revenue	**294.9**	**386.7**	**489.9**	**699**	**640.4**	**689.2**
Operating cost coverage ratio	**1.05**	**1.16**	**0.94**	**1.28**	**1.14**	**1.04**

Source: AAWSA.
Note: AAWSA = Addis Ababa Water and Sewerage Authority.

Although water tariffs are set by water boards, they need to be endorsed by the respective regional administration. Where enabled, utilities over the past three to four years in some secondary towns have started to accumulate tariff revenue for water system expansion. Adama and Mekelle are examples where utilities have reinvested earnings of around US$4 million in 2016. But with regions reluctant to increase tariffs without seeing improvements in efficiency, a vicious cycle has constrained the scope for full cost recovery and financial sustainability.

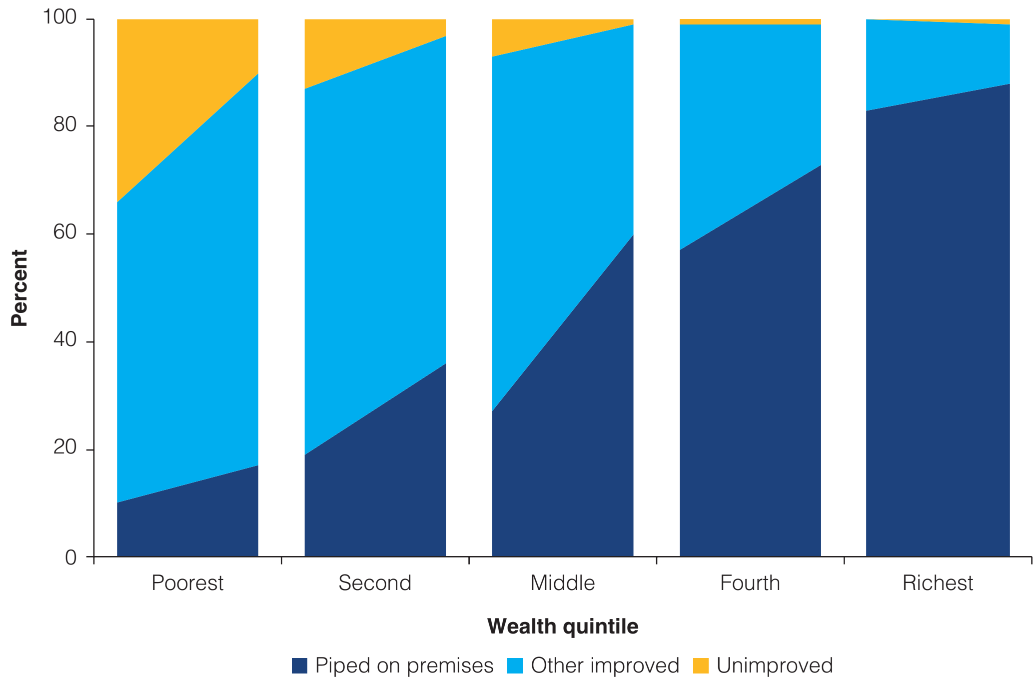
Access Disparities by Wealth and Consumption

In contrast to the equitable distribution of services in rural areas, relative consumption or wealth strongly correlate with access to piped water on premises in urban areas. Although in 2015 nearly 12 million people in urban areas had access to piped water in their house or compound, close to 8 million urban Ethiopians had to fetch water from sources outside their compound (see figure 5.6). This includes 1 million people who relied on unimproved sources, including water from vendors and even lakes, ponds, and streams in or close to urban areas. Those without access to piped water on premises are disproportionately poorer and are members of lower income households (see figure 5.7).

Some of this inequality in access can be explained by the correlation between city size and access (see figure 5.8). Multivariate regression confirms this inequitable capture of piped water on premises by higher income households. The regression results also show that independent of household income levels, piped water on premises is siginificantly correlated with town size. Households in Addis were three times more likley to have access to piped water on premises than medium or large towns. In turn households in medium and large towns, other than Addis, were more than twice as likely to have access to piped water on premises than small towns. The broad trend is that as cities grow, their poverty headcount drops and their levels of piped water on premises rises (although Addis Ababa is an outlier with both higher levels of access and higher rates of poverty). (See appendix B for data sources and regression results.)

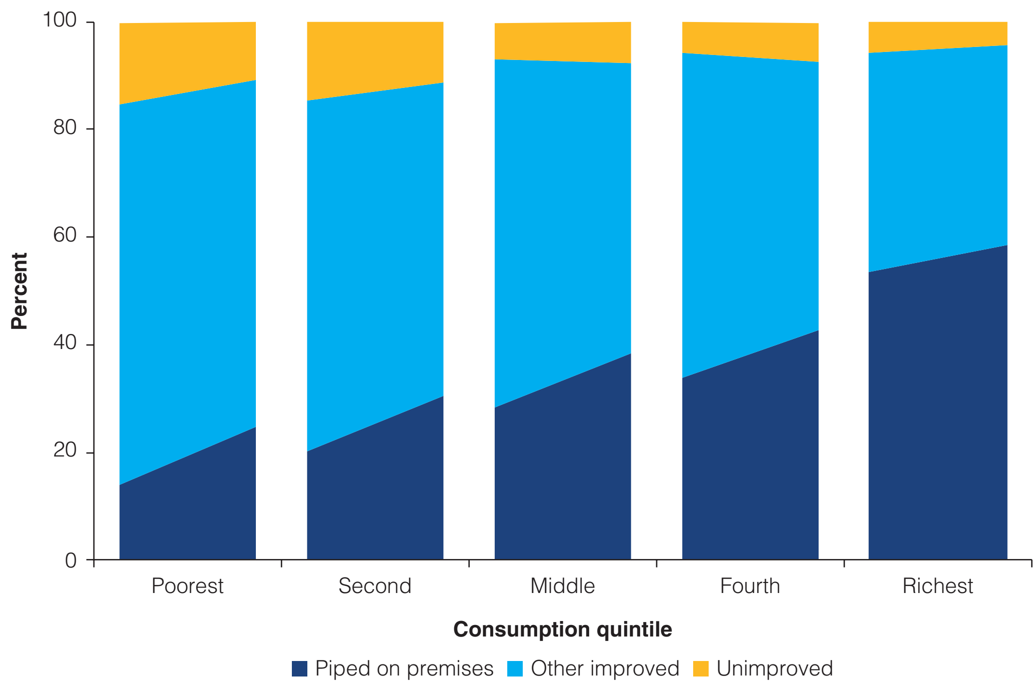
However, this correlation between city size and access does not help explain what should be done to address inequality of access. More interesting perhaps is the unexplained variation among cities of similar sizes, which suggests that some are doing better than others at creating a poverty reducing environment and at providing access to piped water on premises (see figure 5.9).

Figure 5.6: Urban Drinking Water Coverage by Wealth Quintile in Ethiopia, 1995–2011



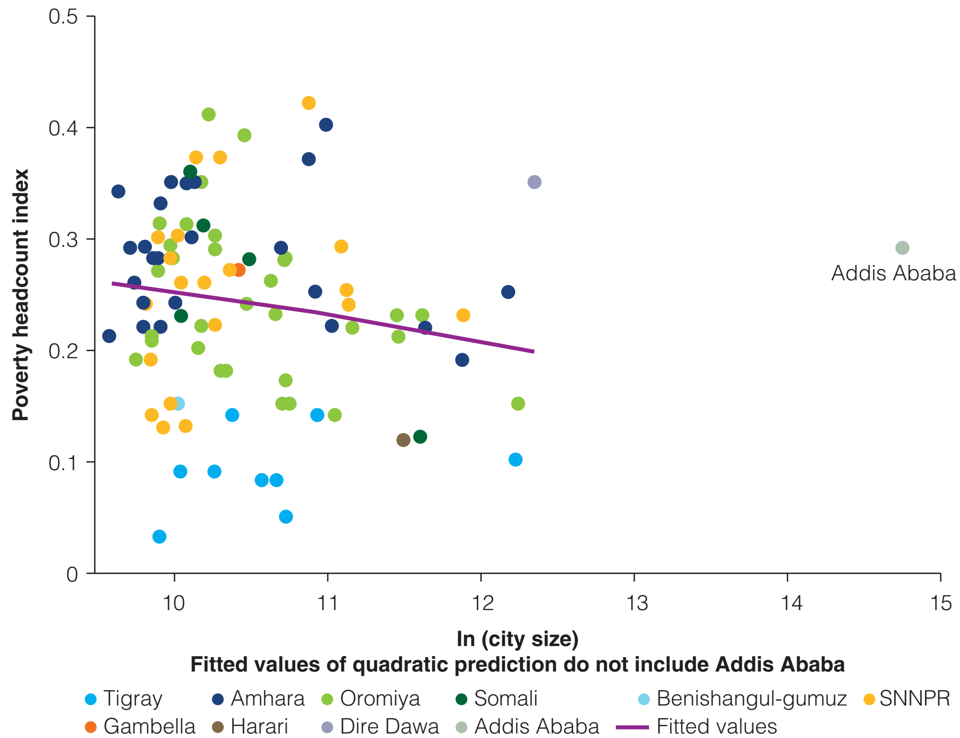
Sources: DHS and WMS/HICES.
Note: Further details in appendix A.

Figure 5.7: Urban Drinking Water Coverage by Consumption Quintile in Ethiopia, 2000–11



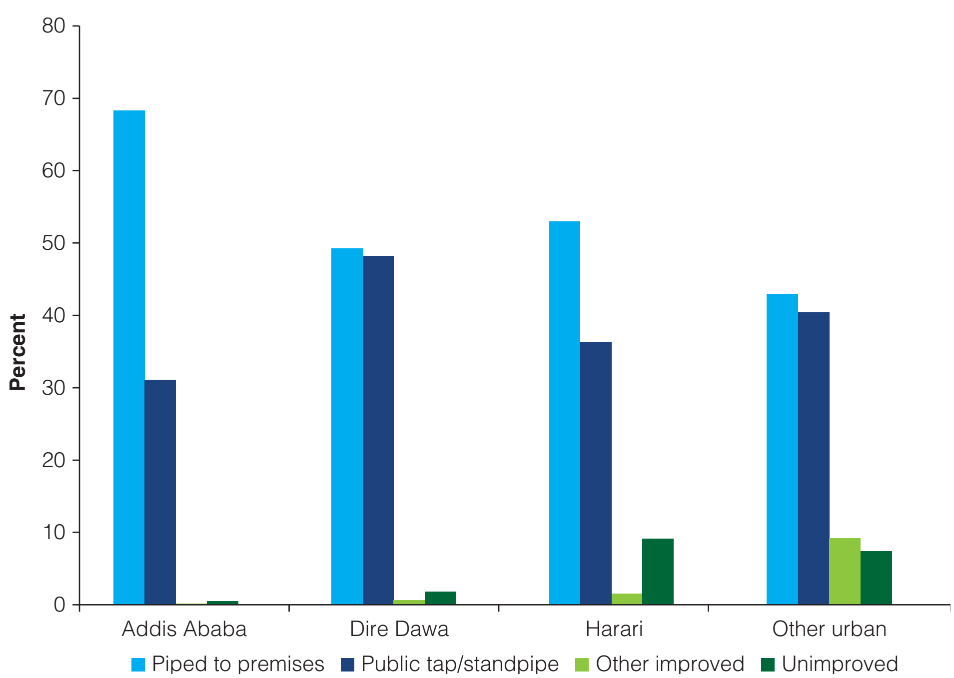
Sources: DHS and WMS/HICES.
Note: Further details in appendix A.

Figure 5.8: City Size and Poverty in Ethiopia, 2015



Source: World Bank 2015a, 97.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Figure 5.9: Improved Access by Addis Ababa, City States, and Other Urban Areas in Ethiopia, 2011



Source: DHS 2011.

An actionable analytical approach is to understand the barriers preventing poorer households from hooking up to piped water either from the demand or the supply side. Demand-side barriers prevent households from hooking up to the service, even when the networks pass close to their homes. Demand-side barriers can include high connection charges that make hooking up unaffordable; land and housing tenure that disqualify or make it difficult for households to connect; and other social and economic factors that may deter households from becoming utility customers (see the case study on Harar City, box 5.1).

Household survey samples are based on geographic clusters that, at least for urban areas, are physically small, amounting to no more than a few city blocks. It is therefore possible to examine the extent to which people lacking access to water supply live in clusters where infrastructure is available as evidenced by their immediate neighbors being hooked up to the service (Banerjee et al. 2008; Wodon 2007).

Box 5.1: Case Study of Applying for Connection by Poor People in Harar City

In Harar, many poor people live in the older, high density parts of the town. Like in many towns in Ethiopia, poor people struggling to meet basic needs live either in kebele or rented housing. Eleni and W/ro Asamenech represent typical poor women who head households in the low-income areas of Kebele 12 of Harar City.

Eleni is a daughter of migrants from Amhara region and has lived in Harar City since the age of three. When she was 12, her father, abandoned the family and left for another woman. Eleni, now 23, is dependent on her mother as she is disabled, with a limp and speech difficulty. Her mother, the main breadwinner, works as a cleaner in a government office in Harar City. They live in social housing, known as kebele housing, renovated by an NGO.

W/ro Asamenech is a 75-year-old woman living with her 14-year-old grandson from her deceased daughter. She lives in a poor community in her one-room residence that was built by an NGO. In the past, she used to work as a house help. She is now very weak and is dependent on donations from people in her neighbourhood.

Access to electricity and water services is available in this low-income neighborhood. Many houses have electricity connections, but fewer houses have water connections due mainly to the high cost of and cumbersome process of connecting. Getting a water connection in Harar includes filling out an application along with a copy of a property title deed, copy of an identity card, a passport size photo, an advance payment of Br 500 for the water meter, plus an additional Br 1,400 payment or more depending on the pipe length requirement from the service water main up to the yard tap. For people in kebele housing, a supporting letter from the kebele is required instead of a copy of the property title deed.

Eleni and W/ro Asamenech do not have water connections and so buy water from the neighborhood public tap paying six to eight times more than if they had their own connection. Beside the hardship of the higher cost, carrying is a real challenge for both women.

box continues next page

Box 5.1: Continued

Asamenech Semei, 75 years old. Applied for water connection twice, still waiting as of December 2017. Kabele 12, Harar, Harari Region.
© Chris Terry/World Bank

The Water for Life Project is being implemented by the Harar utility to improve services to low-income households. The project is financed by the governments of The Netherlands and Ethiopia aim to provide 25,000 low-income people with a common water tap for three to five low-income households. W/ro Asamenech and two other neighbors were among the selected beneficiaries of this project. At the time of finalizing the connection, W/ro Asamenech agreed

box continues next page

Box 5.1: Continued

for the younger neighbors to process the requirements for the connection, not knowing that one of the neighbors would change the location of the tap from a communal area to being installed in her compound, which is up the hill from where W/ro Asamenech lives. Consequently, W/ro Asamenech does not benefit from this new tap since she cannot walk up the hill. So she continues to buy water at a higher price from houses closer by.

When Eleni went to the utility for the first time, she had a supporting letter from an NGO explaining her situation and requesting a water connection free of charge. The utility, instead of receiving her application, told her to wait. Eight months later Eleni decided to try again. This second time the utility had received funding to connect poor HIV victims, but she was still told to wait a month. Returning a month later, the utility told her to submit an application. On that same day Eleni filed her application. Three working days after her application was filed, Eleni got her own water connection. So grateful for getting a connection Eleni allowed her neighbors to collect water from her tap free of charge, though in the future she has not ruled out the possibility of selling water to her neighbors.

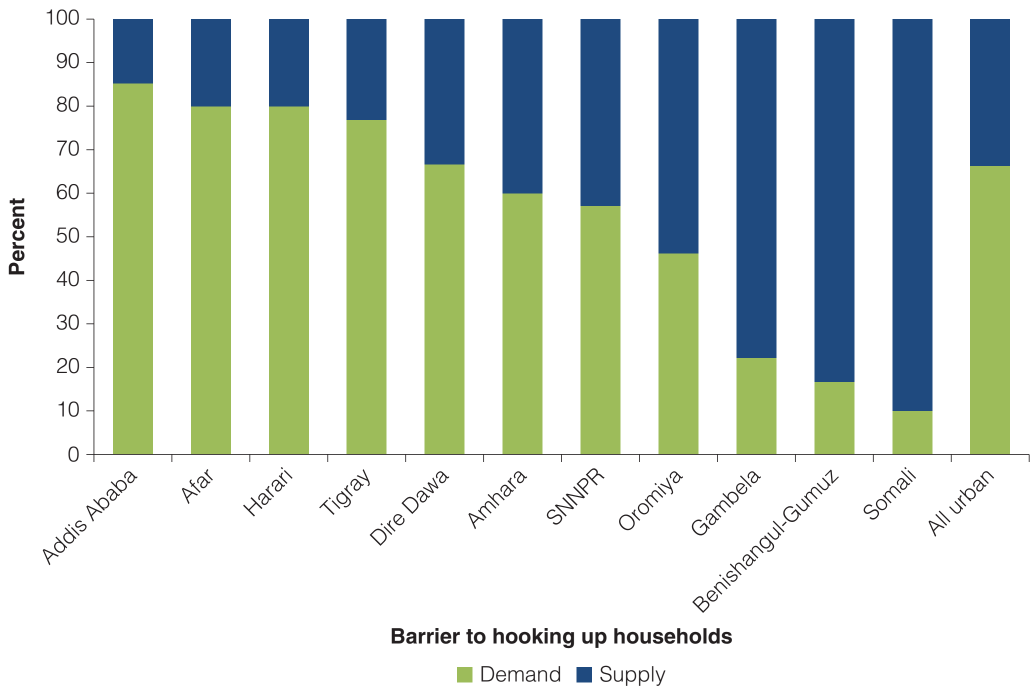
W/ro Asamenech, motivated by Eleni's story, went to get a supporting letter from the Keble and took her application to the utility and is now awaiting their response. A staff member at the utility who knows her well is trying to team her up with other poor neighbors who are also looking for water connections. Yet the chance of finding one seem to be low, since most households in the immediate vicinity have their own private connections.

Source: Yemane and Defere n.d.

Supply-side problems were concentrated in the urban areas of the Somali, Benishangul-Gumuz, and Gambella regions, though Oromia with its large number of emerging small towns also faced greater supply than demand-side barriers (see figure 5.10). Of the 184 urban primary sampling units (PSUs) in the DHS 2011 only five did not have any piped water at all. These were all in small towns in the emerging regions of Somali, Gambella, and Benishangul-Gumuz. In these small towns, even the wealthiest households were almost entirely reliant on water delivered by vendors and had no access to any form of piped water (figure 5.11). In a further 13 PSUs there was piped water but no household connections. These were scatted across the country, including in the cities of Addis Ababa, Dire Dawa, and Harari, representing towns or peri-urban areas in which the water supply entity or utility had not or was not able to connect households. A further 44 PSUs had fewer than 30 percent of households with piped water on premises. All these PSUs, totaling 62, with no or very limited access to piped water, might be considered to have a basic supply-side problem—one that makes it logistically difficult or impossible to connect households to the network (e.g., no utility to make connections, very limited water networks, insufficient water resources). Urban areas like these are home to about a quarter of urban Ethiopians, including around 1 million poorer households (below 40 percent of the wealth quintile [B40]), most (>95 percent) of which do not have piped water on premises.

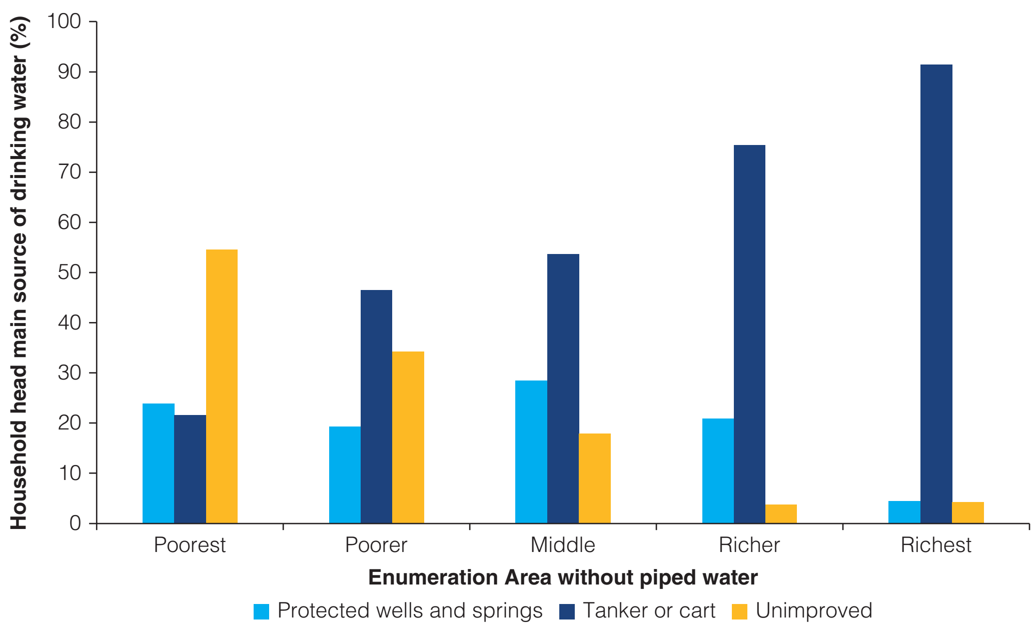
Demand-side barriers were more prevalent in cities and regional capitals. In the remaining two-thirds of PSUs (122), more than 30 percent of households had water to their premises but still had significant numbers of households not hooking up to the network. These might be

Figure 5.10: Proportion of PSUs in Ethiopia with Supply- or Demand-Side Barrier to Hooking Up Households, 2011



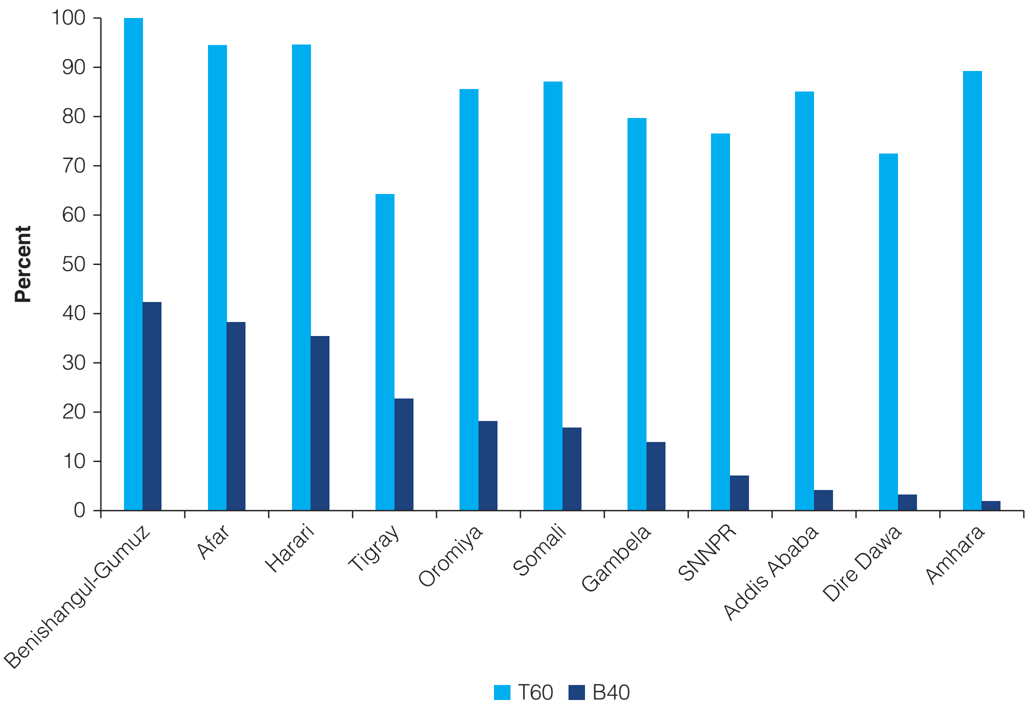
Source: DHS 2011.
Note: PSU = primary sampling unit; SNNPR = Southern Nations, Nationalities, and People Region.

Figure 5.11: Coping Strategies in Areas of Small Towns in Ethiopia with No Piped Water, 2011



Source: DHS 2011.

Figure 5.12: Share of Urban B40 and T60 Households Hooked Up to Available Urban Water Supply in Ethiopia, 2011



Source: DHS 2011.
Note: B40 = bottom 40 percent of wealth index; SNNPR = Southern Nations, Nationalities, and People Region; T60 = top 60 percent of wealth index.

considered areas where there is a problem related to affordability or other socioeconomic barriers to connecting. Across these PSUs 82 percent of wealthier households were connected (top 60 percent of the wealth quintile [T60]) while only 44 percent of the poorer households (B40) were connected (see figure 5.12).

Some of the greatest disparities in access are within the larger cities, including Addis Ababa, Dire Dawa, Bahir Dar in Amhara, and Awasa in the Southern Nations, Nationalities, and People Region. In these urban areas, home to three-quarters of urban Ethiopians, over 3 million poorer households do not have access to piped water on premises.

Addressing inequality in urban areas therefore requires two quite different responses: (a) capital investment for towns facing supply barriers; and (b) incentives to hook up customers in cities with demand barriers. The first needs to target urban areas, mainly smaller towns, with supply-side barriers. These urban areas need capital investment to expand their production facilities and distribution networks so all residents can hook up to the service, including close to a million poorer households (B40). The second response is in mainly larger cities, which experience demand-side barriers. These urban areas already have extensive water supply networks, but 3 million poorer households (B40) are struggling to hook up to them. From both survey data and from case material the main barrier is the connection process, including the connection charge. Once connected affordability of water is not a major barrier. In these cities, municipalities and utilities need to be incentivized to connect poorer customers.

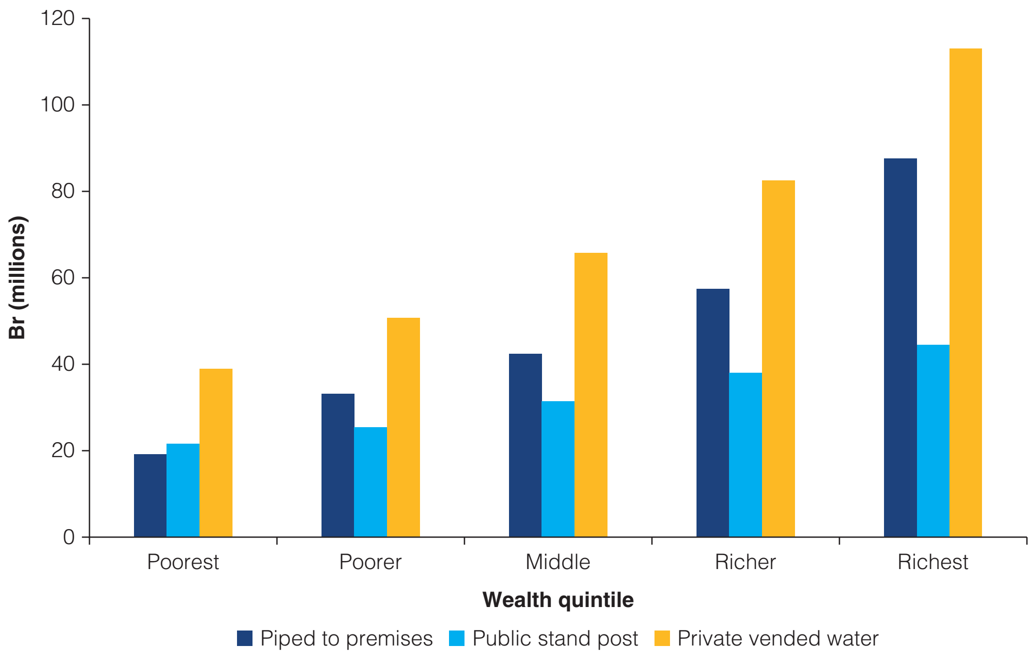
Separating Service Affordability from Other Barriers to Hooking Up

The HICES 2011 reports average actual expenditure on water in urban areas to be Br 168 per person per year (US$10), equating to an implied industry turnover of US$93 million a year. Expenditure rises across quintiles, particularly for privately vended water; the implied revenues to private vendors are higher than those for utility water piped to premises. This suggests that there is both a vibrant water market and opportunity for utilities to win back market share from private vendors (figure 5.13).

The average tariff in Ethiopia was reported as Br 5 per cubic meter (US$0.29) in 2011. There are variations across the country, within the tariff structure of each utility, and between public and vended water (see figure 5.14). Where there are high operational costs, typically driven by the costs associated with pumping water, average tariffs are higher where gravity-fed average tariffs are lower. There is no mechanism of cross-subsidy across utilities. At the lower bands of the tariff structure, equivalent to consumption of 40 liters per person per day, tariffs are just below Br 1 per cubic meter (US$0.05) on average. For a household consuming at this level, the annual per capita spent is around Br 60 per year (approximately US$3.6).[6,7]

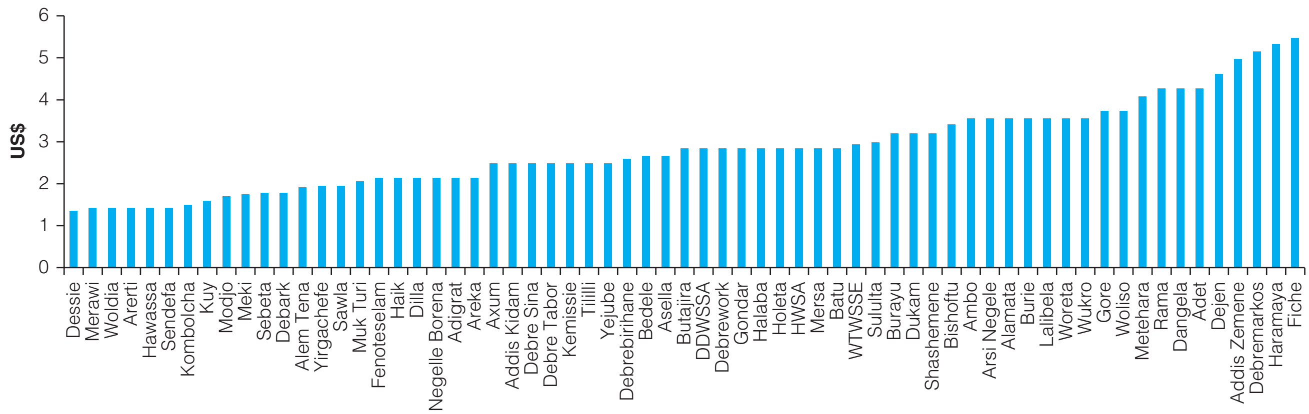
Actual expenditure in urban areas by quintile indicates that even the poorest are paying more than Br 60 (approximately US$3.6) per person per year. Though it is not possible to estimate the volume of water being purchased, households with piped water on premises spent less per person than households that have to fetch water from a public source and much less than households that had to buy from vendors (figure 5.15). This holds true across all consumption quintiles and points to the actual ability, if not willingness, of poor households to pay for water. It also points to the obvious financial benefits of being connected to a utility, particularly given that households with piped water on premises are likely to use more water than those without. Extending utility water supply to all households could reduce the amount that poor, unconnected households pay for water.

Figure 5.13: Total Expenditure per Year by Urban Households on Water, by Wealth Quintile and Source in Ethiopia, 2011



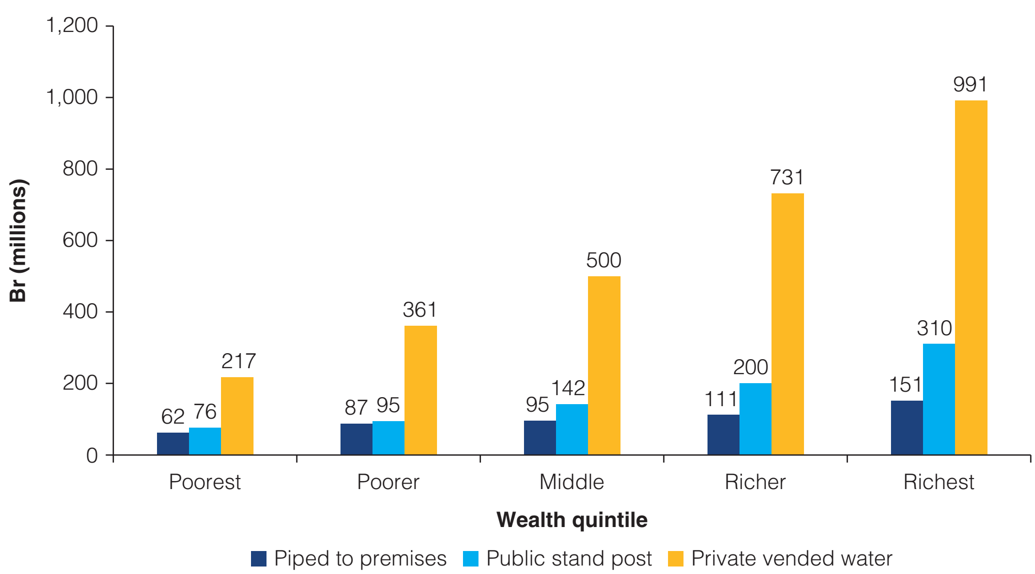
Source: HICES 2011.

Figure 5.14: Annual Water Bill for Households Consuming 6 m^3 of Water per Month in Ethiopia



Source: IBNET.
Note: Source of water is through a household or shared yard tap.

Figure 5.15: Annual Average per Capita Expenditure, by Water Source in Urban Areas in Ethiopia, 2011



Source: HICES 2011.

These results reinforce the argument that it is the connection process, rather than affordability, that is the real barrier to equitable access. While there are no consolidated sources of connection charges, the qualitative work undertaken for this study in urban areas raises three barriers for those wanting to connect. First is a connection charge, usually around Br 500. Second is that utilities require people hooking up to pay the cost of connecting pipe work. Third are the nonfinancial transaction costs of connecting linked to the time and social capital that people have to put into getting a connection (see case study in box 5.1). With connection charges trumping affordability as a barrier to hooking up, greater attention should be paid to incentivize utilities to hook people up rather than the current focus on keeping tariffs low.

Access Disparities by Service Quality Along Service Delivery and Results Chain

The service delivery and results chain for urban water supply is examined to see what differential benefits accrue to the wealthier (T60) compared to poorer (B40) households (see figure 5.16). The section concludes by presenting what this means for the SDG baseline for the urban water supply subsector.

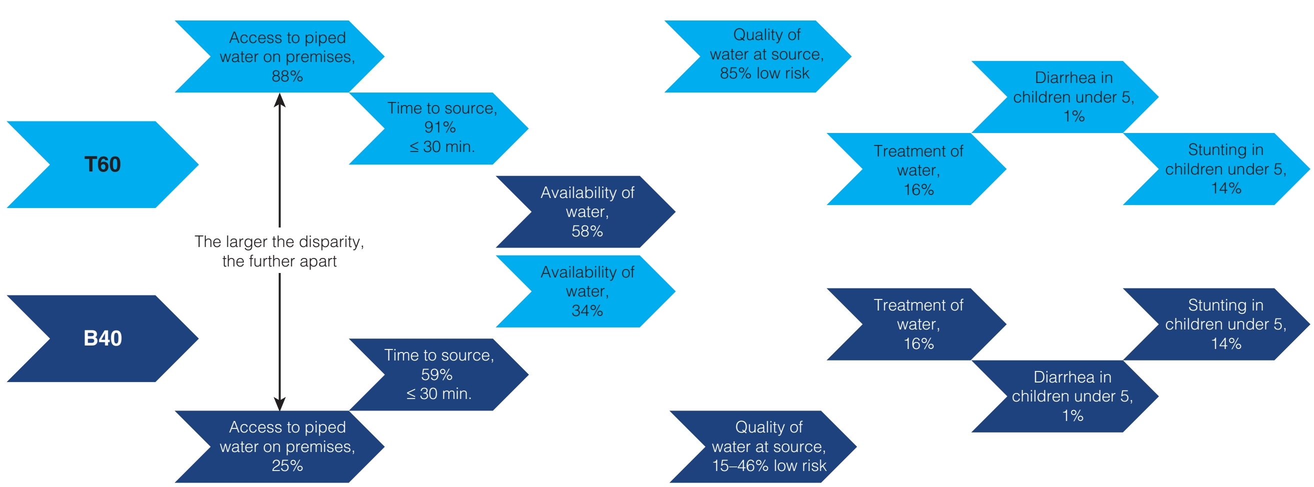
Accessibility of water is the primary divider in urban areas, increasing both direct and indirect costs for poorer households. In urban areas two factors measure the differential access between wealthier (T60) and poorer households (B40). First is whether households have access to piped water on premises and, as a result, lower costs per cubic meter, discussed in the previous subsection. Second is the time they take to fetch water. In urban areas of Ethiopia both these factors show large differentials, but piped water on premises is the bigger divider with only a quarter of poorer households (B40) having piped water on premises compared to just under 90 percent for the households in the T60. Only 9 percent of wealthier urban households spent over 30 minutes fetching water compared to over 40 percent of poorer households. Most of the remaining burden of fetching water in urban areas therefore falls to women and girls from poorer households.[8]

Availability and sufficiency of water are better for those who walk to the source. Availability is an important criterion for assessing drinking water service levels. This is the only factor in the service delivery chain in which there is an inversion of advantage: poorer households report that their primary source of water was not available for at least one full day in the past two weeks. However, this differential is largely because poorer households are much more likely to fetch their water from a source outside their compound. What it does signal is that piped water supply to premises suffers from frequent outages, highlighting the need to improve service levels.[9]

IBNET[10] data on continuity of supply, an upper bound for availability of water from utilities, are reported to be 18 hours out of 24. Utilities also report supplying an average of only 30 liters per capita per day. Neither of these indicators are strongly driven by town size.

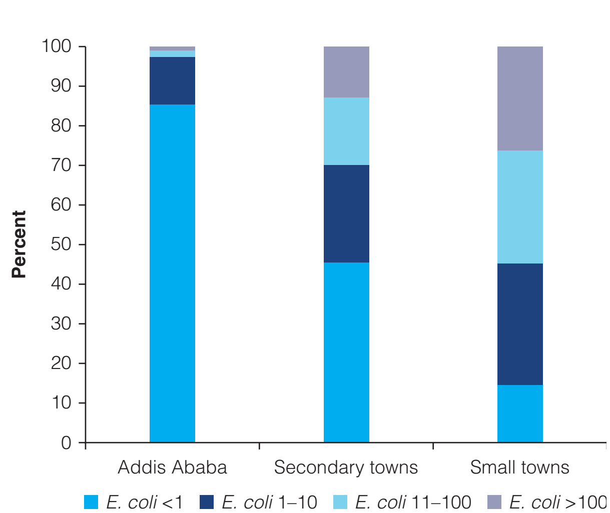
Quality of water at source was the second big divide in urban areas. By far the most common sources of water used by households across urban areas are piped water on premises

Figure 5.16: Disparities Driven by Relative Wealth along Service Delivery and Results Chain in Ethiopia, 2016



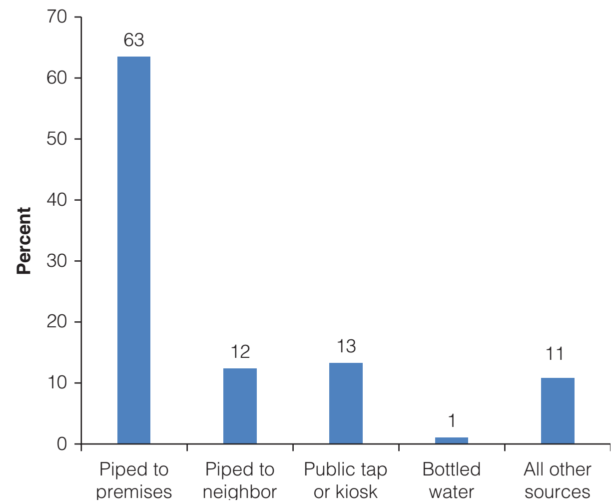
Sources: Access to piped water on premises: DHS 2016; availability of water: ESS 2016; diarrhea and stunting: DHS 2016; quality of water: ESS 2016; time to source: DHS 2016; water treatment: DHS 2016.
Note: B40 = bottom 40 percent of wealth quintile; T60 = top 60 percent of wealth quintile.

Figure 5.17: Water Quality in Addis Ababa, Secondary Towns, and Small Towns in Ethiopia, 2016



Source: ESS 2016 (Water Quality Survey).
Note: SDG = Sustainable Development Goal.

Figure 5.18: Main Source of Household Drinking Water in Urban Areas in Ethiopia, 2016



Source: DHS 2016.

(including to neighbor) and piped water at public taps (see figure 5.17). Together, these account for 89 percent of primary drinking water sources (figure 5.18) While water from both these source types was contaminated in at least half of cases surveyed, there were very large differentials across geography. Water quality in Addis Ababa (only 15 percent of source contaminated with *E. coli*) was much better than in other large urban areas (54 percent of sources contaminated), which in turn was far better than small towns (85 percent of sources contaminated) (see figure 5.19).

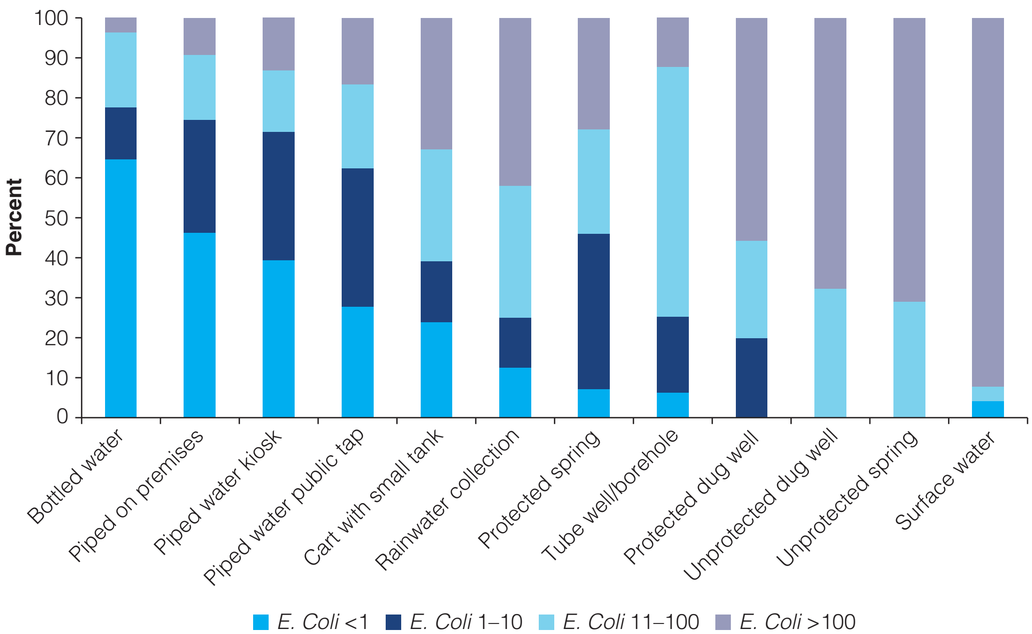
Only by a small proportion of households treated water, even in urban areas. The DHS 2016 reports that fewer than 12 percent of urban households treated water. While there is a differential between the proportion of wealthier (T60, 16 percent) and poorer households (B40, 6 percent) treating water, the more significant point is that nearly one-third of households in the wealthiest quintile do so. The main forms of treatment in urban areas are boiling water (3 percent) and adding chlorine tablets (7 percent).

Implications of Service Quality on the SDG Baseline

The SDG baseline for *safely managed* urban drinking water is estimated to be 38 percent, and the baseline for a *basic service* of water supply in urban areas is estimated at 71 percent (see figure 5.20). Water quality and water availability will be primary challenges to improving access to safely managed water in urban areas. Addressing both will require significant investment in water treatment, reducing NRW, and increasing water production. This is especially the case for utilities that serve secondary cities and small towns.

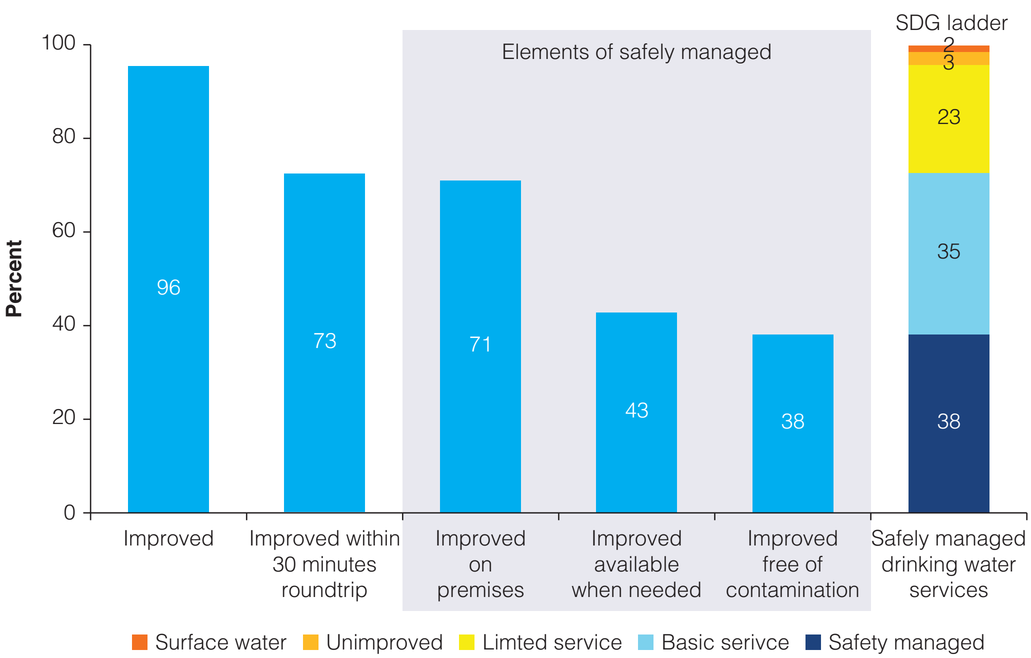
This section has also highlighted the challenge of ensuring equity in urban water supply. In urban areas there are large differences between the services experienced by wealthier versus poorer households. Without proactive and progressive realization of access to safely managed services for all, poorer households will continue to (a) be less likely to have piped water to premises; (b) spend more time fetching water; (c) receive a worse quality of water; and (d) therefore, suffer the consequences of higher prevalence of diarrhea and malnutrition.

Figure 5.19: *E. Coli* Risk Levels at Point of Collection by Urban Water Supply Type in Ethiopia, 2016



Source: ESS 2016 (Water Quality Survey).

Figure 5.20: Estimates of Safely Managed Drinking Water in Urban Areas in Ethiopia, 2016—SDG Methodology



Source: ESS-WQT 2016.
Note: SDG = Sustainable Development Goal.

Kechene Transfer Station, Addis Ababa.

Urban Sanitation Subsector Analysis

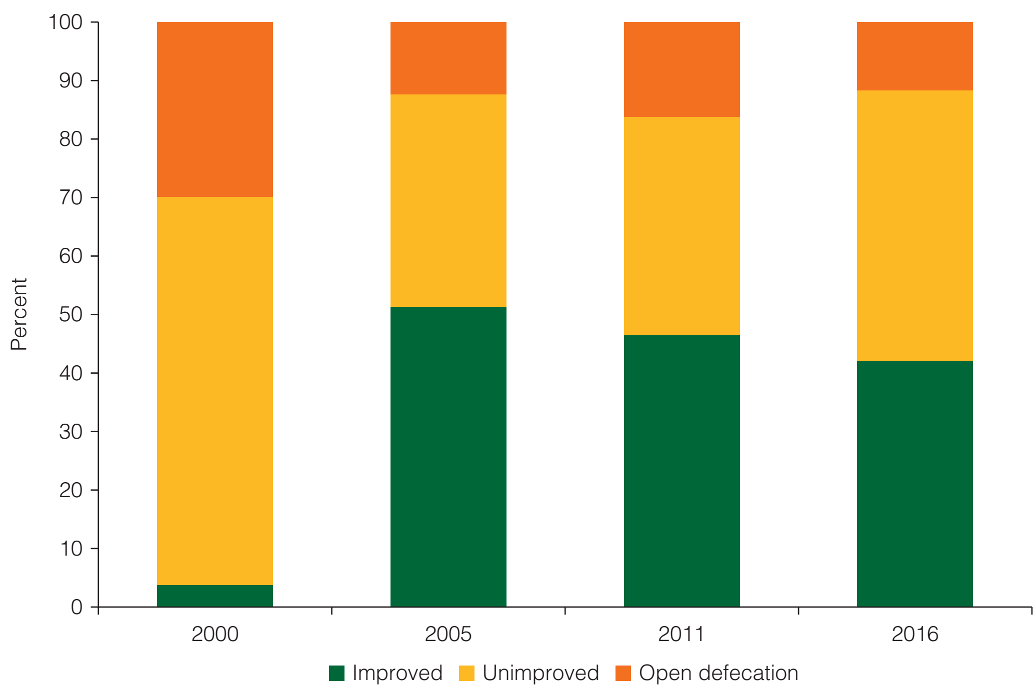
National Status and Trends

Between 2000 and 2005 there was a dramatic improvement in onsite sanitation coverage of urban areas, despite the lack of a clear strategy, but this has not been sustained over the last decade (see figure 5.21). As in rural areas, there was a significant reduction in open defecation, from 29.87 percent to 12.68 percent. However, unlike in rural areas, there was a significant uptake of improved latrines, from 1.88 percent in 2000 to 44.24 percent in 2005. But the lack of continuation of this positive trend is a strong indication that services have not been able to keep up with growing urbanization. In addition, while data are still limited, the number of public and communal latrines in urban areas fall far short of demand, leaving many low-income people without latrine services.

Latrine coverage does not provide a complete picture of whether sanitation is being safely managed in urban areas. The lack of appropriate data hampers the analysis of the effectiveness of sanitation systems beyond simply household containment of fecal waste. However inadequate management of fecal waste across the service chain in densely populated areas is having an impact beyond just the household level, causing the pollution of urban rivers and water bodies (see figure 5.22).

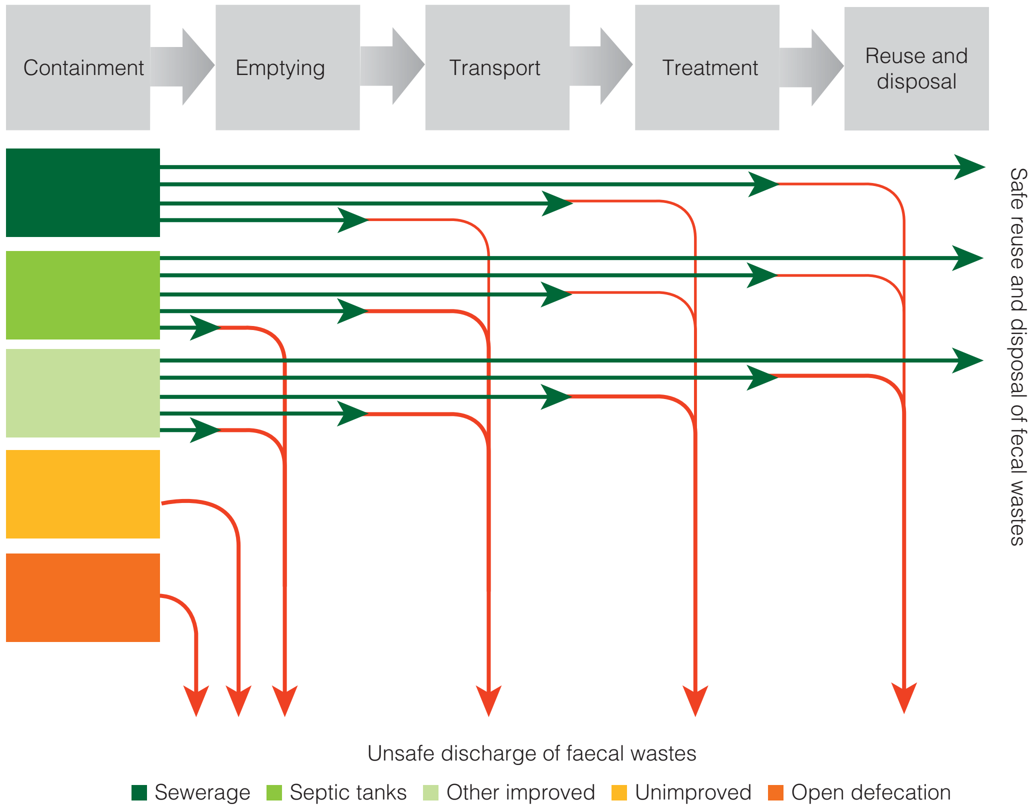
Government data show that in 2011, 55 percent of all latrines in urban areas were shared by more than two households (see figure 5.23). Interestingly, the percentage of shared latrines is very similar between those households using unimproved and improved latrines. The 2016 DHS estimates that 60 percent of households using improved latrines in urban areas are sharing, and more than half of these are sharing improved pit latrines (see figure 5.24).

Figure 5.21: Urban Sanitation Coverage in Ethiopia, 2000–16



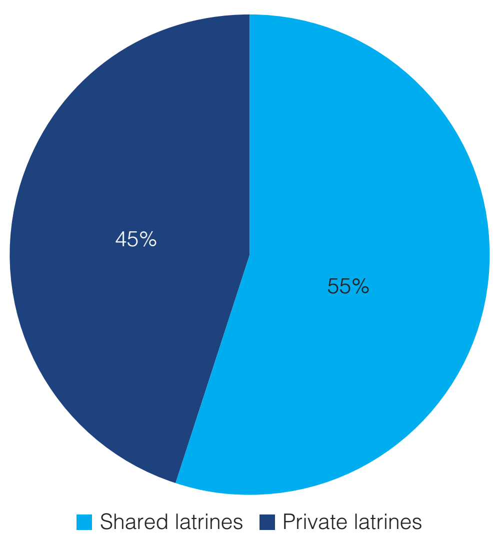
Source: DHS., 2000–2016.

Figure 5.22: Sanitation Service Chain in Ethiopia



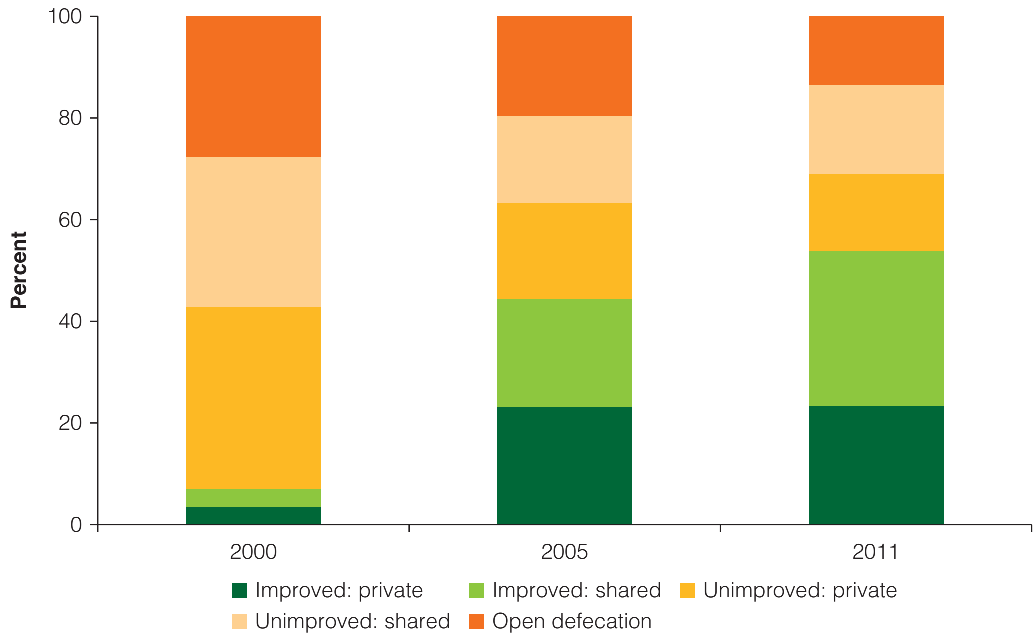
Source: DHS.

Figure 5.23: Share of Improved and Unimproved Private and Shared Latrines in Ethiopia, 2011



Source: WMS 2011.

Figure 5.24: Urban Sanitation Coverage with Shared Latrines in Ethiopia, 2000–11



Source: WMS, 2000–2011.

Shared latrines are more prevalent in larger towns and among tenant renting accommodation. A logit regression analysis was undertaken to examined variables that may be correlated with increasing or decreasing likelihood that households share toilet facilities (see appendix F for details). The results indicate that households were more likely to share toilet facilities in larger towns than in small towns. Households were significantly less likely to share toilet facilities when they owned rather than rented the house they lived in.

Households in the highest urban consumption quintile were less likely than other households to share toilet facilities. However, for other consumption quintiles there was not a significant correlation with shared use of toilet facilities. The variables for education level, gender of household head, and even use of an improved toilet facility were not significantly correlated with shared use of toilet facilities. The results of this regression suggest that it would be worth investigating further the relations between tenure status of household and the sharing of toilet facilities.

Households with greater numbers of household members were also less likely to share toilet facilities with other households. The squared function of household size was examined in a separate model but was not found to be significant. This last result requires further investigation to understand the relation between household size and sharing of toilet facilities.

There is no clear policy regarding urban sanitation; however, the sector documents state that households are responsible for building and managing their own latrine facilities. As a result of this policy direction, public investment in containment has been very low with the exception of communal and public latrines and poor quality septic tanks to service condominium housing. The policy does not clarify how to support poor households to build latrines or connect to sanitation services along the service chain. There is also currently no policy directive to motivate or enforce land and property owners to provide adequate sanitation facilities to their tenants.

Access Disparities by Geography and City Population

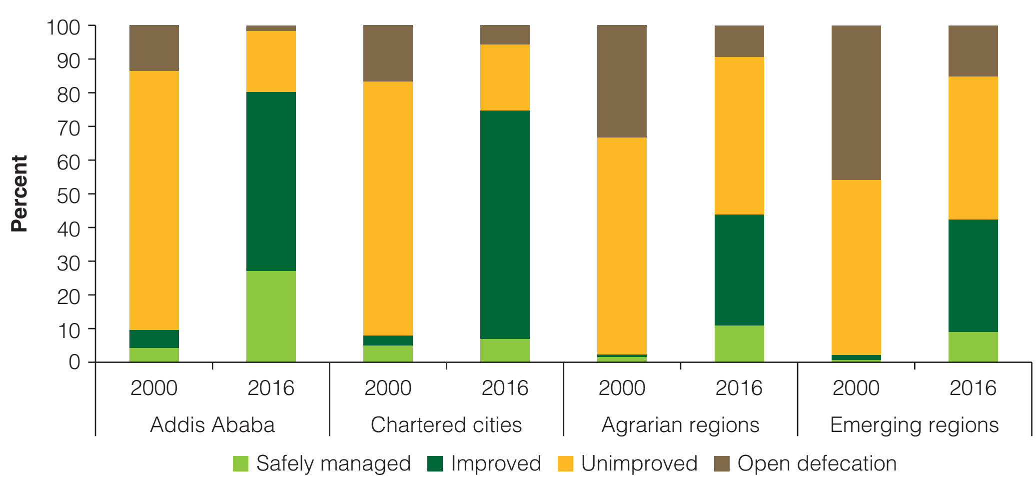
Urban sanitation coverage varies between towns in different regions (see figure 5.25). To analyze regional variations in urban sanitation coverage, urban centers are clustered into four groups.[11] Sanitation coverage in Addis Ababa is the highest among, and is the only city with a municipal sewerage system, even though this serves only 10 percent of the city's population. The coverage in the chartered cities is similar to that of Addis, with over 70 percent of households having access to an improved latrine. Coverage in the towns and cities in the agrarian and emerging regions is notably lower, with considerable open defecation still taking place in urban centers in the emerging regions.

Unsurprisingly, Addis Ababa represents the single largest urban challenge in Ethiopia, with 9 percent of all unimproved latrines and 4 percent of all households that practice open defecation in urban areas (see figure 5.26). However, the sheer size of the urban population in the large regions and the relatively poor coverage mean that most households with unimproved latrines (69 percent) and that practice open defecation (61 percent) in urban areas are across these four large regions.

When Addis Ababa is excluded, there is no significant difference in the sanitation coverage between towns with different population sizes (see figure 5.27). Open defecation remains highest in the secondary towns,[12] which are expected to expand significantly in the coming years. This can be explained by the large new and transient population moving to these areas for job opportunities. As demonstrated by regression analysis, as towns get larger, households tend to increase the sharing of toilet facilities. Households living in Addis Abba and regional capitals are almost three times more likely to share toilet facilities than households in smaller towns.

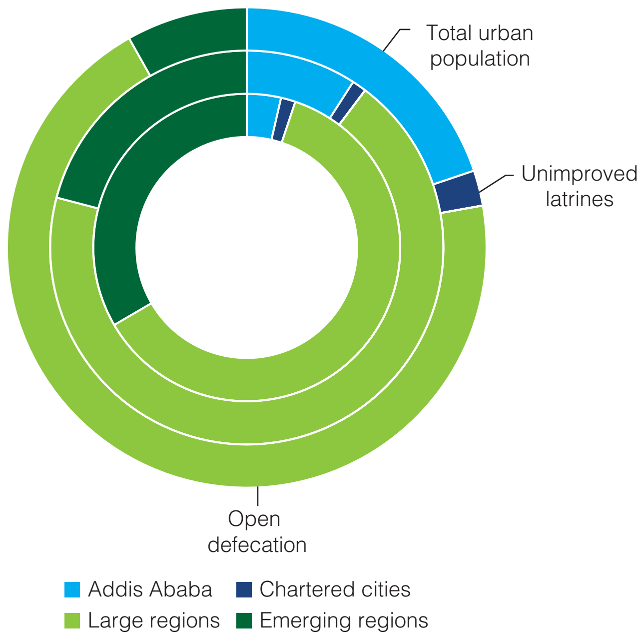
Despite relatively similar patterns of coverage, many factors will impact the strategies taken to address these challenges in coming years, including population density and growth, water supply, and capacity of institutions. Tools that could help towns address sanitation challenges include developing sanitation investment plans, and setting out institutional arrangements and management of service delivery models.

Figure 5.25: Trends in Access to Urban Sanitation across Regional Groups in Ethiopia, 2000 and 2016



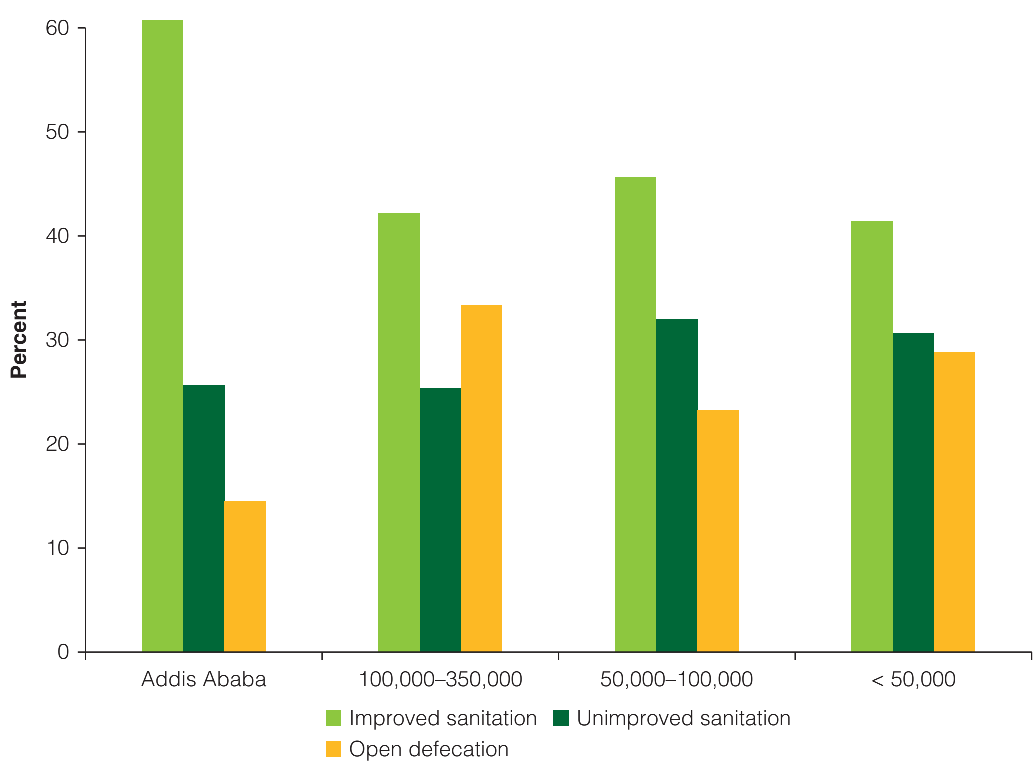
Source: DHS. 2000 & 2016.

Figure 5.26: Share of Total Urban Population, People with Unimproved Latrines, and Practicing Open Defecation in Ethiopia, 2016



Source: DHS 2016.

Figure 5.27: Access to Sanitation in Urban Areas by City Population in Ethiopia, 2007



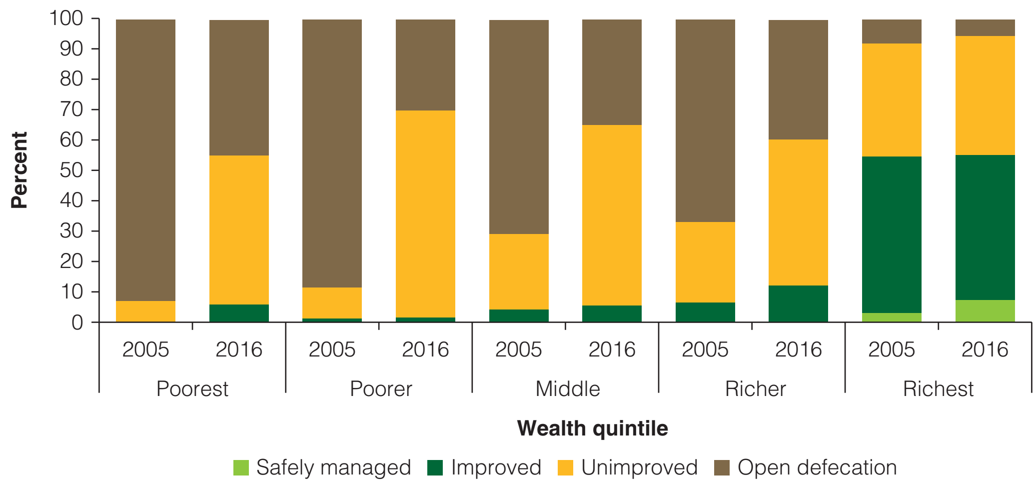
Source: Housing and Population Census 2007.

Access Disparities by Poverty

Unlike in rural areas, where wealth does not appear to be a key factor in determining sanitation access levels, in urban areas wealth is a driver of sanitation access. Only 5 percent of the richest quintile practice open defecation in urban areas, compared to 45 percent of households in the poorest quintile. While the percentage of improved latrine is much greater in urban areas, most improved latrines are owned by the richest quintile (see figure 5.28).

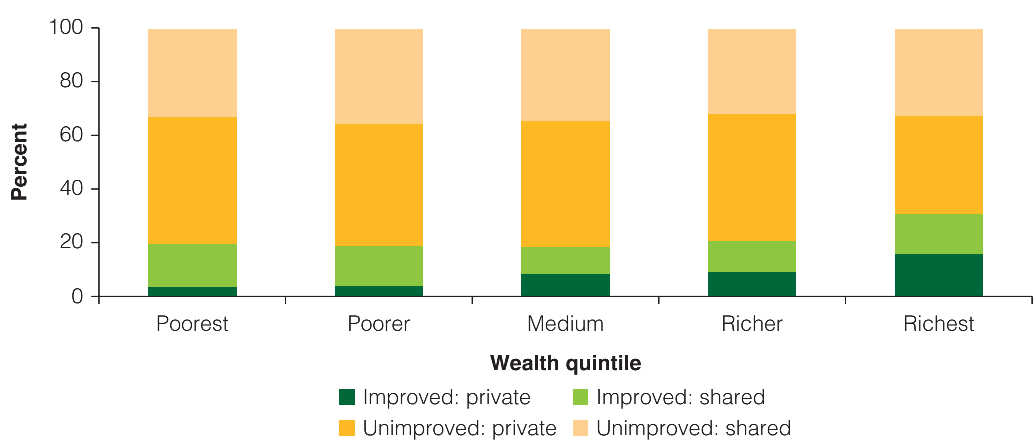
Wealth appears to have less impact on whether households have a shared or private latrine (see figure 5.29). Some variations are seen, such as only one in five households in the B40 with improved latrines have a private latrine compared to half of households in the T60. However, the split of shared and private for all wealth groups with unimproved latrines is approximately half and half.

Figure 5.28: Urban Sanitation Coverage by Poverty Quintile in Ethiopia, 2005 and 2016



Source: DHS 2005 and 2016.

Figure 5.29: Share of Private Latrines by Wealth Quintile in Ethiopia, 2011



Source: WMS 2011.

Access Disparities by Tenants Compared to Home Owners

Nearly two-thirds of urban residents live in rented accommodation, with privately rented households constituting the largest and growing group, but there is an ongoing change to the structure of the housing and rental market in urban areas. Kebele housing is on the decline due to GoE's ambitious condominium construction program, but it made up 24 percent of housing in Addis Ababa in 2007 and slightly below 20 percent, on average, across all cities in 2007.

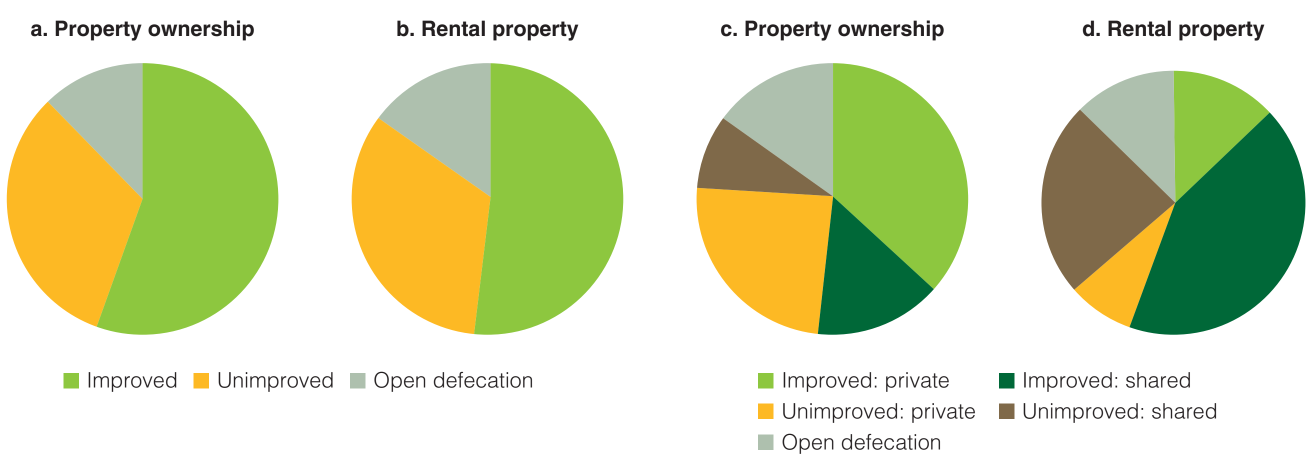
The construction of condominium houses aims to replace poor quality kebele housing with more robust housing stock, which in theory should benefit the poorest households. In the first phase of the Integrated Housing Development Program (IHDP), 244,436 units were completed, 170,000 of which were in Addis Ababa, and during the current phase of the program, the government plans to build 50,000 units per year in Addis Ababa.

However, the World Bank Urbanization Review (2016) finds that for the bottom third of households, IHDP condominiums are not affordable. As a result, poorer households use them to generate income by renting them to wealthier households, creating a new breed of relatively poor landlords. The removal of kebele housing in the center of Addis Ababa and other cities has forced an increasing number of poorer households to live on the peripheries. These households rent from private landlords and farmers in peri-urban areas, creating yet another new group of landlords.

As demonstrated by the previous regression analysis, those living in rented accommodation are significantly more likely to have a shared latrine irrespective of whether it is improved or unimproved. This is even though the sanitation coverage patterns in urban areas looks very similar for both households that own and households that rent their properties (see figure 5.30). At the national level, of households that own their property and have access to an improved latrine, 71 percent have private latrines and 29 percent are shared. This is compared to 23 percent private latrines and 77 percent shared latrines among households that rent their property and have an improved latrine. A similar pattern can be observed in house owners and tenant households with unimproved latrines.

A World Bank study on urban sanitation across ten towns and cities finds that 16 percent of condominium residents surveyed were using dry pit latrines because their indoor flush toilets were not functioning. The problems were related to poor quality plumbing installations, badly

Figure 5.30: Sanitation Coverage among Urban Households Owning or Renting Properties in Ethiopia, 2011



Source: WMS 2011.

constructed or undersized septic tanks, and low water pressure. Sanitation facilities do not appear to have been adequately planned and effectively implemented in Ethiopia's new generation of housing infrastructure.

Landlords and tenants are less inclined to invest in building a private latrine. For household renting from kebele councils, major renovations by tenants are not currently permitted. Tenants of private landlords also choose or are not incentivized to make repairs or upgrade household basic infrastructure for fear of increased rents. There is currently no regulation that forces landlord to rent houses with private sanitation facilities.

Sanitation Solutions across the Service Chain

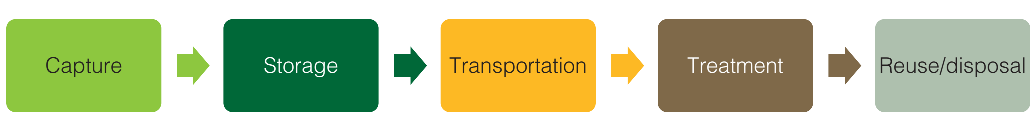
While the problems of open defecation and unsafe containment remain significant in urban areas, policy makers in sanitation infrastructure and services in urban areas need to look beyond conventional on-site sanitation technologies to address the whole sanitation service chain (see figure 5.31). Fecal sludge[13] is often accumulated in poorly built latrine pits, and then discharged directly into storm drains, open water bodies or the ground, or manually removed and dumped into the neighborhood or the wider environment.

Ethiopia has limited large-scale sewerage and treatment infrastructure. The only sewerage networks are in Addis Ababa and manage across three catchments: Akakai, Kality, and Eastern. Reception facilities, such as Addis's treatment plants in Kaliti and Kotebe, do not have adequate capacity to deal with the city's volume of sludge. The World Bank has financed the expansion of the Kality sewerage system to add capacity of 90,000 cubic meters per day, once completed in late 2017. A further 15 decentralized WWTPs have recently been completed or are still under construction and will come online in 2018. These will provide a conveyance and treatment capacity of 60,500 cubic meters per day.

Conventional sewers are not the solution in many urban centers due to their high cost, reliance on large volumes of water, and challenges of installation in densely populated and unplanned settlements. As a result, the GoE's Integrated Urban Sanitation and Hygiene Strategy (2017) sets out a new vision for urban sanitation infrastructure and services, which emphasizes achieving safe wastewater management. The strategy combines the traditional approach of improving existing on-site and sewer-based solutions, with fecal sludge management services, investing in more decentralized WWTPs, and introducing wastewater reuse.

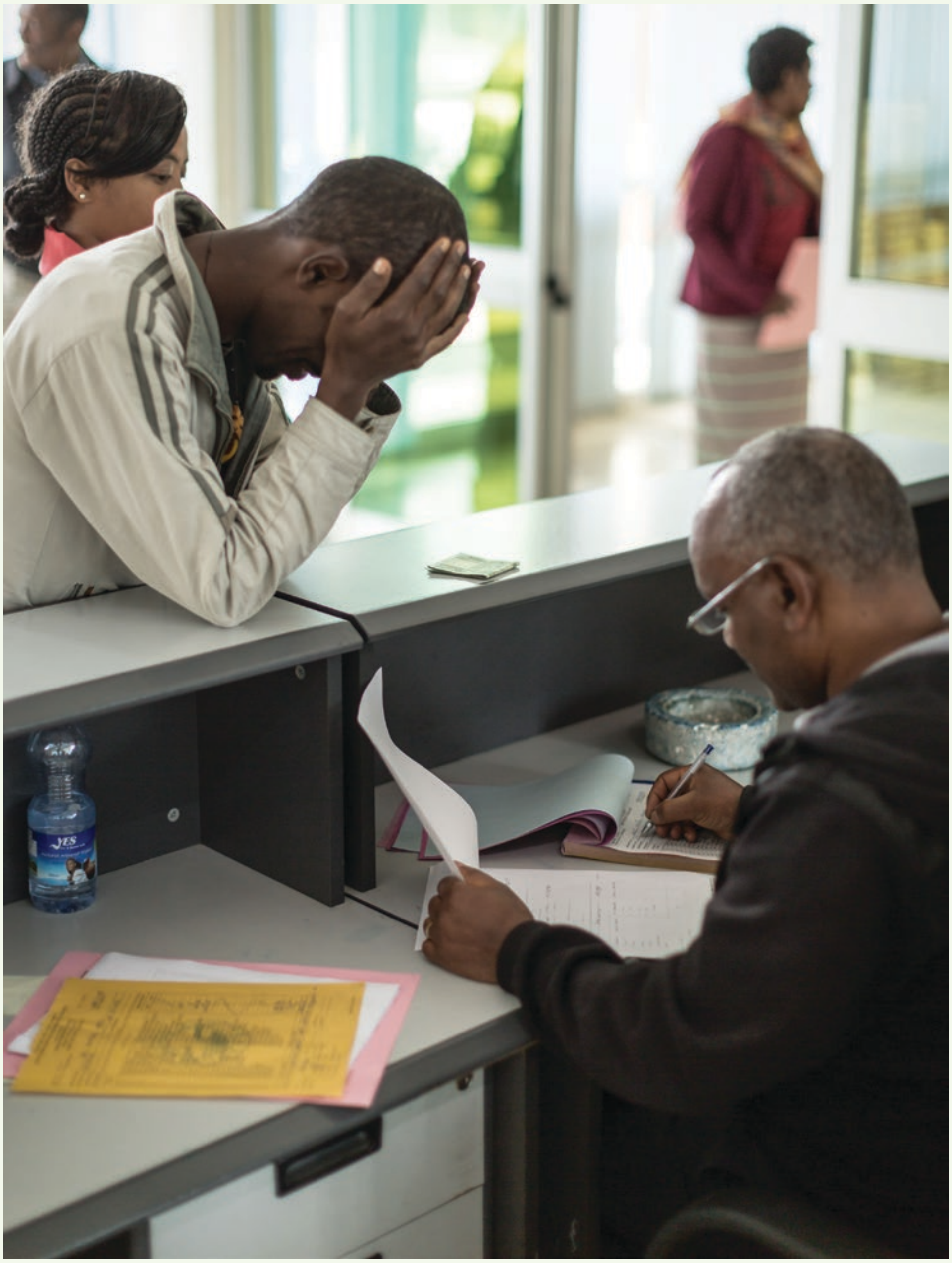
To date there has been limited investment in these alternatives, resulting in a lack of appropriate desludging services, as well as limited infrastructure to facilitate treatment of wastewater. Only a limited number of municipalities have vacuum trucks to desludge latrines and septic tanks, while fleet management and operation is patchy, and mechanical failure is common. For example, AAWSA owns 104 vacuum trucks and regulates a fleet of 58 private vacuum truck operators. Recent World Bank Group analysis (2016) finds only 62 percent of AAWSA's trucks were functional. More worryingly sludge is mostly released into the environment without adequate treatment due to the absence of reception facilities.

Figure 5.31: Sanitation Service Chain



Box 5.2: Accountability for Urban Sanitation Service Delivery in Addis Ababa

In Addis Ababa, there is no formal accountability between citizens, AAWSA, and local administration because the board members are all government representatives. However, AAWSA established a customer forum, in which representatives of AAWSA branch offices and subcity offices and customers meet quarterly. The arrangement has provided some



Water customers reception at Gulele Branch, AAWSA.
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box continues next page

Box 5.2: Continued

degree of accountability among the different groups, but it has still some limitations. The main limitation is that the forum cannot pass binding resolutions and can be interpreted differently by the groups. Another major limitation is that it focuses on service delivery routine issues and neglects broader strategic issues, such as on how to address poor families and land management issue.

In the case of Addis Ababa, the separation of roles between the utility and the local administration is clearly delineated because of AAWSA branch offices' accountability (responsible for operations and service delivery) to the AAWSA head office, and subcities' accountability to the municipality. The structure of Addis Ababa city, which is organized as a region, also forces division of roles in a clearer way than in smaller towns. The role of residents is reflected in their representatives on the city council.

There is conflict of interest between the woredas (health stations), which want affordable solutions for public health, and AAWSA, which focuses on addressing large infrastructure projects (such as sewerage) and neglects pro-poor solutions. There is a perception from both sides that they are pushing challenging issues to the other party. The lack of the woredas' clear understanding of AAWSA policies leads to further misunderstanding.

Accessing land is very challenging in Addis Ababa, and woredas are unwilling to change policies or administrative rules to address urban sanitation. In addition, AAWSA does not seem inclined to change its service delivery model to address the urban poor. If effective accountability mechanisms are not established, the utility will continue with its priority of infrastructure-driven approaches. Neglecting more diverse and pro-poor sanitation solution will lead to further marginalization of poor families.

There is a need to improve the institutional framework for urban sanitation, create policy integration among the different actors, and create awareness on the need for policy reform. Further improvements in accountability can be achieved through the formalization of the customer forum. There is also a need to establish formal links between AAWSA branches and subcities with a proper framework to engage solution-targeted dialogue. Addis Ababa could develop a citywide forum, including municipalities, to harmonize interests and achieve sustainable solutions for all and create branch-level, customer-focused platforms.

Financing plans should be designed to support pro-poor interventions and create incentives for increased accountability to poor customers. Better managed shared latrines, credit mechanism for building latrines, and incentives for landowners to build latrines will improve service delivery for poor households. The introduction of these strategies will require a combination of incentives to utilities and municipalities, and the establishment of performance targets and monitoring.

Source: Yemane and Defere n.d.

Sanitary suppliers, Merkato, Addis Ababa.
© Chris Terry/World Bank

Most of networked sanitation services are not available or affordable to the poorest communities in urban areas. Utilities target households they perceive are able and willing to pay. Furthermore, existing technologies are unable to reach densely populated slum areas where poor households reside, and when they can pay, often the quality of the latrine means a risk that the desludging will damage the latrine. Hence, the AAWSA strategy for these groups has been to construct and outsource mobile and fixed public and communal latrines in low-income and public areas. These have the potential to create income and job opportunities for small enterprises.

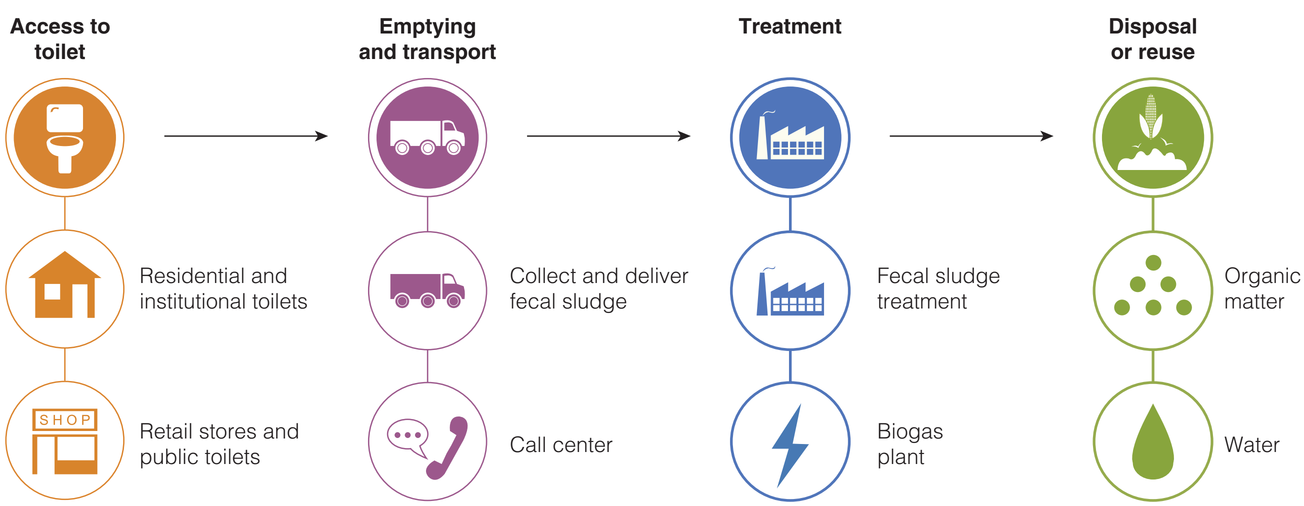
There is a need to shift to a new paradigm that addresses sanitation across whole cities. Such a shift would need to include systemic policy and institutional transformation, and create a framework that promotes a range of technologies and solutions. Cities and towns would need to develop investment strategies addressing challenges and growing demand across the sanitation service chain in different urban environments and for different wealth groups. Such an approach would also require responding to the lack of reliable water supply within cities. To set up such mechanisms along the service chain and provide the institutional system to carry it requires clearly defined and organized delivery mechanisms, as well as mobilization and allocation of adequate fiscal resources.

Role for the Private Sector

Despite a huge market opportunity, private sector participation in the delivery of sanitation products and services in urban areas is currently limited. Water utilities and local governments have not harnessed the potential of the private sector to improve the efficiency of sanitation service provision. This is in part because many key elements to create a conducive enabling environment for private sector participation are still not in place.

The private sector, from large to micro-business, has opportunities across the sanitation service chain in urban areas (see figure 5.32). In relation to the containment, the private sector is producing and selling latrine pans, but these are mostly priced out of reach of the poorest section of society. This goes some way to explain why the richest quintiles have most of the improved latrines in urban areas. The private sector has yet to fully take on the challenge of innovating a lower cost latrine option for poor households to tap the growing need for on-site

Figure 5.32: Opportunities for Private Sector Engagement across the Service Chain in Ethiopia



Source: CGIAR, IWMI, and World Bank.

Box 5.3: Example Case of a Household in a Densely Populated and Inaccesible Area's Attempt to Empty Latrine Facilities

The case study documents the process of accessing a pit emptying service from AAWSA branch office. Girma Abebe and his family live in a compound with eight households that share a latrine in poor working condition. Due to the large number of users, the latrine fills quickly and needs emptying to remain functional. The road leading to the compound is narrow and difficult to access it with a conventional vacu-truck.

AAWSA is responsible for the provision of fecal sludge management services including pit emptying. The Gulele Branch Office (under Woreda 3 Administration) is the service provider. There are also private vacuum truck operators, but their primary focus is businesses and conventional houses. The Health Station provides health services and hygiene promotion to

Girma Abebe, Addis Ababa.
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box continues next page

Box 5.3: Continued

Shared latrine, Addis Ababa.

the residents. With one HEW supporting 500 households to access water supply and sanitation service, households can go directly to the branch office and apply for fecal sludge services, but it can take some time. The service is provided more quickly if the family has a letter from the health station stating the urgency of the situation. The household contacts HEW, HEW facilitates the paperwork in the health station, and the application is sent to the branch office. The household makes the payments and the branch will send vacuum trucks to empty the latrine.

box continues next page

Box 5.3: Continued

The family applied through the correct channels to have their latrine emptied. They obtained a supporting letter from the health station and went to the branch office in 2015 and paid the charge for the service. However, the latrine was not emptied due to its inaccessibility. In 2016, the family reapplied for emptying and paid the fee again. After it was identified that AAWSA's vacu-trucks could access the latrine to empty it, the issue was forwarded to the woreda.

The woreda HEW and health office came to assess the situation and agreed to facilitate construction of a new latrine. They attempted to allocate land, which was initially was taught to be public land, but was found to be private, and they still look for viable solution. The likelihood of achieving a sustainable solution is very low. It requires introducing a new service delivery model, or encouraging other service providers to enter the market. It also depends on the woreda to give priority on its policy of land allocation to move from revenue-based approach toward service provision. That seems at present unlikely without high-level policy intervention.

Source: Yemane and Defere n.d.

sanitation solutions among low-income urban communities. Some plastic latrine pans are starting to emerge in the market, but their production and marketing has not been done to scale to date.

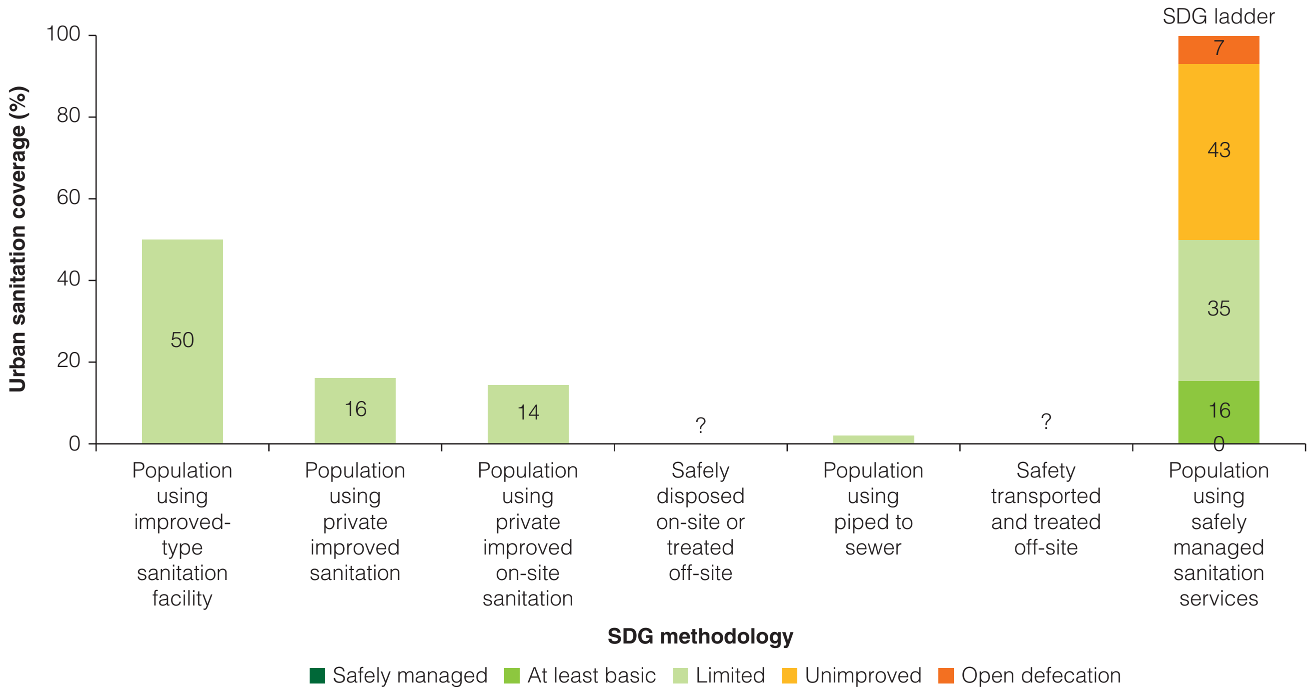
Small and medium enterprises have opportunities in both managing public latrines and in providing services for emptying and transportation of domestic waste. Examples of private engagement in these areas include the private management of public latrines built by AAWSA. However, the long-term viability of these businesses will depend on consumer demand and willingness to pay, as well as the enterprises developing business models that might include provision of complementary products and services. Due to these businesses relying on the wider service chain, the availability and cost of complementary services in the service chain will also impact their long-term success.

The private sector has the capacity to innovate to reduce costs and find solutions to service provision for the poorest households. Existing large trucks are not suitable for emptying pits and emptying and transporting fecal sludge from densely populated low-income areas. There is a need to introduce new technologies that would be better serve and provide viable business opportunities to this market segment. Currently the private sector is not prepared to take the risk of investing in such research and development in an untested and infant market. Partnership between the public and private sectors on such research offer opportunities to develop solutions for low-income households.

While the situation is improving, the public sector lacks the skills to engage with private sector in an effective manner. For the government to effectively facilitate these market opportunists, contract management skills need to be developed in municipalities and utilities, and the legal frameworks for engaging private partners have to be clarified and refined. For example, there is currently no policy for effective regulation of the removal and treatment of fecal sludge. While private vacuum trucks operate side by side with the utility's trucks, investing in such a business is a risk for entrepreneurs if market regulation is unclear.

Another major challenge is the difficulty of accessing seed money for startup activities for small operators. This issue is a serious constraint because small operators lack both

Figure 5.33: Urban Sanitation Coverage in Ethiopia, 2016—SDG Methodology



Source: World Bank calculation based on DHS 2016.
Note: SDG = Sustainable Development Goal; ? = figure based on best estimate using existing data.

adequate private equity and the ability to mobilize external financial resources. While some progress has been made in freeing up private capital through increasing liquidity and introducing guarantees to reduce the risk to the bank, in many case the banks' collateral requirements, particularly cars and houses, are still too stringent. The most success to date in mobilizing finance for new businesses has been through microfinance lenders lending to new businesses organized by government agencies. However much more needs to be done if private enterprises of different scales are going to make a meaningful contribution to sanitation service provision in urban areas.

Implication of Achieving the SDGs Targets

The SDG targets and monitoring system reflects the progress required across the sanitation service chain in urban areas. The status looks more encouraging compared to the rural SDG assessment, however as discussed above the institutional and technological improvement required to achieve safely managed sanitation access in urban areas are significantly more complex (see figure 5.33). The SDG indicators in the urban context further highlights the complexity of monitoring progress across the service chain.

Notes

1. Unless otherwise stated, population figures in this report are taken from the Ethiopian Central Statistics Agency. The Sub-Saharan average is from the World Bank World Development Indicators (WDI). *Urban population* refers to people living in urban areas as defined by national statistical offices.
2. Population between 100,000 and 350,000 people.
3. People fetching drinking water from plot or premises has risen from 1.2 million to 10.7 million between 1995 and 2015. People fetching water from standpipes or neighbors has gone from 5.4 million to 7.1 million over the same period (WHO/UNICEF 2016).
4. DHS 2011 reports that women (72 percent) and girls (15 percent) are primary fetchers of water in rural areas and in urban areas (women 69 percent and girls 8 percent) but over 60 percent urban households have access to water in their yard compared to less than 2 percent in rural areas. Female- and male-headed urban households have equal access to water on premises (about 57 percent).
5. See IBNET's website: https://www.ib-net.org/.
6. At 2011 exchange rates.
7. IBNET 2011 data for Ethiopia.
8. Data for access and time to fetch water form DHS 2016.
9. Data for availability from ESS 2016.
10. International Benchmarking Network for Water Supply and Sanitation Utilities.
11. Addis Ababa, the chartered cities of Dire Dawa and Harari, and urban centers in the large regions and the emerging regions.
12. Secondary towns are a distinct group with a population between 100,000 and 300,000 people.
13. Fecal sludge is a highly variable mix of raw and partially digested feces and urine, along with different amounts of contaminated wastewater, and in some places solid waste and other materials.

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Shumba Bukeri, Mareko Woreda, SNNPR, cannot afford to pay for water from a community water point 200 yards from her house.

Chapter 6
WASH, Nutrition, and Health

Inadequate water supply, sanitation, and hygiene (WASH) services can result in exposure to a wide range of pathogens and cause many health problems. The ingestion of contaminated water, food, or soil as a result of the unsafe management of human excreta, or poor personal and domestic hygiene, provide routes of transmission for numerous microorganisms that can cause diarrhea and other important infections. Despite the increase in access to WASH services in Ethiopia, the poor quality of services provided have constrained the potential of WASH services to contribute to improvements in health outcomes.

The under-five mortality rate in Ethiopia has decreased by 72 percent since 1990, when it was 205 deaths per 1,000 live births, to 59 deaths per 1,000 live births today (UNICEF/WHO/ World Bank 2015). This large drop in under-five mortality is the result of both preventive and curative interventions. WASH interventions target preventing the spread and so burden of disease experienced by people.

Dehydration from diarrhea is still ranked as the second leading cause of child mortality in Ethiopia and persists as a significant public health problem.[1] The prevalence of diarrhea has halved from 24 percent to 12 percent from 2000 to 2016 (DHS 2000 and DHS 2016). Neglected tropical diseases (soil-transmitted helminth infection, schistosomiasis, and trachoma), for which inadequate WASH is a risk factor, also persist as public health problems in Ethiopia. Studies in Ethiopia have reported an association between using an unimproved water source and higher prevalence of childhood diarrhea, with children in households not using an improved water source around twice as likely to experience episodes of diarrhea (Godana and Mengistie 2013; Mekasha and Tesfahun 2003; Mihrete, Alemie, and Teferra 2014). However, while there is some good evidence that water quality is associated with diarrhea, there are few studies assessing water availability (distance to source) as a risk factor.

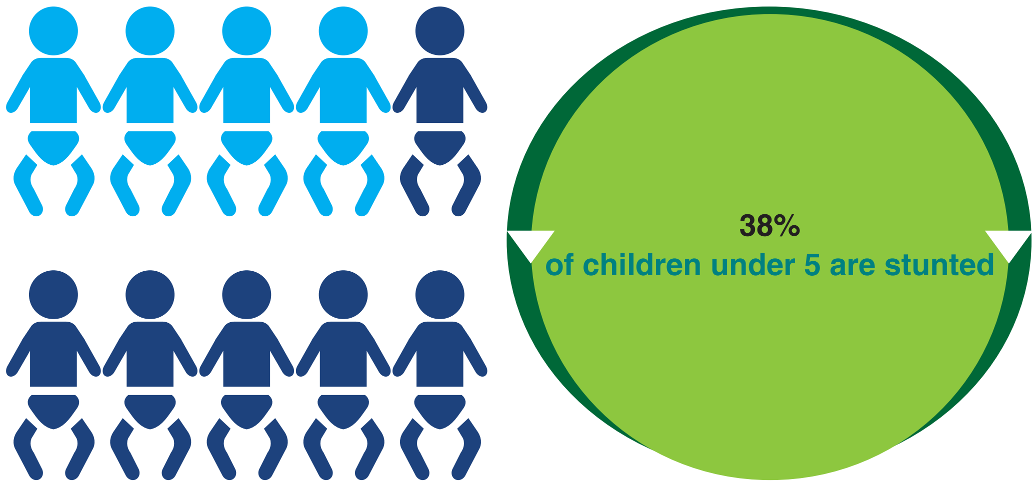
There is evidence in the wider literature that open defecation increases the odds of children under five having diarrhea. Children in households that practice open defecation were more than twice as likely to have diarrhea as children from households using a latrine. In addition, children from households that do not practice proper infant feces disposal have over twice the odds of having diarrhea; in one urban setting, the presence of feces in the compound increased the odds of children having diarrhea by nearly two times (Godana and Mengistie 2013; Mihrete, Alemie, and Teferra 2014). It has also been found that children under five were up to twice as likely to have diarrhea if their caregivers did not wash their hands at critical times (Eshete 2008).

Malnutrition is an acute health risk and can also have long-term negative effects. Stunting is a powerful risk factor for disease and death and is associated with 53 percent of infectious disease related deaths in developing countries (Schaible and Kaufmann 2007). Malnutrition can also have long-lasting wider negative effects, including on poor mental development, impacting school achievement and future employment prospects. This risks long-term disadvantages for affected individuals and negative impact on wider growth and development goals.

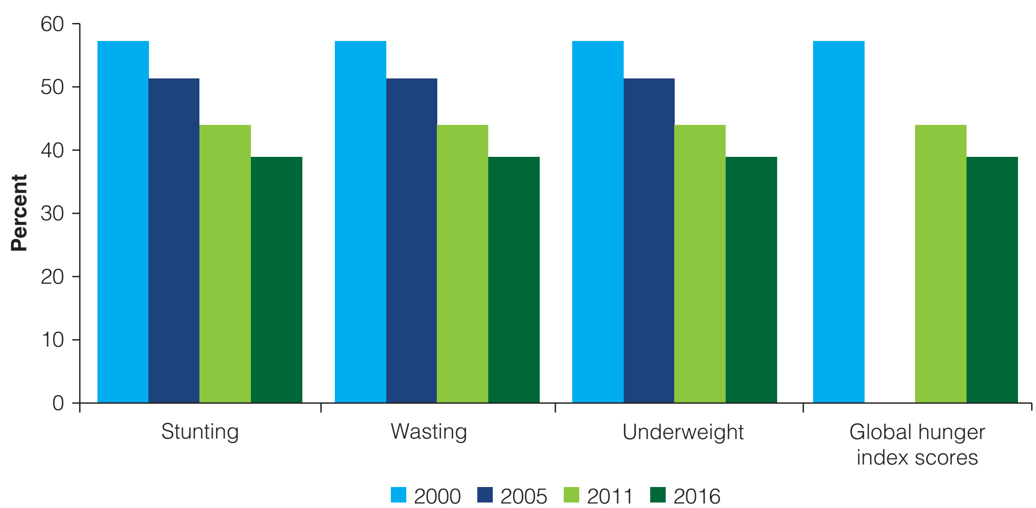
Undernutrition still presents a significant problem, despite good progress since 2000. Diarrhea and environmental enteropathy[2] can lead to chronic problems with absorbing nutrients, leading to stunting, wasting, and being underweight (see figure 6.1). DHS 2016 data show that among under-five children, 38.4 percent, 23.6 percent, and 9.9 percent were stunted[3], underweight, and wasted, respectively. However, similar to the 2011 data, the DHS 2016 data do not report a

Figure 6.1: Trends in Nutritional Status of Children under Age Five in Ethiopia, 2000–16

a. Child stunting in Ethiopia, 2016



b. Nutritional status of children in Ethiopia, 2000–16



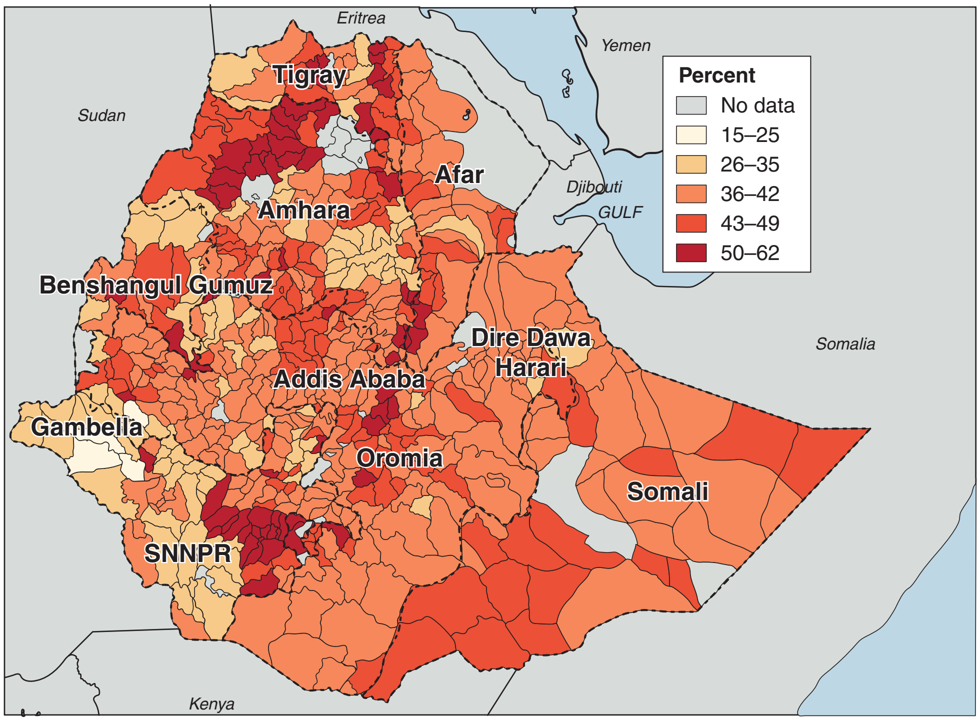
Sources: DHS; IFPRI Global Hunger Index database 2016.

substantial differential in stunting between B40 (43 percent) and T60 (37 percent) in rural areas. While other environmental factors, most notably sanitation, are known to influence stunting rates, the cumulative effect of factors clearly benefits wealthier more than poorer households.

Regions of Ethiopia show significant variation in the distribution of child stunting and children being underweight, as shown in maps 6.1 and 6.2. There is a high prevalence of stunting and underweight children in areas of both high and low water supply and sanitation coverage. This is because there are many drivers for children being underweight and stunted, including maternal nutrition; food availability and nutritional value of food intake; overall health; and geographic and environmental factors such as access to water, sanitation, health, and education services.

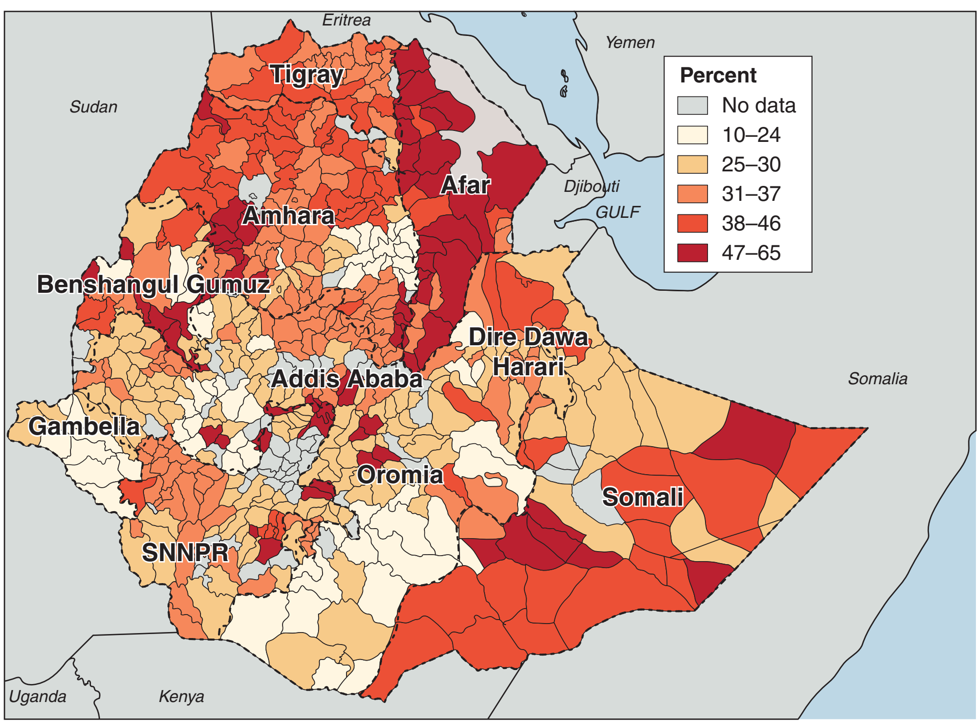
The negative impacts of poor WASH conditions and other external factors are, however, concentrated among certain groups, reflecting broader structural inequities relating to poverty and geography. Overall measures of exposure and susceptibility are positively associated.

Map 6.1: Share of Children Stunted in Ethiopia, 2017



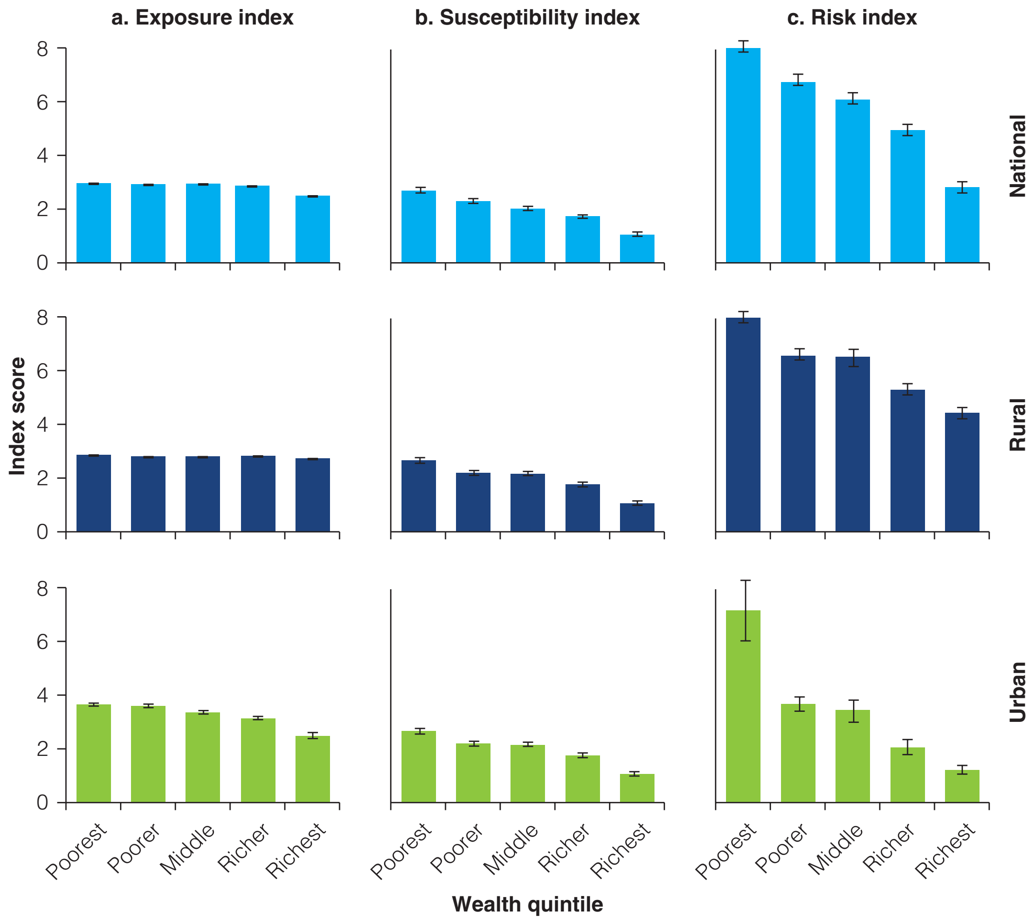
Source: Sohnesen et al. 2017.

Map 6.2: Share of Children Underweight in Ethiopia, 2017



Source: Sohnesen et al. 2017.

Figure 6.2: Exposure, Susceptibility, and Risk Indexes for Children under Five in Ethiopia, 2011

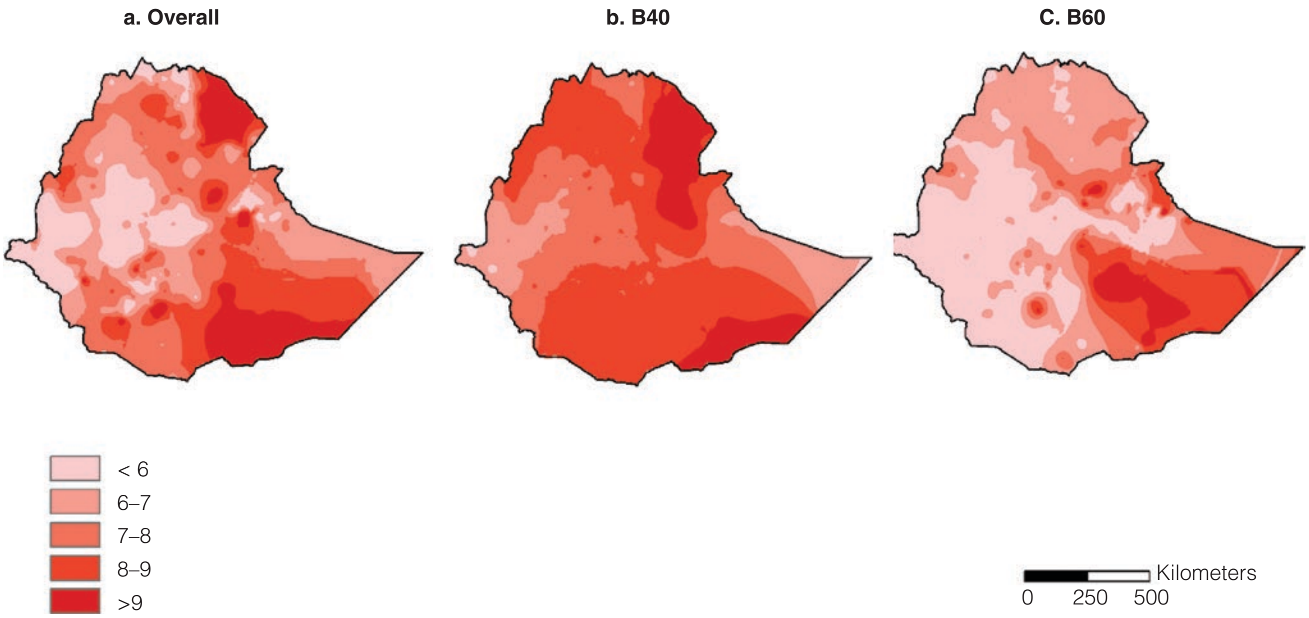


Source: DHS 2011.

That is, those with the worst WASH conditions are also more vulnerable due to inadequate health. Children with poor WASH conditions also suffer from poor access to health and nutrition. This is true in rural and urban communities. These correlations between exposure and susceptibility add to (and are likely caused by) the underlying difference in wealth and urban–rural inequalities (see figure 6.2). More details of this are provided in appendixes I and J.

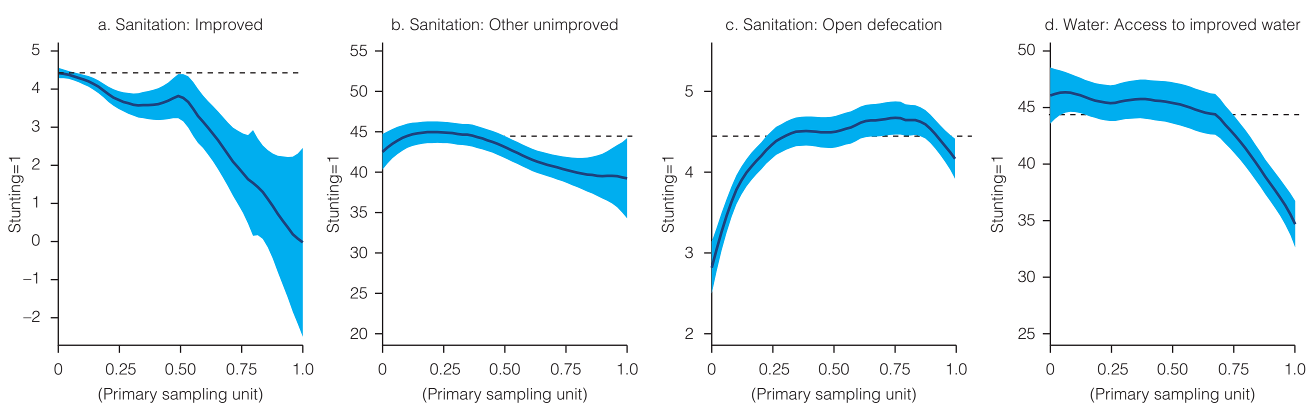
Regions of Ethiopia with the largest disparity in disease risk between the poorest (below 20 percent of the wealth index [B20]) and wealthiest (top 20 percent of the wealth index [T20]) quintiles are in Tigray and Addis Ababa. Areas with children at the highest risk index values are concentrated in the southeast and northeast of Ethiopia, with children from Afar being particularly vulnerable to disease. Panels a–c of map 6.3 show a finer scale spatial resolution map of the disease risk index value distribution across children under five in Ethiopia. Areas with the highest risk index values are concentrated in the southeast and northeast, while the children with the lowest risk index values are concentrated in the west in the overall map (panel a) and the top 60 percent (T60) of the wealth index population (panel c). For the below 40 percent (B40) of the wealth index children population, there are larger areas of the higher risk index values (>7.25) in the north and south, and to a lesser extent in the center.

Map 6.3: Risk Index Values in Ethiopia for Populations of Children under Five, 2011



Source: DHS 2011.
Note: Maps are at 5 km² resolution. B40 = below 40 percent of wealth index; T60 = above 60 percent of wealth index.

Figure 6.3: Relationship between Community-Level Access to Water or Sanitation Services and Stunting in Ethiopia, 2011



Source: DHS 2011.

Analysis shows water supply and sanitation coverage needs to reach an advanced level within a community before stunting starts to reduce (see figure 6.3). Until fewer than 25 percent of households within a community practice open defecation there is very limited impact on child stunting rates. However once over 75 percent of the community stop defecating in the open, significant improvements in stunting are observed. In the same way very little impact is seen on stunting until more than 50 percent of households have improved latrines.

Most concerning in the Ethiopian context, unimproved latrine coverage has very limited impact on stunting, with only marginal improvements shown in communities with high coverage of unimproved latrines. In addition, even high coverage of poor quality sanitation services has very limited impact on stunting, compared to improved latrines. Therefore, there needs to be a focus on ensuring households don't build unimproved latrines and build improved latrines.

Significant improvements in stunting are observed only when access to improved water supply reaches 70 percent, but prior to this point improved water access has a very limited impact on stunting. The poor water quality data presented in this report make this finding unsurprising, and reinforce the need to increase the quality of water for all households to realize the health benefits. The insufficient protection even "improved" water sources provide against malnutrition is aggravated by the extremely low level of point-of-use water treatment in the Ethiopia, which has clear protective effects.

This analysis shows that increases in quality of services need to be combined with reductions in inequality of access to water supply and sanitation services within a community. Although Sustainable Development Goal (SDG) targets for universal "safely managed" WASH are extremely ambitious, this analysis demonstrates that both universality and higher service levels are outcomes that matter most for WASH interventions to contribute to wider human health and development goals.

Notes

1. "Country Profile: Ethiopia," accessed March 29, 2016,available from http://www.healthdata.org/print/4314.
2. Environmental enteropathy, also known as tropical enteropathy or environmental enteric dysfunction (EED), is a condition or subclinical disorder believed to be due to frequent intestinal infections.
3. Children whose height-for-age is less than two standard deviations below the median (–2 SD) of the reference population are considered short for their age or stunted, a condition reflecting the cumulative effect of chronic malnutrition.

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Mekonei Jare, 70 years old. Digna Koisha Humbo Kabele, Digana Fango Woreda, SNNPR.
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Chapter 7 Conclusions and Recommendations

The Government of Ethiopia (GoE) has been successful at linking its decentralized generic service delivery machinery with the sector policy direction, plans, and capacity to rollout basic water supply, sanitation, and hygiene (WASH) services at an industrial scale. This has been done with strong country leadership that directs both domestic public and overseas aid resources well where WASH services are basic and public access (nonrivalrous, nonexclusive goods). However, where WASH services have added value and a private dimension (rivalrous and exclusive goods), progress on implementing the policy direction, particularly on cost recovery, has been limited and the sector outcomes regressive, with wealthier households disproportionately capturing the benefits of public expenditure.

The rollout of basic WASH services has been equitable across wealth groups albeit less equitable across livelihood types. Basic water services in rural areas include public water points (protected wells, springs, and boreholes). Basic sanitation and hygiene services have been achieved through knowledge disseminated through health extension workers (HEWs) across the country. Looking ahead, the challenge for *basic WASH services* is to improve the quality while achieving universality.

Two priorities in rural water supply are improving water quality and reducing the time spent fetching water. First, to ensure that rural water services deliver their potential health benefits the microbiological quality of water needs to be addressed. This requires (a) improving implementation quality to ensure that protected supplies are well constructed (e.g., with crack-free masonry and grout seals); (b) site selection that minimizes sanitary risks (e.g., no latrines or other sources of pollution nearby); (c) sanitary conditions at water points (e.g., keeping animals away from water sources for domestic drinking water); (d) implementing regular water testing protocols; (e) instituting controlled chlorination of improved sources; and (f) hygiene education to encourage household management of safe water chains. Second, rural water supply needs to deliver on the economic promise of freeing up people's time by bringing services closer to people's homes. While 35 million rural people gained access to improved water, only half this number are able to fetch water within half an hour. As a result, women, who bear the brunt of the water-fetching burden, have not seen the full economic benefits from the transition to improved water. In addition, the poor quality of water delivered has not resulted in the expected health benefits.

Functionality of schemes continues to be a problem stemming from weaknesses in upstream planning at regional level and financing of postconstruction support by woreda water desks. A contributor to the lengthy water-fetching times is nonfunctional systems. In additional to mechanical breakdowns, recent droughts have exposed the vulnerability of water points to drying up. At the regional level, attention in the planning and design process is needed to better match types of water intervention with hydrological or hydrogeological conditions. At the woreda level, more operational budget is needed for water desks to backstop village and scheme water management committees. This includes checking whether cost recovery mechanisms are working and to facilitate the sourcing and fitting of spare parts when water committees need help in keeping systems running.

The greatest challenges to achieving universality of basic services are in pastoralist and agropastoralist areas. Across Ethiopia, woredas dominated by agropastoralist and pastoralist livelihoods were just over half as likely to have access to improved water as agrarian woredas. Government programs targeted at the poorest areas, both from within the sector and broader poverty reduction programs (such as the Productive Safety Nets Program (PSNP) and the Food Security Program), have increased water access in food insecure agrarian areas. However, they have been less successful in areas dominated by pastoralists and agropastoralists. Reasons for this include (a) the community infrastructure funding under the PSNP public works component has been too small to address the complex hydrogeological conditions in agropastoralist and pastoralist areas; (b) both government and nongovernmental organization (NGO) water actors have struggled to find adequate ground water sources to drill for; (c) alternative storage technologies to collect rainwater run-off have been underdeployed (e.g., sand dams, underground dams, infiltration galleries); and (d) the standard regional planning process has not been as successful at engaging with agropastoralists and pastoralists as they have in agrarian areas.

In 2009 the GoE set up the Ministry of Federal Affairs principally to close the service and capacity gap between large and emerging regions. As part of the recent rollout of the Millennium Development Goal (MDG) special purpose grant the regions of Afar and Somali drew on capacity in larger regions to set up drilling agencies. While this may be part of the solution, the same larger regions are having difficulty delivering services to pastoralists and agropastoralists in their own regions. This suggests that both the existing technologies and the service delivery interface in pastoralist and agropastoralist areas need revisiting for water supply and sanitation services. Addressing this gap, therefore, requires building further technical expertise in areas with difficult hydrogeology. It also means finding ways for the decentralized service delivery machinery to interface with pastoralist and agropastoralist communities, both to address their specific needs and ensure they are a vocal stakeholder in finding solutions.

In view of the shift envisaged from point sources to piped schemes under the Growth and Transformation Plan (GTP) II, the *affordability* of rural water services and cost-sharing arrangements will need to be examined carefully. Evidence from national surveys and qualitative studies suggests that affordability of rural water from piped schemes, particularly motorized piped schemes, can be a real barrier for poorer households. The costs, which range from five to 25 times that of urban utility water, partly explain the skewed distribution of access to piped water in rural areas. As this shift is planned, careful attention needs to be given in the design stage to keep recurrent costs down and so not to jeopardize the equitable goals with which basic services have been rolled out in Ethiopia (see box 7.1).

Box 7.1: Rural Water Supply Recommendations

- Reduce microbiological contamination of rural water sources by (a) ensuring protected sources are well constructed, sited, and managed to avoid contamination; (b) implementing regular water testing protocols; (c) instituting controlled chlorination of improved sources; and (d) promoting household management of safe water chains.
- Raise functionality rates of existing improved water sources to increase access rates and reduce the travel time for fetching water.
- Improve siting of new water points to deliver time savings for fetching water, and, where possible, extend existing piped schemes to provide public stand posts (bearing in mind affordability).
- Further research how time-to-source relates to topography and invest in planning and design skills to improve the matching of water supply technology with hydrological and hydrogeological conditions.

box continues next page

Box 7.1: Continued

- Address remaining geographic inequities by building further technical expertise in areas with difficult hydrogeology, and develop planning methods that engage pastoralist and agropastoralist communities.
- Specifically target woredas and kebeles with low levels of basic access across all regions.
- Harness government mechanisms, such as technical and vocational education and training agencies (TVET) agencies and universities, to improve the availability of skilled staff for recruitment into the civil service.
- Improve staff retention, especially at the woreda level, by ensuring staff members have operational budgets to carry out their roles in backstopping rural water supply.

The two priorities for rural sanitation should be to improve the quality of latrines used across Ethiopia and effectively target those households that were not reached in Ethiopia's last sanitation push. Without more universal coverage and a higher level of service provision, the positive health benefits expected from improved sanitation will not materialize.

The health system needs to reinvigorate its efforts to address the next phase of sanitation and hygiene promotion in Ethiopia. Progress in rural sanitation has benefited from the systematic inclusion of sanitation promotion in the Health Extension Program (HEP); however, the slowing of progress in recent years shows a fatigue within the system. This is partly due to the lack of evolving communication messages within the HEP, as existing messages become redundant or fail to influences new audiences. In addition, HEWs' lack of knowledge on what constitutes improved latrines and the negative impact of poor quality latrines have made unimproved latrines an acceptable standard of progress for HEWs and the households they serve.

Moving the millions of households in rural areas up the sanitation ladder is going to require a combination of demand- and supply-side approaches. Weak supply chains of sanitation products and services, as well as supporting financing options, have meant households have not had access to the technical or financial solutions required to move up the sanitation ladder. Prioritizing the engagement and development of the private sector to provide products and services will reduce the burden on the health system and create innovation and jobs in the sanitation sector.

Analysis shows that when access to effective health care and education services are combined with improved WASH services, more positive health outcomes have been achieved. Reducing vulnerable children's susceptibility to poor environmental condition and increasing access to basic health care can reduce stunting rates and the cycle of poverty in which poor families are locked.

While the last phase of Ethiopia's sanitation and hygiene promotion in rural areas has been delivered in a relatively equitable manner across wealth quintiles, there are a number of geographic inequities. These are driven primarily by livelihood types, with a clear systematic failure to effectively address sanitation coverage within pastoralist communities. While it is clear that pastoralist communities' coverage lags behind those of other areas, in terms of the scale of the problem, significant efforts need to be placed in addressing the large numbers of people without access to improved sanitation in Oromia; Amhara; and the Southern Nations, Nationalities, and People Region (SNNPR).

Although poverty has not been a significant barrier to improving sanitation, as the GoE pushes for increasing the quality of latrines to higher service levels, poverty may increasingly become a barrier to access. Strategies need to be put in place to ensure the poorest households don't fall behind as sanitation service levels increase and Ethiopia strives for universal coverage.

Achieving the GoE and Sustainable Development Goal (SDG) targets will require strong and sustained leadership and champions at all levels. It has been proven that the greatest success in the reduction of open defecation has occurred when HEP has been complemented by strong political support and external engagement of development partners.

Box 7.2: Rural Sanitation Recommendations

- Health extension workers, and employees among the wider health delivery system, need to be reinvigorated with new communication strategies and tools to address the changing landscape of sanitation coverage.
- Behavior change communication needs to look beyond the eradication of open defecation, and support households to improve the quality of their sanitation services and make linkages with wider health promotion, such as nutrition and early childhood initiatives.
- Tailored demand creation tools and community engagement strategies need to be developed to target pastoralist communities.
- Build on the supply-side activities to increase the role of private sector in service delivery, including (a) deepen new institutional partnerships to promote business development; (b) create a conducive market-based environment to support the establishment of businesses to provide sanitation products and service; (c) ensure sanitation business development is mainstream in wider job creation and cash for work programs; and (d) align supply-side initiatives with renewed demand creation strategies.
- Review the financing approach for rural sanitation, including (a) working with financial institutions to develop financing products for households and small-scale businesses; (b) consider innovation grants to drive down costs and stimulate mass production of affordable sanitation products; and (c) review the policy on hardware subsidies to explore targeted subsidies to the poorest households possibly through existing mechanisms, such as the Productive Safety Nets Program (PSNP).

The challenge for value added WASH services is addressing equity while improving quality and sustainability. The rollout and uptake of *value added services*—the stepping stone toward safely managed services—over the past 20 years, mainly in urban areas, have resulted in an additional 10 million people gaining access to piped water on premises and 8 million people building improved latrines.

In urban water supply, services with added value and a private dimension have had active uptake, with wealthier households disproportionately capturing piped water on premises. This has unintentionally resulted in disadvantaging poorer households, the majority of whom still fetch water from outside their compounds at public taps or purchase from private vendors. Poorer women, therefore, spend more time fetching water than wealthier women, and water quality consumed by poorer households is considerably worse than that consumed by wealthier households. This is borne out in the differential health and nutrition outcomes in urban areas: there are higher rates of diarrhea and stunting among children under five in poorer households.

Differential access in urban areas has both supply and demand side barriers. Supply-side barriers, in which very limited network availability affects around 1 million poor households, are found predominantly in small towns across Ethiopia. Demand-side barriers, in which people have not connected to the networks that exist in their neighborhoods, are a feature of larger towns and cities and affect around 3 million poor households.

Actual expenditure in urban areas, even by the poorest households, was greater than existing utility tariffs, equivalent to 40 liters per person per day. This holds true across all consumption quintiles and points to the actual ability, if not willingness, of the poor to pay for utility water. It also points to the obvious financial benefits of being connected to a utility—particularly as many households were paying more for water from public stand posts or private water vendors. Extending utility water supply to all households could reduce the amount that the unconnected poor pay for water.

These findings reinforce the argument that it is the connection process, rather than affordability of services, that is the main barrier to equitable access. The qualitative work undertaken for this study in urban areas has identified three barriers for those wanting to connect. First is a connection charge, usually around Br 500. Second is that utilities require people hooking up to pay the cost of connecting pipe work. Third, there are nonfinancial transaction costs of connecting linked to the time and social capital that people have to put into getting a connection. With connection costs trumping affordability as a barrier to hooking up, greater attention should be paid to incentivize utilities to hook people up to utility services.

Investment to address the supply-side constraints is needed especially for towns that have transitioned from being classified as rural to urban local governments (ULGs). As towns make this transition to becoming ULGs, they lose access to woreda block grants but have yet to build up own source revenue capacity for investment. The MDG special purpose grant for capital investment introduced in 2011 may be part of the solution, but it is too early to tell. However, the MDG grant is highly discretionary in nature, being multisector (for rural or urban areas), and so does not favor targeting this transitional demographic. Rather, a specific transitional infrastructure financing arrangement is needed to plug this gap for this fast growing segment of urban settlements (see box 7.3).

Box 7.3: Urban Water Supply Recommendations

- Address equity while improving quality and sustainability of utility supplies.
- For newly graduated ULGs with supply-side problems, develop a rural–urban transition grant and improve the functioning and reach of the Water Resource Development Fund (WRDF) to help small towns invest in their water supply production, treatment, and distribution needs—bridging this “coming of age” problem.
- For larger towns and cities with demand-side problems, incentivize utilities to develop flexible connection arrangements for poorer households to hook up to the utility supply, such as by (a) streamlining the application and connection request process; (b) allowing shared connections with flat tariff rates; and (c) amortizing connection charges within the tariff.
- Give utility boards clear policy conditions that give them more flexibility in tariff setting to improve financial autonomy for inward investment and domestic borrowing, e.g. linking reductions in nonrevenue water (NRW) to tariff increases.

box continues next page

Box 7.3: Continued

- Reduce microbiological contamination by (a) implementing regular water testing protocols; (b) instituting controlled chlorination of improved sources; and (c) promoting household management of safe water chains.
- Improve urban water security through (a) medium- and long-term planning for water source sustainability; (b) ensuring utilities play an active role in wider water governance discussions; and (c) initiating integrated urban water management.

Rapid and mostly unplanned urbanization continues to pose the major challenge to improving urban sanitation access in the coming years. The stagnation of progress in urban sanitation shows the current institutions, investment levels, and innovation are struggling to adapt to the new pressures being placed on urban areas. The weak institutional framework in Ethiopia has resulted in a lack of clear leadership in sanitation, since roles and responsibilities are still not clearly understood between government agencies. As a result, while other urban infrastructure and service development initiatives have received significant resources over the last 10 years, urban sanitation has not received the necessary level of funding.

Adequate urban sanitation infrastructure and services still lags due to limited service provision across the sanitation service chain. Addressing this must be the highest priority in the coming year. Greater relative wealth and the increased availability of products and services in urban areas have resulted in higher access to sanitation compared to rural areas, and most significantly a higher proportion of improved latrines. While sanitation has provided privacy to the urban population, the poor management of fecal sludge across the service chain in highly populated areas continues to poses a significant environmental and health risk. The enforcement of government pollution laws has been weak and has not provided the incentive for individuals, businesses, or state actors to address this challenge.

Wealth has a significant impact on service levels in urban areas, with most of those with access to improved latrines being in the top 60 percent (T60) of the wealth quintile of the urban population. Those with safely managed services remain solely in the richest quintile. Urban households in the bottom 40 percent (B40) have the highest rate of open defecation and lowest level of latrine access. In addition, there is a significantly higher percentage of shared facilities in urban areas, and a big driver of this relates to property ownership, with families living in rented accommodations much more likely to share latrines.

While Addis Ababa provides the single largest challenge in addressing urban sanitation, the shift in urban demographics shows smaller towns are growing at faster rates than the largest urban centers and now represent a significant proportion of the urban population. Many of these urban centers have recently graduated from rural woreda status. If tackled quickly there is an opportunity to get ahead of the curve, but this will require significant investment in developing the institutional capabilities in these towns.

As in rural areas, the private sector can reduce the burden on public systems and budgets. The current low sewerage coverage level, high cost and challenge of fitting sewers in fast expanding and unplanned cities means most transportation will be through vacuum trucks, which provides a great opportunity for the private sector to engage. However, there are opportunities across the sanitation service chain for the private sector to engage in. A critical part of the enabling environment in the urban sanitation sector will be clear and appropriate regulation to guide the parameters of engagement for new private entrant to the market (see box 7.4).

Box 7.4: Urban Sanitation Recommendations

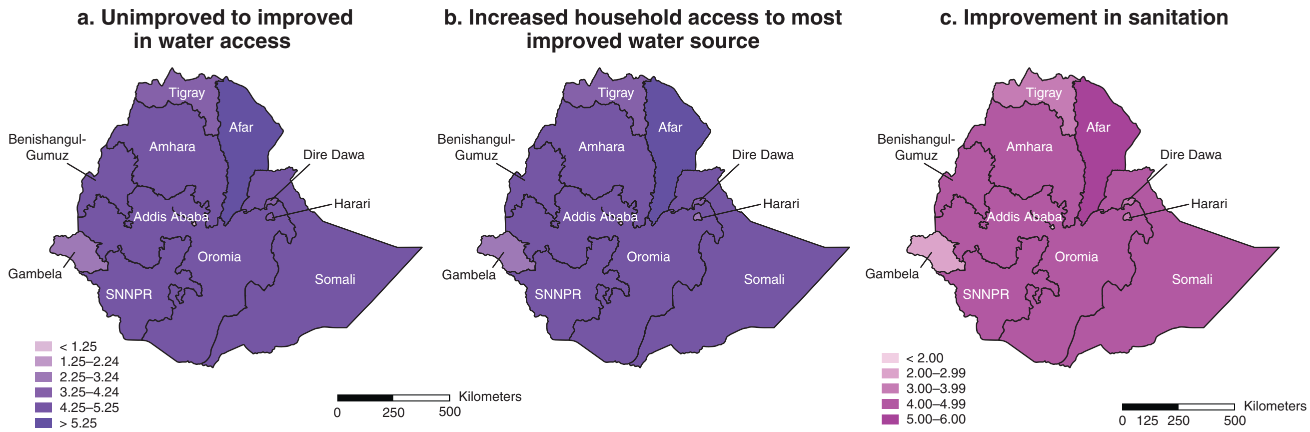
- Sanitation planning in urban areas should take a citywide approach to tackle the full service chain and ensure fecal sludge is safely captured, transported, and treated.
- Increased clarity and understanding of institutional roles and responsibilities to manage urban sanitation services and implement existing pollution regulations are needed. The swift and effective implementation of the Integrated Urban Sanitation Strategy is critical to achieve this.
- Public investment is needed in infrastructure to support fecal sludge management across the service chain, including in treatment plants and, where appropriate, in sewers.
- New financing strategies need to be developed to improve services for the growing urban poor, including targeted subsidies to improve household infrastructure, facilitate sewer connections, and encourage the use of fecal sludge transportation services.
- There needs to be alignment with new urban safety net initiative as a mechanism to both target the poorest household and stimulate new private sector initiatives.
- Public investment needs to be better linked to enabling investments in the urban housing sector and the private sector to bring innovation and efficiency across the service chain.
- Increased alignment with urban housing initiatives to tackle poor quality sanitation infrastructure in new and rented accommodation, including (a) a combination of incentive and regulation for landlords; (b) greater responsiveness of kebele administrations to support tenants to undertake home improvements; and (c) building regulation for new condominium housing to ensure sufficient standards of sanitation infrastructure and supporting services are provided.
- The government needs to develop and implement a clearer regulatory framework to incentivize private operators to enter the market.
- Invest in building institutional capacity to drive and deliver the GoE and SDG targets through citywide approaches and to facilitate services provision across the sanitation service chain.

The analysis in this report has shown that the health burden of inadequate access to WASH services is disproportionately borne by poorer children and those in vulnerable geographic areas. Children in poor households are up to 2.7 times more likely to be underweight and five times more likely to be severely underweight. The analysis suggests that overlapping vulnerabilities may substantially modify the impact of WASH investments. Children with poor WASH conditions also suffer from poor access to health and nutrition.

Children in poor households have higher exposure and susceptibility than children in rich households, with the B40 having approximately 50 percent of the cumulative share of the susceptibility and risk. Children in poorer households are also more vulnerable to the risks posed by poor WASH due to low nutrition and access to key health interventions (oral rehydration treatment [ORT] and vitamin A).

According to the sanitation and water improvement panels shown in map 7.1, children from Afar would experience the highest risk reduction in response to water or sanitation access improvements, but all regions would benefit from water or sanitation improvements. Children from Tigray and Gambella would also experience a reduction in risk, but less than the other regions, this is likely because children from these regions have lower risk index values.

Map 7.1: Effect of Water Supply and Sanitation Access Improvement on WASH Risk Reduction in Ethiopia, 2011



Source: DHS 2011.
Note: WASH = water supply, sanitation, and hygiene.

In Ethiopia, the national enteric burden associated with inadequate WASH is 11,135 disability-adjusted life years (DALYs) per 100,000 children per year, which is approximately 75 percent of the Global Burden of Disease (GBD) enteric burden estimated for the country. The WASH-related enteric burden is lower within urban than in rural populations, but the disparities in both are equivalent. The burden for the poorest communities is 1.8 times as high as the burden for the richest in rural communities, and 5.4 times higher for the poorest households than the richest in urban communities (see box 7.5).

Box 7.5: Targeting WASH Investment for Health Benefits

- As the health benefits of improvement in water supply and sanitation are not seen until coverage levels reach universality, more focus should be placed on ensuring communities are fully served with improved services and that behavior change is sustained across the whole communities.
- This analysis describes how WASH-related risk is distributed across wealth quintiles, between rural and urban populations, and by location. A simple next step would be to map existing World Bank programs in Ethiopia against these factors to assess to what extent investments are reaching the populations that stand to gain the most.
- Geographic targeting of WASH investments to areas with higher concentrations of children vulnerable due to poor nutrition and health access offers a simple compass for reaching the most vulnerable that might facilitate cross-sectoral planning, delivery, and monitoring.
- Regional distributions of exposure, susceptibility, and risk index values in the B40 population indicate that every region has highly vulnerable children. This emphasizes the importance of combining geographic and economic targeting of health investment.
- The government needs to implement pro-poor targeting in the sector coordinating with social protection programs that focus on households with young children who are economically vulnerable.

In summary, improving and expanding both basic and safely managed WASH services calls for continuing GoE's twin track development of its core country systems for decentralized service delivery and its sector policy direction that together have driven progress at scale over the past decade and more. On top of the challenges of delivering services under the MDG framework, GoE and its development partners now need to consider the additional rigor required in delivering on the SDGs. With the estimated SDG financing gap running into billions of dollars a year, much more than incremental improvements to past progress are needed. The reward for making this transition from MDGs to SDGs is the real prospect of delivering on the health and economic gains that have been elusive under the MDG framework.

The transition to the SDGs needs to be done with two supporting factors in mind: (a) a massive upgrading of skills in the public and private sector, and (b) a full integration of WASH service delivery into the broader water governance agenda. Transitioning to the SDGs will require a very significant upgrading of skills in the public sector and much greater use of the economywide capacity. In the public sector greater effort is needed to ensure institutions have the right mix of skills, including in many new areas (such as water quality and private sector engagement) required to tackle the challenges achieving the SDG targets pose. In parallel to evolving the skill sets within public institutions, strong systems need to be put in place to ensure the effective transfer and institutionalization of knowledge. The reskilling and knowledge retention need to be combined with an increased recognition that the private sector has complementary skills to support the significant expansion and improvement in services. By effectively harnessing the skill and resources of the private sector, the GoE has the ability to reduce pressure on human resources in the public sector, as well as shift the burden away from the government's fiscal budget.

To date, WASH service delivery in Ethiopia has largely operated in a silo, disconnected from wider concerns about water availability and competing demands from other users. As plans to deliver the SDGs are drawn up, the higher service levels associated with safely managed services will begin to compete with other fast growing demands for water. With the GoE simultaneously promoting household irrigation based on self-supply, and the increase in large-scale commercial irrigation for horticulture competition for water at local and basin scales, trade-offs are inevitable. Ethiopia's progression up the water service ladder, and its ability to sustain higher levels of service for rural and urban users, will depend increasingly on the ability of public institutions to manage water resources for a range of competing uses. The implication is that those working on WASH services will need to play a much more active role in wider planning and policy debates around water allocation and sustainability than they currently do. This will be a long-term process. Good water governance, including measures to protect the quality and quantity of water needed for drinking water services, will likely take decades to build.

Appendix A
Poverty Calculations

Different methods of wealth quintiles and consumption quintile analysis reveal different aspects of inequality in Ethiopia. Here we compare DHS and HICES methods.

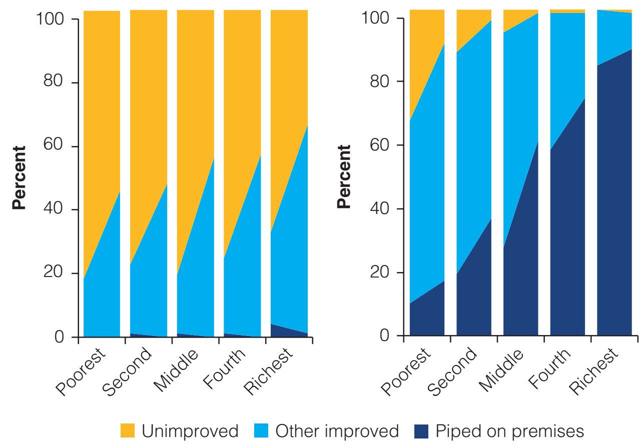
- Method 1: National population split into uneven urban and rural wealth quintiles
- Method 2: Rural and urban population split into even wealth quintiles
- Method 3: Rural and urban population split into even consumption quintiles

Figure A.1: Access to Water by Wealth Quintile Analysis in Ethiopia, 2000 and 2011

a. Method 1: JMP—estimated trends of drinking water coverage by wealth quintile

Ethiopia		Rural		Urban	
		1995	2012	1995	2012
Poorest	Piped on premises	0	0	10	17
	Other improved	18	45	56	73
	Unimproved	82	55	34	10
Second	Piped on premises	1	0	19	36
	Other improved	21	47	68	61
	Unimproved	78	53	13	3
Middle	Piped on premises	1	0	27	60
	Other improved	18	55	66	39
	Unimproved	81	45	7	1
Fourth	Piped on premises	1	0	57	73
	Other improved	23	56	42	26
	Unimproved	76	44	1	1
Richest	Piped on premises	4	1	83	88
	Other improved	28	64	17	11
	Unimproved	68	35	0	1

b. Drinking water trends by rural wealth quintile / **c. Drinking water trends by urban wealth quintile**

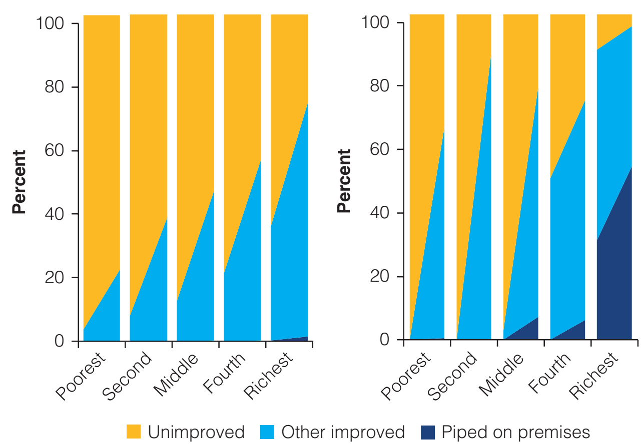


	Poorest	Second	Middle	Fourth	Richest	Poorest	Second	Middle	Fourth	Richest
1,000s of people per WQ (2011):	12,688	12,688	12,688	12,688	12,688	2,788	2,788	2,788	2,788	2,788

a. Method 2: HBS - estimated trends of drinking water coverage by wealth quintile (based on national quintiles)

Ethiopia		Rural		Urban	
		2000	2011	2000	2011
Poorest	Piped on premises	0	0	0	1
	Other improved	4	22	0	65
	Unimproved	96	78	100	35
Second	Piped on premises	0	0	0	0
	Other improved	8	38	0	88
	Unimproved	92	62	100	12
Middle	Piped on premises	0	0	0	7
	Other improved	12	46	3	71
	Unimproved	88	54	97	22
Fourth	Piped on premises	0	0	0	6
	Other improved	21	56	50	68
	Unimproved	79	44	50	26
Richest	Piped on premises	0	1	31	53
	Other improved	35	72	58	43
	Unimproved	65	27	11	3

b. Drinking water trends by rural wealth quintile / **c. Drinking water trends by urban wealth quintile**



	Poorest	Second	Middle	Fourth	Richest	Poorest	Second	Middle	Fourth	Richest
1,000s of people per WQ (2011):	15,162	15,352	15,289	14,337	3,235	321	139	153	1,115	12,211

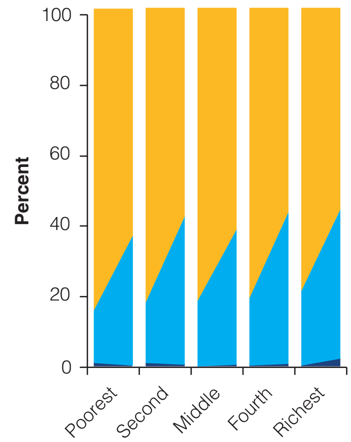
Sources: DHS 2000 and 2011.

Figure A.2: Access to Water by Consumption Quintile Analysis in Ethiopia, 2000 and 2011

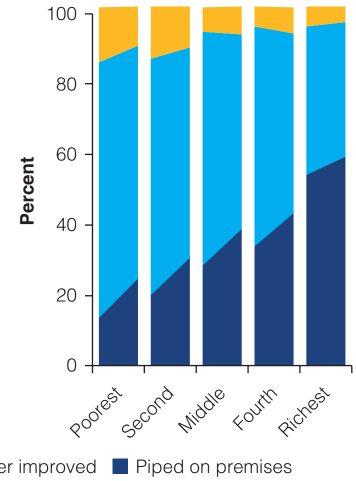
a. Method 3: JMP—estimated trends of drinking water coverage by wealth quintile (separate rural and urban quintiles)

Ethiopia		Rural		Urban	
		2000	2011	2000	2011
Poorest	Piped on premises	1	0	14	25
	Other improved	15	37	71	65
	Unimproved	84	63	15	11
Second	Piped on premises	1	1	20	31
	Other improved	18	42	65	58
	Unimproved	82	58	15	11
Middle	Piped on premises	0	1	28	38
	Other improved	19	38	65	54
	Unimproved	81	61	7	8
Fourth	Piped on premises	0	1	34	43
	Other improved	19	43	61	50
	Unimproved	81	57	6	7
Richest	Piped on premises	0	2	53	59
	Other improved	21	42	41	37
	Unimproved	79	56	6	4

b. Drinking water trends by rural consumption quintile



c. Drinking water trends by urban consumption quintile

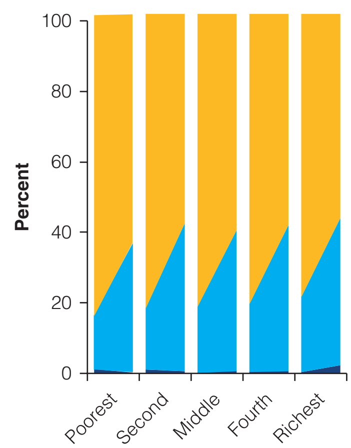


	Poorest	Second	Middle	Fourth	Richest	Poorest	Second	Middle	Fourth	Richest
1000s of people per WQ (2011):	14,179	13,753	13,414	12,132	8,114	552	981	1,311	2,617	6,587
2011 annual consumption Br per quintile	1,891	2,970	3,857	5,062	9,837	1,891	2,970	3,857	5,062	9,837

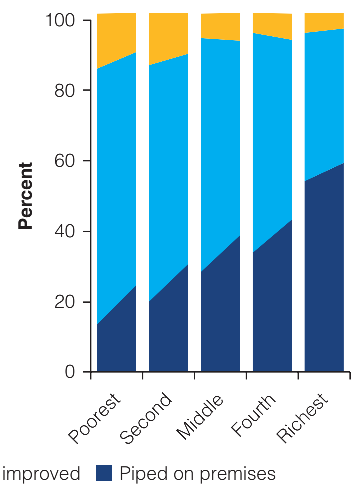
a. Method 2: HBS - estimated trends of drinking water coverage by wealth quintile (based on national quintiles)

Ethiopia		Rural		Urban	
		2000	2011	2000	2011
Poorest	Piped on premises	1	0	16	35
	Other improved	15	36	69	58
	Unimproved	84	63	15	7
Second	Piped on premises	1	0	27	42
	Other improved	18	42	65	51
	Unimproved	82	58	8	6
Middle	Piped on premises	0	1	35	50
	Other improved	19	39	59	44
	Unimproved	81	60	6	6
Fourth	Piped on premises	0	1	46	58
	Other improved	19	41	47	38
	Unimproved	81	58	7	4
Richest	Piped on premises	0	2	62	65
	Other improved	21	41	33	32
	Unimproved	79	56	5	4

b. Drinking water trends by rural consumption quintile



c. Drinking water trends by urban consumption quintile



	Poorest	Second	Middle	Fourth	Richest	Poorest	Second	Middle	Fourth	Richest
1000s of people per WQ (2011):	12,371	12,359	12,362	12,355	12,361	2,367	2,368	2,368	2,366	2,366
2011 annual consumption Br per quintile	1,796	2,806	3,588	4,545	7,374	3,125	4,883	6,516	8,934	18,493

Source: WMS and HICES. 2000 and 2011.

Appendix B
Linear Regression Model of Improved Water Supply in Rural Areas of Ethiopia

Coverage of improved water (protected and piped water supply) was significantly higher in woredas dominated by agrarian cropping livelihoods than it was in woredas dominated by pastoralist livelihoods. Possible determinants of access to improved water were examined using multivariate analysis. All regions where agropastoralist and pastoralist livelihoods are practiced (Somali, Afar, Oromia, and Southern Nations, Nationalities and People Region [SNNPR]) were correlated with significantly lower access to improved water. The one exception was Gambella region, which has agropastoralist woredas but did not have improved water coverage that was significantly lower than other regions.

The relative mean poverty headcount ratio of the woreda explains the largest share of the variation observed. However, independent of relative poverty, the woredas with cropping dominated livelihoods or those with easier hydrology or hydrogeology had significantly higher levels of access to improved water.

Across Ethiopia, woredas targeted by the Productive Safety Nets Program (PSNP) reported significantly higher levels of access to improved water than woredas not targeted by PSNP. However, further analysis revealed that these differences were only significant across agrarian cropping woredas but not across agropastoralist or pastoralist woredas. Average annual rainfall and population density of woredas, though returning significant results, had only very small effects on improved access to water supply.

Method and Data Sources

To examine the possible determinants of improved access to water in Ethiopia the WASH Poverty Diagnostic (WPD) merged woreda level estimates from the following sources:

- Housing and Population Census 2007: water supply and sanitation data
- HICES 2011: woreda-level poverty headcount estimates from the small area estimation work done under the Ethiopia Poverty Assessment
- Boost database: woreda-level spending data (capital and recurrent)
- Livelihoods Integration Unit: livelihood types and zones, rainfall, population density
- PSNP: woredas targeted by PSNP in 2010
- Hydrological Index (HI): index of the technological difficulty (or ease) of exploiting water based on the variation in hydrological and hydrogeological factors across Ethiopia based on British Geological Survey (BGS) data developed in 2016

Woreda-level estimates were used rather than using household data directly since a number of the variables (HI, population density, livelihoods, and rainfall) were available only at woreda level (they are not part of household survey data).

First, a t-test was done on mean improved water access between the two groups: (a) agrarian cropping areas (CR) and (b) agropastoralist and pastoralist areas (NCR) (figure B.1). Second, an ordinary least squares (OLS) regression model was then built to explain the variation in the

Figure B.1: Mean Improved Water Coverage Levels by Livelihood Type in Rural Areas in Ethiopia, 2007

```
. ttest improved_water , by( group)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      Cr |     556     .388741    .0072733    .1715017    .3744545    .4030276
     NCR |     107    .2418692    .0152254    .1574929    .2116833     .272055
---------+--------------------------------------------------------------------
combined |     663    .3650377    .0068988    .1776354    .3514916    .3785838
---------+--------------------------------------------------------------------
    diff |            .1468718     .017876                .1117713    .1819724
------------------------------------------------------------------------------
    diff = mean(Cr) - mean(NCR)                                   t =   8.2162
Ho: diff = 0                                     degrees of freedom =      661

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000

. ttest improved_water , by( group) unequal

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      Cr |     556     .388741    .0072733    .1715017    .3744545    .4030276
     NCR |     107    .2418692    .0152254    .1574929    .2116833     .272055
---------+--------------------------------------------------------------------
combined |     663    .3650377    .0068988    .1776354    .3514916    .3785838
---------+--------------------------------------------------------------------
    diff |            .1468718    .0168735                .1135457     .180198
------------------------------------------------------------------------------
    diff = mean(Cr) - mean(NCR)                                   t =   8.7043
Ho: diff = 0                     Satterthwaite's degrees of freedom =  158.325

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000

.
```

Source: World Bank data.
Note: Top of figure shows simple t-test results for with equal variance, and bottom of figure shows results without equal variance. Cr = cropping-dominant woredas; NCR= agropastoralist- and pastoralist-dominant woredas.

Figure B.2: Ordinary List Squared Regression Results for Possible Determinants of Improved Water in Rural Areas of Ethiopia

```
. reg imp_wat poverty pop_den rain  psnpdummy Livhod_dummy i.hydoindex_new i.region

      Source |       SS           df       MS      Number of obs   =       659
-------------+----------------------------------   F(14, 644)      =     23.70
       Model |  6.94928357        14  .496377398   Prob > F        =    0.0000
    Residual |  13.4855645       644  .020940317   R-squared       =    0.3401
-------------+----------------------------------   Adj R-squared   =    0.3257
       Total |   20.434848       658     .031056   Root MSE        =    .14471

-------------------------------------------------------------------------------
      imp_wat |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+----------------------------------------------------------------
      poverty |  -.1888641   .0444429    -4.25   0.000    -.2761346   -.1015936
      pop_den |   .0002722   .0000675     4.03   0.000     .0001396    .0004048
         rain |  -.0001088   .0000288    -3.77   0.000    -.0001655   -.0000522
    psnpdummy |   .0536959   .0147039     3.65   0.000     .0248226    .0825692
 Livhod_dummy |   .1039398   .0297297     3.50   0.001      .045561    .1623186
              |
hydoindex_new |
           2  |   .0720592   .0211346     3.41   0.001     .0305581    .1135604
           3  |   .0780186   .0258925     3.01   0.003     .0271747    .1288624
              |
       region |
           2  |  -.2044332    .046704    -4.38   0.000    -.2961437   -.1127227
           3  |  -.0984595   .0311878    -3.16   0.002    -.1597016   -.0372174
           4  |  -.1979022   .0301896    -6.56   0.000    -.2571841   -.1386202
           5  |  -.2155759   .0423232    -5.09   0.000     -.298684   -.1324678
           6  |  -.1427942   .0440178    -3.24   0.001    -.2292299   -.0563585
           7  |  -.1753249   .0323677    -5.42   0.000    -.2388839   -.1117659
          12  |  -.0172276   .0523254    -0.33   0.742    -.1199766    .0855214
              |
        _cons |   .4818979   .0497604     9.68   0.000     .3841858    .5796101
-------------------------------------------------------------------------------
```

Source: World Bank regression results using data from the 2007 census, GoE HICES 2011, and HCES 2011.

dependent variable of access to improved water (not improved=0; improved=1) observed across rural Ethiopia (figure B.2). The following independent variables were included:

- Poverty headcount (continuous variable as percentage)
- Population density (continuous variable as people per square kilometer)
- Rainfall (continuous variable long-term mean rainfall in millimeters per year from GoE *Ethiopian Livelihoods Atlas*)
- Agrarian compared to agropastoralist and pastoralist (binary variable dummy: pastoralist=0; agrarian=1)
- PSNP woreda (binary variable PSNP dummy: woredas not in PSNP=0; woredas in PSNP=1)

- Hydrological Index (three dummy variables: hard=0; medium=1; easy=2)
- Regions (categorical variable using improved water coverage by region: Tigray=1; Afar=2; Amhara=3; Oromiya=4; Somali=5; Benishangul-Gumuz=6; SNNPR=7; Gmabella=12)

Third, simple t-tests were done to check whether there was a significant difference in the mean access to improved water between woredas targeted by the PSNP and those not targeted. This was done separately for (a) woredas dominated by agropastoralist or pastoralist livelihoods and (b) woredas dominated by agrarian cropping livelihoods.

Results

The simple t-test to check whether there was a significant difference in the mean access to improved water between the cropping- and agropastoralist- and pastoralist-dominant woredas returned significant differences for both equal and unequal variance assumptions.

- The OLS regression model results explain just over one-third of the variation in woreda level estimates for access to improved water.
- Poverty headcount ratio at the woreda level has a strong effect on access to improved water. The higher the poverty headcount ratio the less likely households in the woreda are to have access to improved water supplies.
- Agrarian woredas are significantly more likely to have access to improved water than agropastoralist and pastoralist woredas—by about 10 percentage points.
- Woredas with medium or easy hydrology or hydrogeology are more likely to have improved water, but the difference between medium and easy hydrology or hydrogeology is small.
- Average annual rainfall and population density of woredas, though significant, has only very small effect on access to improved water.
- Access to improved water varies significantly across regions.

While across Ethiopia, woredas targeted by the PSNP have better access to improved water than non-PSNP woredas, separate simple t-tests reveal that these differences are significant only across woredas dominated by agrarian cropping livelihoods. Across woredas dominated by agropastoralist and pastoralist livelihoods the PSNP is *not* associated with higher access to improved water supply (figures B.3 and B.4).

Figure B.3: Mean Improved Water Coverage Levels in Agropastoralist and Pastoralist Areas with and without PSNP in Ethiopia, 2007

```
. ttest imp_wat , by(noncrp_psnp_dmmy)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      32    .2139916    .0261187    .1477495    .1607222     .267261
       1 |      75    .2540725    .0186517    .1615286    .2169082    .2912369
---------+--------------------------------------------------------------------
combined |     107    .2420857    .0152668    .1579207    .2118178    .2723536
---------+--------------------------------------------------------------------
    diff |           -.0400809    .0332739               -.1060569     .025895
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -1.2046
Ho: diff = 0                                     degrees of freedom =      105

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1155         Pr(|T| > |t|) = 0.2311          Pr(T > t) = 0.8845

. ttest imp_wat , by(noncrp_psnp_dmmy) unequal

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      32    .2139916    .0261187    .1477495    .1607222     .267261
       1 |      75    .2540725    .0186517    .1615286    .2169082    .2912369
---------+--------------------------------------------------------------------
combined |     107    .2420857    .0152668    .1579207    .2118178    .2723536
---------+--------------------------------------------------------------------
    diff |           -.0400809    .0320947               -.1042027    .0240408
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -1.2488
Ho: diff = 0                     Satterthwaite's degrees of freedom =  63.7357

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1081         Pr(|T| > |t|) = 0.2163          Pr(T > t) = 0.8919
```

Source: Census, 2007.
Note: Top of figure shows simple t-test results for with equal variance, and bottom of figure shows results without equal variance. Agropastoralist and pastoralist woredas: not targeted by PSNP=0; targeted by PSNP=1. PSNP = Productive Safety Nets Program.

Figure B.4: Mean Improved Water Coverage Levels in Agrarian Cropping Areas with and without PSNP in Ethiopia, 2007

```
. ttest imp_wat , by(crp__psnp_dmmy)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |     330    .3402772    .0084816    .1540762    .3235922    .3569622
       1 |     224    .4563948      .01124    .1682242    .4342446    .4785449
---------+--------------------------------------------------------------------
combined |     554    .3872273    .0072087    .1696722    .3730675     .401387
---------+--------------------------------------------------------------------
    diff |           -.1161176    .0138464               -.1433157   -.0889194
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -8.3861
Ho: diff = 0                                     degrees of freedom =      552

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

. ttest imp_wat , by(crp__psnp_dmmy) unequal

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |     330    .3402772    .0084816    .1540762    .3235922    .3569622
       1 |     224    .4563948      .01124    .1682242    .4342446    .4785449
---------+--------------------------------------------------------------------
combined |     554    .3872273    .0072087    .1696722    .3730675     .401387
---------+--------------------------------------------------------------------
    diff |           -.1161176     .014081               -.1437902    -.088445
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -8.2464
Ho: diff = 0                     Satterthwaite's degrees of freedom =  450.301

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Source: Census, 2007.
Note: Top of figure shows simple t-test results for with equal variance, and bottom of figure shows results without equal variance. Agrarian cropping woredas: not targeted by PSNP=0; targeted by PSNP=1. PSNP = Productive Safety Nets Program.

Appendix C
Hydrogeological Index

The Hydrogeological Index (HI) is based on scores for five factors affecting the ease of groundwater development for rural water supply, and draws on existing rainfall, geology, water quality, and topographic data. The variables include the following:

- **Depth to water.** Affects drilling costs, pumping costs, and technology options (e.g., hand pumps compared to motorized pumps).
- **Water quality.** Determines whether water is safe to drink. We considered two "natural" contaminants: salt (salinity) and fluoride.
- **Borehole yield.** The volume of water that can be abstracted from a borehole, which determines the number of people it can serve or the amount of water they can access. Since yield is a function of storage and permeability, yield also indicates resilience to climate variability and change.
- **Rainfall and recharge.** The amount of rainwater that could potentially be converted into groundwater recharge, based on some fairly conservative assumptions about conversion.
- **Other factors.** Include the presence of wetlands, steep slopes, and flood plains that might limit groundwater development potential.

Table C.1: Relationship between HI Index and Recommended Development Approach

HI	Hydrogeological characteristics	Required exploration and development approaches and technologies
0	Very deep (>250 m) strike depth (depth to aquifer not necessarily depth to static water level); or salinity, fluoride, or other water quality indicators fail to satisfy local WQ standards/WQ unacceptable for the communities; limited recharge may impose limit on groundwater availability; groundwater may not receive present-day recharge (fossil); aquifers with very low yield (unsuitable for any type of pump also included under this category). Geology: sedimentary basins or alluvio-lacustine sediments with brackish water or highly dissected mountainous areas with limited water storage.	• Drilling: deep drilling involving heavy-duty rigs in the cases of deep water strike depth; steel casing and usually 10 ft. wells required; drilling compressor capacity up to 36 bar needed. Highest drilling cost. • Study (deep aquifers): integrated and thorough hydrogeological survey, airborne geophysics, water quality survey, multiple test well drilling, geology, and stratigraphy survey. • Study (poor water quality): detailed integrated survey of shallow aquifers to identify targeted low salinity or low fluoride areas in otherwise poor water quality zones. • Capacity: beyond capacity of woredas and the regional government; may be beyond current national capacity. • Technologies: water treatment technologies such as defluoridation plants may be required to remove fluoride, or reverse osmosis to remove salinity. • Technologies: alternative water sourcing from surface waters (e.g., dams) or multicommunity RPS schemes through interworeda water transfer in cases of low yielding aquifers.

table continues next page

Table C.1: Continued

HI	Hydrogeological characteristics	Required exploration and development approaches and technologies
1	Low yielding deep aquifers Geology: sedimentary basins	• Drilling: heavy-duty drilling rigs with >20 bar compressors. Steel casing and 8 ft to 10 ft hole diameter required. • Study: Integrated survey including geology and stratigraphy, surface geophysics, RS, and test drilling. • Capacity: beyond capacity of woreda but within capacity of regional government with support from national federal enterprises. • Technologies: low yields and deeper water levels preclude use of hand pumps. Solar pumps could be used. Yield too low for motorized pumps. • Technologies: alternative water sources from surface waters (e.g., dams) or multicommunity RPS schemes through interworeda water transfer required; or installation of solar pumps in desperate communities. Hand-dug wells may produce sufficient water for RWS in some cases.
2	Woreda with moderate water strike depth (90–150 m), which can be accessed with light duty trailer rigs (with compressor capacity of 12–15 bar), but yield too low (0.1 to 0.5 lps) for installation of motorized pump, or too deep for hand pumps. Woreda with moderate aquifer yield (0.5 to 1.0 lps) but unfavorable depth (150–250 m) for light duty track (trailer rigs?) and unfavorable for compressor capacity mounted on trailer rigs (12–15 barr). Also unfavorable for hand pumps. Solar pumps may be appropriate. Geology: volcanic rocks (mainly tuffs, volcanic ash and ignimbrites)	• Drilling: light-duty trailer rigs with low capacity compressors (12–15 bar) in case of moderate water strike depth. Low yielding aquifers at that depth do not allow installation of hand pumps or motorized pumps. Solar pumps may be used in desperate situations. PVC casing may be used safely but steel casing should apply depending on the nature of geological formation or water temperature. • Drilling: heavy-duty drilling rigs with larger compressor capacity (20 bar or above); trailer rigs generally not applicable. Steel casing required. • Study: integrated survey: geology, geophysics, RS applications, topography with lower requirement for test drilling and aquifer scale mapping to identify locally productive zones. • Capacity: regional government may have capacity to conduct study in these woredas. • Technologies: hand pumps unsuitable in most cases; low yields do not allow motorized pumps; solar pumps may apply in cases of desperate water need. • Technologies: alternative water sources could include spring development for multicommunity RPS in which high discharge springs from fractures; drilling multiple boreholes with low capacity and installing solar pumps; interworeda water transfer through RPS.

table continues next page

Table C.1: Continued

HI	Hydrogeological characteristics	Required exploration and development approaches and technologies
3	Woredas underlain by shallow but low yielding aquifers (basement rocks in general). Aquifers may run dry in extended dry seasons; groundwater occurs in specific fractured zones or in overburden regolith; locally higher yields may be encountered but wildcat drilling could produce dry wells; heterogeneous nature of aquifer means water may not be encountered successfully in most cases regardless of the shallow depth of the aquifer. Geology: fractured basement rocks with thin regolith.	• Drilling: light-duty trailer rigs with compressor capacity of 12 bar can be used, PVC casing may be sufficient, 6-in drilling sufficient; drilling more than 120 m in such areas is a sunk cost since productive aquifers not expected deeper than this level; change drilling site in case of drilling difficulty but only consider if second site is high water probability. • Study: heterogeneous nature of aquifers requires integrated hydrogeology study including surface geophysics, remote sensing, topographic survey, and woreda-scale hydrogeological mapping. • Capacity: exists at regional level to conduct hydrogeological mapping; mapping may be required prior to drilling. • Technologies: hand pumps [Indian Mark II or Afridev].
4	A high yielding aquifer (>5 lps) but deep water strike depth may exceed capacity of hand pumps. High yield means motorized pumps can be used. Geology: multilayered volcanic and sediments.	• Drilling: light-duty rigs could be sufficient but local heavy-duty rigs may be required; steel casing required; 10-in drilling may be required depending on yield and pump installation; consider on-site solution in case of drilling difficulty. • Study: integrated study involving surface geophysics, remote sensing, regional–woreda scale hydrogeological mapping, water quality surveys, and pumping tests may be required. • Capacity: regional government capacity may be sufficient but in some cases support from national institutions is needed. • Technologies: aquifers suitable for RPS; high cost of drilling means multiple wells per woreda may be expensive so RPS from productive wells may be more appropriate.
6	Moderate yielding aquifer at shallow depth suitable for installation of hand pumps and deployment of truck mounted trailer rigs. High yielding aquifer with relatively deep water strike depth. Depth may not favor installation of hand pumps but higher yield favors motorized schemes for multicommunity initiatives. Geology: fractured volcanic rocks and fractured and weathered basement rocks	• Drilling: light-duty trailer rigs with up to 12-bar compressor capacity; PVC casing may be used in most cases, but steel casing may be needed at some sites. Consider on-site solution in case of drilling difficulty but selecting new site possible if shallow. • Study: topographic survey combined with surface geophysics at local level adjacent to the sites to be drilled may be sufficient; pumping test may be required in cases of high yielding aquifers considered for motorized pump installation. • Capacity: zonal level expertise may be sufficient. • Technology: hand pumps for shallower systems; motorized pumps for deeper aquifers.

table continues next page

Table C.1: Continued

HI	Hydrogeological characteristics	Required exploration and development approaches and technologies
8	High yielding aquifer at intermediate depth Geology: alluvial valleys; field with sediments	• Drilling: light duty trailer rigs, PVC or steel casing, motorized pumps, or hand pumps. Drill at alternative site in case of drilling difficulty. • Study: surface geophysics, topographic survey, and integrated hydrogeological survey (geological mapping, water point inventory, and water quality survey). • Capacity: zonal- or woreda-level expertise. • Technology: motorized pumps and appropriate for RPS.
9	High yielding shallow aquifer Geology: fractured volcanic rocks in high rainfall areas	• Drilling: light-duty trailer rigs, PVC casing; drill another nearby site in case of drilling difficulty. • Study: topographic survey or surface geophysics in case of complex topography. • Capacity: local woreda, zone. • Technology: hand pumps. • Technology: MUS for productive water use can be considered if motorized pumps installed; piped systems also suitable.
12	Very high yielding aquifer at shallow depth Geology: quaternary basalts in the highlands	• Drilling: light-duty trailer rigs, PVC casing. Drill at alternative site in case of drilling difficulty. • Study: topographic survey. • Capacity: woreda-level experts and drillers can locate sites. • Technology: hand pumps. • Technology: MUS for productive water use can be considered; piped system also possible.

Source: World Bank.
Note: HI = Hydrological Index; MUS = Multi-Use System; WQ = water quality.

Appendix D
Water Quality

The objective of undertaking this water quality survey was to generate new data to improve sector knowledge on the microbial and chemical water quality of water being used by households across Ethiopia. Data collection and analysis of water samples from both households and their sources will be a baseline to monitor the water supply, sanitation, and hygiene (WASH) component of Growth and Transformation Plan (GTP) II and the Sustainable Development Goals (SDGs).

The collection of the water quality data was linked to the third wave of the Ethiopia Socioeconomic Survey (ESS) carried out in 2015/16. ESS is an ongoing household panel survey, which means the same households are revisited over a period of several years. Each wave of data collection covers a 12-month period during which two visits are conducted to capture seasonal variations in productivity, particularly related to agriculture. Linking the water quality data collection to the ESS enabled analysis disaggregated by different socioeconomic groups, residence areas, and geographic locations. This appendix is a summary of the methods, results, and interpretation. Full details are reported in the ESS-WQT module (forthcoming).

Methods

Implemented by the Ethiopian Central Statistical Agency (CSA) in collaboration with the World Bank Living Standards Measurement Study–Integrated Surveys on Agriculture (LSMS-ISA),[1] ESS is aligned with the National Strategy for the Development of Statistics (NSDS) covering 2009/10 to 2013/14, and the data are made publicly available.

To ensure representation is at the same level as in ESS, the water quality testing component (ESS-WQT) was administered to all ESS households. The ESS consists of a probability-based sample of households representative of the population of all households in rural, small town, and (as of wave 2) urban areas of Ethiopia. The current sample size of roughly 5,200 households is also statistically representative at the region level for five regions (Addis Ababa; Amhara; Oromiya; Southern Nations, Nationalities and People Region [SNNPR]; and Tigray) plus a sixth "region" that comprises all the other regions.

In the ESS water quality testing (WQT) module, two samples were tested for *E. coli*: one at the point of collection, and one directly from a glass used for drinking. A total of 4,533 tests were conducted at points of collection, which resulted in 4,513 risk classifications (99.6 percent).

The survey was conducted over one data collection period, May–July 2016, and as such does not address seasonality. Experts note that water quality can have important seasonal variations and conducting water quality tests during only the dry season could introduce systematic bias (WHO/UNICEF 2013). Because ESS is an ongoing panel survey, future waves of water quality testing could provide greater insights on water quality components, across years and during different seasons, than would normally be possible in a household survey. This would be an important step toward developing a more complete measure of sustainability, which is sorely lacking at present.

The fieldwork was taken by 18 mobile teams, and each team comprised two testers, a data collector, and one supervisor and a four-wheel vehicle. The 25 statistical branch offices of the CSA participated in the survey undertaking, especially in deploying field staff members to their respective sites of assignment, and administering the financial and logistic aspect of the survey within the areas of their assignment. To accomplish the data collection operation, all the data collectors were supplied with the necessary survey equipment at the completion of the training. To assure data quality, experts from WHO, UNICEF, MAWIE, and the World Bank had frequent field visits. It took 93 days to complete the water quality survey.

A range of quality assurance and quality control measures were incorporated into the project at every stage including intensive training, enumerator exams, and field practice. The quality control measures included the following:

- **Blank tests.** Two blank tests were assigned for each EA, particularly for the first four weeks. The water sample for this test was assumed that they are free from any bacteria. The intention of performing this test was to check the performance of the field workers and reminding them to adhering the proper procedure. One blank test was assigned to a randomly selected household in the household listing that the field workers were provided. A second blank test questionnaire for EA-level was added to the Survey Solution template. If water tester 1 was assigned to the selected household for blank test, then water tester 2 was expected to complete the EA level blank test. For the eight weeks, the field workers did one blank test per EA at household level.

- **Proportion of filtered water.** The field workers were informed that the proportion of filtered water was expected to imply a given outcome of interest. For example, if water sample from the fetching point filtered less than 100 percent during the process, the possibility of high turbidity increases. This means, if the field workers enter a low level turbidity result for low proportion of filtered water, it indicates a possible wrong practice during the test.

- **Photo analysis.** This analysis refers to counting the colonies on the 1 milliliters and 100 milliliters water plates using photos, and analyzing consistency between the mentioned water plates. The field workers were requested to take pictures of each plate (1 milliliters and 100 milliliters) after the required incubation period for each bacteria test using the Survey Solution template. Every day, the number of colonies recorded in the data was rechecked by the field coordinators. This practice had been serving in two ways. First, it flagged the possibility of existing contamination during the test process, which could attribute to the inconsistency between the 1 milliliters and 100 milliliters water plates. Second, any discrepancy between the number of colonies in 1 milliliters and 100 milliliters, means that field workers made a mistake in recording results in the reverse order (the 100 milliliters for 1 milliliters and vice versa); consequently, the field workers communicated about the issues and requested to record correctly.

- **Test timing.** The bacterial test conducted within an hour after the sample was collected. This procedure was managed through a daily base communication between the team leader and water testers.

- **Control sample for chemical lab test.** This test was done in a central laboratory based in Addis Ababa. The institute, which conducted the chemical lab test, anonymously had been provided with control samples along the main source samples. The control samples have features of the standard measure for each chemical test. At the end of the lab test, the control sample results from the institute were checked against the original result.

- **Internal consistency checks.** Intensive internal consistency had been done on and after data collection. Based on the data edit specifications, syntaxes were written for checking data consistencies. If the enumerator recorded wrong values, it flags error messages. The supervisor reviewed whether the uploaded data were error free and qualified the stated points. If some errors were recorded on the uploaded data, the supervisor rejected the data to the respective enumerator by writing comments about the errors. If the data were error-free, consequently approved by the supervisor.

Testing approaches included microbiological, chemical, and physicochemical analysis. All household- and source-level samples were tested for *E. coli* and a subset (1 per EA) were also tested for enterococci at the household-level. For every water sample measured for *E. coli* or enterococci, two CompactDry growth plates (Nissui, Japan) were used. One was inoculated with 1 milliliter of test water, while the other was used with a portable membrane filter (Millipore Microfil®), which contained all of the bacteria filtered from a 100 milliliter sample. The microbiological tests were incubated at 35°C for at least 24 hours using portable MX45 electric incubators (Lynd, U.K.). After incubation, the number of visible colonies (or colony-forming units, CFU) were counted. The 100 milliliter test result should therefore be expected to be approximately 100 times as high as the 1 milliliter test result. When teams found more than 100 colonies on a growth plate the results were reported as ">100."

During analysis of microbiological data the results from the 1 milliliter sample and the 100 milliliter sample were combined to produce risk categories. In a minority of cases, test results from the two volumes were inconsistent and no risk category was assigned. For example, if the 1 milliliter test showed 10 colonies but the 100 milliliter test shows only five colonies.

In addition to the microbiological tests, assessments for chlorine residual and turbidity were conducted onsite using photometric methods and samples were collected for subsequent analysis in a central laboratory in Addis Ababa. Chlorine residual was measured using DPD tablets according to the manufacturer's instructions (Hach, USA). A 10 milliliter vial was first rinsed with water and then filled with 10 milliliter to which a tablet was added and then crushed. Intensity of the color change was used to assess the level of residual chlorine and the result (milligram per liter). The results are reported as either <0.2 milligrams per milliliter (low), 0.2–0.5 milligram per milliliter (moderate) or >0.5 milligram per milliliter (high). Turbidity was measured using a turbiditimeter (Lovibond, U.K.) with care taken to ensure that vials were cleaned thoroughly and free of marks such as fingerprints. Results were classified as <0.5 NTU (low), 0.5–1 NTU (moderate), >1 NTU (high). Chlorine residual and turbidity photometers were calibrated in advance of the fieldwork.

For the laboratory testing, water samples were collected from each unique water source in a given cluster and a barcode was used to keep track of these samples. No household-level samples were collected as it was not anticipated that the values would change substantially from the source. These samples were stored in regional offices and then transferred to the central laboratory (Waterworks Enterprise, Addis Ababa) and all analyses were completed within six months of the fieldwork. Parameters tested in the laboratory were fluoride, hardness, electrical conductivity, and iron. Fluoride concentrations were assessed using the SPADNS method. Levels of fluoride exceeding the national standard and WHO guideline value of 1.5 milligram per liter were recorded as "high." Given the importance of fluoride from a public health perspective, in addition to the water quality samples additional "blinded" tests were sent to the central laboratory to complement the internal quality control procedures.

Results

The most common source for collecting low-risk water was piped on premises (47.2 percent), while most of the very high risk water was collected from unimproved sources (63.3 percent) especially unprotected springs (34.5 percent) and surface water (22.5 percent).

Table D.1 shows that 14 percent of the population collected water from low-risk supplies (with no detectable *E. coli*), while 36.6 percent collected water from very high-risk supplies. Water collected from improved sources was of better quality (20.2 percent low risk) than water collected from unimproved sources (2.2 percent low risk). Water quality was better in large towns (46.4 percent low risk) and worst in rural areas (8.4 percent low risk). Water quality was best in Addis Ababa region (84.8 percent low risk), and worst in Southern Nations, Nationalities and People Region (SNNPR) (7.1 percent low risk).

Water quality was the highest in bottled water (53.4 percent low risk), but less than 1 percent of the population used this source of drinking water. Piped water on premises, used by 15 percent

Table D.1: *E. Coli* Risk Levels at Point of Collection by Water Supply Type, Location, and Region in Ethiopia, 2017

	Low risk: *E. coli* < 1 cfu/ 100 mL	Moderate risk: *E. coli* 1–10 cfu/ 100 mL	High risk: *E. coli* 11–100 cfu/ 100 mL	Very high risk: *E. coli* >100 cfu/ 100 mL	*E. coli* at source (CFU/ 100 mL)	Population (millions)	Count
Total	**14**	**23.2**	**26.2**	**36.6**	**100**	**90.2**	**4,402**
Source of drinking water sample							
Piped on premises	41.5	33.6	16.3	8.6	100	13.7	1,004
Piped water public tap/ standpipe	22.6	40.3	28.1	9.1	100	11.4	475
Tube well/borehole	14.9	33.2	20.8	31.1	100	12.6	554
Protected dug well	3.1	16.8	48.1	32	100	4.1	230
Unprotected dug well	0.6	4.8	18.9	75.7	100	2.8	217
Protected spring	7.5	26.2	42.1	24.3	100	13.4	477
Unprotected spring	2.5	7.1	28.7	61.6	100	18.2	641
Rainwater collection	1	13.6	33.3	52.1	100	0.8	36
Piped water kiosk/retailer	27	29.8	19.9	23.4	100	1.6	115
Bottled water	53.4	23.6	17.7	5.3	100	0.4	40
Cart with small tank/drum	3.5	69.4	6.2	20.9	100	1.2	46
Surface water	0.2	0.7	14	85	100	9	481
Other	18.3	34	15.6	32.1	100	1	86
Type of drinking water source							
Unimproved	2.2	5.9	23.2	68.7	100	31	1,425
Improved	20.2	32.2	27.7	19.9	100	59.2	2,977
Location type							
Rural	8.4	22.2	27.8	41.6	100	72.7	3,019
Urban (small town)	14.1	28.7	29.6	27.7	100	4.8	345
Urban (large town)	46.4	26.8	15.4	11.4	100	12.6	1,038
Urban (all)	37.4	27.3	19.3	15.9	100	17.5	1,383
Region							
Addis Ababa	84.8	12.8	1	1.3	100	3.3	195
Amhara	10.9	17.5	26.6	45	100	21.7	905
Oromia	11.4	24.9	26.5	37.2	100	34.9	844
SNNPR	7.2	30.6	30.1	32.1	100	19.3	1,025
Tigray	23.8	19.4	25.7	31.2	100	5.4	542
All other	14.7	18.7	24.2	42.4	100	5.6	891

Source: ESS-WQT 2016.
Note: SNNPR = Southern Nations, Nationalities and People Region.

of the population (table D.1), had relatively good water quality, with 42.4 percent low risk, and 9.8 percent very high risk. Water collected from kiosks or retailers was often of good quality (33.1 percent low risk). Very high-risk water was most commonly collected from unimproved sources (69.4 percent), especially surface water (85.8 percent) and unprotected dug wells (72.6 percent).

It is well known that microbiological contamination tends to increase when water is stored in the household after collection. In some cases, particularly when the quality is poor at the collection point, or when water is treated at the household level, there can be a decrease in fecal indicator bacteria between the source and household. Figure D.1 compares the *E. coli* risk levels at the collection point to the risk levels at the household level (in a glass of water provided for drinking). The cells on the diagonal, shaded yellow, represent households in which the risk class was the same at both testing points. This was the case for 50.1 percent of the population. In a few cases (10.4 percent, shaded green or dark green) *E. coli* levels decreased between collection and the household, but it was more common that *E. coli* levels would increase moderately (26 percent) or substantially (13.5 percent).

Unimproved sources, which are more contaminated, were more likely to see a decrease in risk after collection than improved sources. This is especially true of surface water, which was the most highly contaminated source. Households that reported treating water at the household level were more likely to see a decrease in *E. coli* levels (18.1 percent) than households that did not report treatment (9.5 percent). However, only 5 percent of the population reported water treatment. Highlights of the chemical and physicochemical analysis include the following:

- Fluoride in drinking water at the point of collection: 3.8 percent of samples were above the Ethiopian national standard for fluoride in drinking water (1.5 milligram per liter), which is also the WHO Guideline Value.

- Iron in drinking water at the point of collection: 53.8 percent of samples were above the Ethiopian national standard for iron in drinking water (0.3 milligram per liter). Of these 5.6 percent of samples were above 1 milligram per liter. There is no health-based WHO Guideline Value for iron in drinking water.

- Hardness in drinking water at the point of collection: 11.2 percent of samples were above the Ethiopian national standard for hardness in drinking water (300 milligram per liter) (as $CaCO_3$). There is no health-based WHO Guideline Value for hardness in drinking water.

Electrical conductivity in drinking water at the point of collection: 6.4 percent of samples were above 800 micro-Siemens per centimeter. There is no Ethiopian national standard for electroconductivity in drinking water, nor is there a WHO Guideline Value for this parameter.

Figure D.1: *E. Coli* Risk Levels at Collection Point and Household Level in Ethiopia, 2017

E. coli in the glass	*E. coli* at collection point: <1	1_10	11_100	>100	Total
<1	3.7	0.8	0.5	0.2	5.3
1_10	3.2	4.1	1.7	0.9	9.9
11_100	5.2	12.3	13.3	6.2	37
>100	1.7	6.5	10.5	29	47.8
Total	13.9	23.8	25.9	36.4	100

1.7	Large decrease
8.7	Slight decrease
50.1	No change
26	Slight increase
13.5	Large increase

Availability and Sufficiency of Water

Availability is an important criterion for assessing drinking water service levels.[2] In the Ethiopia Socioeconomic Survey–Water Quality Testing Component (ESS-WQT 2016) water quality module, two questions were asked about availability and sufficiency of water:

1. In the past two weeks, was the water from this source not available for at least one full day?
2. Has there been any time in the last month when you did not have water in sufficient quantities?

If the answer to the second question was yes, the respondent was asked the main reason that he/she did not have water in sufficient quantities.

Table D.2: Availability and Sufficiency of Water, by Technology and Location, 2016

	Available	Sum	Count	Sufficient	Sum	Count
Total	**77.5**	**1406620281**	**4407**	**75.4**	**1371148145**	**4413**
Source of drinking water sample						
Piped on premises	38	120728554	1004	48.1	153033817	1005
Piped water public tap/standpipe	66.1	145219167	477	71	156335517	479
Tube well/borehole	92.8	240259843	554	85	220152732	554
Protected dug well	93.4	69520699	230	83.2	61929773	230
Unprotected dug well	88.2	46454028	218	78.7	41747905	219
Protected spring	95.8	247322852	474	94.6	244565055	475
Unprotected spring	93.4	332661389	645	88	313337470	645
Rainwater collection	59.3	9637861	37	50.6	8237452	37
Piped water kiosk/retailer	25.3	9700015	113	35.9	13793835	114
Bottled water	76.9	8500189	40	68.2	7537796	40
Cart with small tank/drum	17.5	3887253	46	7.1	1571749	46
Surface water	94.5	161543236	484	82.3	140780241	484
Other	57.6	11221447	86	41.9	8161055	86
Improved water source						
Unimproved	92.2	551588773	1430	84.2	503735344	1431
Improved	70.2	855067761	2978	71.2	867449054	2983
Location type						
Rural	87.7	1211338396	3023	83.4	1152437165	3026
Small town (urban)	58.2	61544290	345	52.6	55604246	345
Large town (urban)	40.4	131608576	1038	49.2	160977715	1041
Region						
Addis Ababa	34.3	25861173	195	55.1	41519866	195
Amhara	81.4	408487400	911	74.1	371750586	911
Oromia	77.1	504529347	836	77.1	505253405	839
SNNPR	82.8	296386519	1024	80.3	288101852	1026
Tigray	76.9	89904630	545	73.1	85417072	545
All other	74.6	81451211	896	72.2	79105363	897

Source: ESS-WQT 2016.
Note: SNNPR = Southern Nations, Nationalities, and People Region.

Safely Managed Water

The four subindicators of improved, on premises, available (sufficient), and low *E. coli* risk can be combined to create the safely managed drinking water services indicator. This combination can be done at different scales (e.g., national, urban, or rural). If the four subindicators are combined at the household level, only 3.4 percent of households are considered to be accessing safely managed drinking water services.

Table D.3: Safely Managed Drinking Water Services in Ethiopia, 2016

	Improved	On premises and improved	Sufficient and improved	Quality and improved	Safely managed (household)	Safely managed (domain)
Total	**66**	**18.2**	**46.9**	13.2	**3.4**	**13.2**
Source of drinking water sample						
Piped on premises	100	100	42.3	41.5	21.4	41.5
Piped water public tap/ standpipe	100	0	73.5	22.6	0	0
Tube well/borehole	100	1.3	84.7	14.9	0	1.3
Protected dug well	100	9.3	84.7	3.1	0	3.1
Protected spring	100	0	94.9	7.5	0	0
Rainwater collection	100	88.3	65.5	1	0	1
Piped water kiosk/retailer	100	0	34	27	0	0
Bottled water	100	100	76.2	53.4	44	53.4
Cart with small tank/drum	100	0	7.7	3.5	0	0
Location type						
Rural	58.8	4.7	48.2	7.4	0.1	4.7
Urban (small town)	89.3	49.2	44.9	14	5.3	14
Urban (large town)	95.5	77.6	41	46.4	21.7	41
Urban (all)	93.8	69.8	42.1	37.4	17.1	37.4
Region						
Addis Ababa	99.7	93.7	51.3	84.8	45.6	51.3
Amhara	61.4	14.7	45.4	10.6	2	10.6
Oromia	66.1	14.8	45.9	10.4	0.9	10.4
SNNPR	66.4	14.1	50.3	6.7	1.6	6.7
Tigray	71.9	22.8	53.7	23.8	7.1	22.8
All other	56.1	16.5	38.9	11.2	2.7	11.2
Consumption quintiles						
Poorest	56.1	3.8	44.7	7.5	0.3	3.8
Poor	67.9	7.6	52.2	8.1	0.8	7.6
Middle	66.8	13.5	50.4	9.6	1.3	9.6
Rich	64.1	21.4	42.3	13.9	3.6	13.9
Richest	80.7	48.2	47.1	31.9	12.7	31.9

Source: ESS-WQT 2016.
Note: SNNPR = Southern Nations, Nationalities and People Region.

However, because these subindicators in some cases will come from different data sources, and therefore cannot always be combined at the household level, **the JMP will estimate the safely managed indicator by combining subindicators at the scale of the domain for which estimates are being made**. In this case, the safely managed indicator will be taken to be the lowest of the four subindicator elements at that scale. For example, at the national scale in Ethiopia, *E. coli* risk is the subindicator with the lowest value (13.2 percent), so this would be taken as the estimate of safely managed drinking water services in Ethiopia from the ESS-WQT survey.

Table D.3 shows the four subindicators, highlighting in red the subindicator that is the lowest among the four, and therefore determines the overall indicator of safely managed drinking water services. In most cases the quality subindicator is the limiting factor, but in rural areas and for some technologies on premises is the limiting factor. In large towns and in the Addis Ababa region, the availability subindicator is the lowest and drives the safely managed indicator.

Notes

1. The LSMS-ISA is a regional project funded by the Gates Foundation that supports seven countries in Sub-Saharan Africa to collect multitopic panel household level data with a special focus on improving agriculture statistics and the link between agriculture and other sectors in the economy. It aims to build capacity, share knowledge across countries, and improve survey methodologies and technology. The project in Ethiopia is implemented by the Central Statistical Agency.
2. The human right to water specifies that water should be "available continuously and in a sufficient quantity to meet the requirements of drinking and personal hygiene, as well as of further personal and domestic uses, such as cooking and food preparation, dish and laundry washing and cleaning. Supply needs to be continuous enough to allow for the collection of sufficient amounts to satisfy all needs, without compromising the quality of water."

Reference

WHO/UNICEF. 2013. *Second Meeting of the WHO/UNICEF JMP Task Force on Monitoring Drinking-water Quality*. Geneva: WHO. http://www.wssinfo.org/fileadmin/user_upload/resources/2013-Water-Quality-Task-Force-Report-Final.pdf.

Appendix E
Logit Regression Model for Improved Water on Premises in Urban Areas of Ethiopia

Piped water on premises is associated with economic benefits, especially time saved in collecting water from stand posts. However, access to piped water on premises is skewed toward wealthier consumption quintiles. Multivariate regression confirms this inequitable capture of piped water on premises by higher income households and examined other variables that may be correlated with this improved access.

The regression results show that independent of household income levels, piped water on premises is siginificantly correlated with education level and the size of town. However, improved access is not correlated with gender of head of household or the tenure status of households.

Households in Addis were three times more likely to have access to piped water on premises than medium or large towns. In turn, households in medium and large towns, other than Addis, were over twice as likely to have access to piped water on premises than small towns. This points to the need to channel more capital investment to smaller towns to help them catch up with larger towns. In addition, given that piped water supply on premises is principally provided by utilities and that these utilities benefit from both capital and recurrent subsidies, greater effort needs to be made to hook up poorer households regardless of town size.

Method and Data Sources

To examine the possible determinants of improved water supply on premises in urban areas of Ethiopia a logit regression model was estimated using data from the Ethiopia Socioeconomic Survey (ESS) 2015–16, a nationally representative survey of just under 5,000 households. The dependent variable was household access to piped water on premises (HH without=0; HH without=1).

Piped water supply on premises includes piped water into the dwelling or in the yard or plot that the dwelling is in. It does not include any nonpiped water sources such as boreholes, wells, or springs. The regression includes the following independent variables:

- Urban consumption quintiles (dummy variables for each quintile based on consumption quintiles built for urban areas)
- Town strata (dummy variables for: small towns[1] =0; medium and large size towns other than Addis Ababa=1; Addis Ababa=2)
- Level of education (dummy variable: not completed primary=0; completed primary=1; secondary=2; tertiary=3)

- Gender of household head (dummy variable: female=0; male=1)
- Tenure status of household (dummy variable: rents house=0; owns house=1)
- Household size (continuous variable)

Results

Improved piped water on premesis was significatly correlated with (a) urban consumption quintiles; (b) education level; (c) town stratum; and (d) household size.

Relative to the lowest urban consumption quintile the highest consumption quintile was five times more likely to have access to piped water on premesis (see figure E.1). The likelihood of accessing piped water on premises improves with increasing town size. Households in Addis were six times as likely to have access to piped water on premises than small towns. Households in medium and large towns, other than Addis, were over twice as likely to have access to piped water on premises than small towns.

Access to improved water on premises is correlated with level of education. Though completion of primary education was not significantly correlated with improved access, the odds ratio was

Figure E.1: Odds Ratio Results for Improved Water on Premises in Ethiopia, 2017

```
. xi: logistic water_premis i.con_quturb i.towndummy  i.educ i.sexhead hh_size i.hhownwer[pw=factor_pop] ,c
> luster(psu)
i.con_quturb      _Icon_qutur_1-5     (naturally coded; _Icon_qutur_1 omitted)
i.towndummy       _Itowndummy_0-2     (naturally coded; _Itowndummy_0 omitted)
i.educ            _Ieduc_0-3          (naturally coded; _Ieduc_0 omitted)
i.sexhead         _Isexhead_0-1       (naturally coded; _Isexhead_0 omitted)
i.hhownwer        _Ihhownwer_0-1      (naturally coded; _Ihhownwer_0 omitted)

Logistic regression                              Number of obs     =      1,623
                                                 Wald chi2(12)     =     125.69
                                                 Prob > chi2       =     0.0000
Log pseudolikelihood =  -10686245                Pseudo R2         =     0.1802

                                  (Std. Err. adjusted for 143 clusters in psu)
```

water_premis	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
_Icon_qutur_2	2.807555	.7263403	3.99	0.000	1.690887	4.661674
_Icon_qutur_3	3.250561	1.06162	3.61	0.000	1.713797	6.165342
_Icon_qutur_4	4.513481	1.642123	4.14	0.000	2.212189	9.208758
_Icon_qutur_5	5.034557	1.925202	4.23	0.000	2.37938	10.65267
_Itowndummy_1	2.234137	.6698225	2.68	0.007	1.241392	4.020784
_Itowndummy_2	6.925044	2.279119	5.88	0.000	3.633134	13.19969
_Ieduc_1	1.193993	.2575607	0.82	0.411	.7823223	1.82229
_Ieduc_2	2.569214	.6336868	3.83	0.000	1.584363	4.166256
_Ieduc_3	2.952135	.8265819	3.87	0.000	1.705314	5.110555
_Isexhead_1	.884194	.1701049	-0.64	0.522	.6064428	1.289155
hh_size	1.192363	.0715682	2.93	0.003	1.060029	1.341218
_Ihhownwer_1	1.016193	.2227904	0.07	0.942	.6612387	1.561686
_cons	.0933795	.0387694	-5.71	0.000	.0413855	.2106951

Source: World Bank.

above one. Households in which a member had completed secondary or tertiary education were two to three times more likely to have access to piped water on premises, as compared to the reference group of households in which no member had completed primary school. Neither the gender of head of household nor the tenure status of the household were associated with improved access to piped water on premises. Increasing household size was correlated with increased access to piped water on premises. Further analysis is requred to understand this relationship.

Note

1. CSA defines small towns based on population estimates from the 2007 Population Census; a town with the population of less than 10,000 is a small town (Ethiopia Socioeconomic Survey Wave Three (2015/2016) Basic Information Document, 13).

Appendix F
Logit Regression Model for Shared Sanitation in Urban Areas of Ethiopia

This regression analysis examines variables that may be correlated with increasing or decreasing the likelihood that households share toilet facilities. The results indicate that households were more likely to share toilet facilities in larger towns than in small towns. Households were significantly less likely to share toilet facilities where they owned rather than rented the house they lived in.

Households in the highest urban consumption quintile were less likely than other households to share toilet facilities. However, for other consumption quintiles there was not a significant correlation with shared use of toilet facilities. The variables for education level, gender of household head, and even use of an improved toilet facility were not significantly correlated with shared use of toilet facilities. As towns get larger, households tend to increase the sharing of toilet facilities. The results of this regression suggest that it would be worth investing further the relations between tenure status of household and the sharing of toilet facilities.

Method and Data Sources

To examine the possible determinants of shared use of toilet facilities in urban areas of Ethiopia a logit regression model was estimated using data from the Ethiopia Socioeconomic Survey (ESS) 2015–2016, a nationally representative survey of just under 5,000 households. The dependent variable was household sharing of toilet facilities (toilet facility not shared=0; shared=1).

Households that reported resorting to open defecation were omitted from the observations since they had no shared facility. All other households were included whether they had a basic unimproved or an improved facility. The regression model included the following independent variables:

- Urban consumption quintiles (dummy variables for each quintile based on consumption quintiles built for urban areas)
- Town strata (dummy variables for: small towns=0; medium size towns=1; Addis Ababa=2)
- Level of education (dummy variable: not completed primary=0; completed primary=1; secondary=2; tertiary=3)
- Gender of household head (dummy variable: male=0; female=1)
- Household size (continuous variable)
- Type of toilet facility used (dummy variable: not improved=0; improved=1)
- Tenure status of household (dummy variable: rents house=0; owns house=1)

Results

The only variables that had a significant corelation with shared use of toilet facilities were (a) town stratum; (b) tenure status of household; (c) the highest consumption quintile; and (d) household size. Households living in regional capitals and Addis were almost three times more likely to share toilet facilities than households in smaller towns. People who owned the house they lived in were almost three times less likely to share toilet facilities with other households than people who rent the house they live.

Households in the highest urban consumption quintile were less likely to share toilet facilities with other households, though for lower consumption quintiles no significant correlation was found. Households with greater numbers of household members were also less likely to share toilet facilities with other households. The squared function of household size was examined in a separate model but was not found to be significant. This last result requires further investigation to understand the relation between household size and sharing of toilet facilities.

Figure F.1: Odds Ratio Results for Sharing of Toilet Facilities in Ethiopia

```
. xi: logistic sharelatr  i.con_quturb i.towndummy  i.educ i.sexhead hh_size  i.hhownwer i.imp_lat[pw=facto
> r_pop], cluster(psu)
i.con_quturb      _Icon_qutur_1-5     (naturally coded; _Icon_qutur_1 omitted)
i.towndummy       _Itowndummy_0-2     (naturally coded; _Itowndummy_0 omitted)
i.educ            _Ieduc_0-3          (naturally coded; _Ieduc_0 omitted)
i.sexhead         _Isexhead_0-1       (naturally coded; _Isexhead_0 omitted)
i.hhownwer        _Ihhownwer_0-1      (naturally coded; _Ihhownwer_0 omitted)
i.imp_lat         _Iimp_lat_0-1       (naturally coded; _Iimp_lat_0 omitted)

Logistic regression                              Number of obs     =      1,509
                                                 Wald chi2(13)     =     122.59
                                                 Prob > chi2       =     0.0000
Log pseudolikelihood =  -11132626                Pseudo R2         =     0.1350

                                  (Std. Err. adjusted for 142 clusters in psu)
```

sharelatr	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
_Icon_qutur_2	1.05111	.27208	0.19	0.847	.6328704	1.74575
_Icon_qutur_3	.9732969	.2616244	-0.10	0.920	.5746989	1.648353
_Icon_qutur_4	.9751355	.275745	-0.09	0.929	.5602288	1.697323
_Icon_qutur_5	.5868164	.1629297	-1.92	0.055	.3405383	1.011203
_Itowndummy_1	2.797032	.7642045	3.76	0.000	1.637315	4.77818
_Itowndummy_2	2.742771	.9078314	3.05	0.002	1.433672	5.24722
_Ieduc_1	1.156627	.2494829	0.67	0.500	.7578622	1.76521
_Ieduc_2	1.240276	.2542981	1.05	0.294	.829838	1.853715
_Ieduc_3	1.34664	.3641433	1.10	0.271	.7926453	2.287831
_Isexhead_1	.8724282	.1484826	-0.80	0.423	.6249709	1.217866
hh_size	.7830279	.0409694	-4.67	0.000	.7067094	.8675882
_Ihhownwer_1	.3871289	.0639282	-5.75	0.000	.2800872	.5350791
_Iimp_lat_1	.9463606	.205139	-0.25	0.799	.6187923	1.447333
_cons	2.679607	1.079112	2.45	0.014	1.216975	5.900119

Source: World Bank data.

Appendix G
Supply- and Demand-Side Barriers Households Face in Hooking Up to Utilities

Household survey samples are based on geographic clusters that at least for urban areas are physically small, amounting to no more than a few city blocks. It is therefore possible at least in urban areas to study the extent to which people lacking access to infrastructure live in clusters where infrastructure is available (indicated by the fact that some immediate neighbors are hooked up to the service). The resulting analysis gives us a sense of the degree to which low access to services is driven by supply-side issues (infrastructure networks not reaching the areas where people live) or by demand-side issues (people not connecting to available infrastructure networks).

The basic concepts used to analyze this issue are defined in box G.1. The main novelty is that we decompose the traditional measure of household coverage into two components (as per Foster and Araujo 2004; Komives et al. 2006). The first, which we call access, gives the percentage of the population that lives in a cluster where at least one household has service coverage, indicating that the infrastructure is physically proximate and that there could be an opportunity to connect. The second, which we call hook up, gives the percentage of the population living in clusters where the service is available that actually make a connection, and hence take up that opportunity. Using these two concepts it is possible to estimate the percentage of the unserved population that constitutes a supply-side deficit (meaning that they are too far from the network to make a connection until further rollout takes place) compared to a demand-side deficit (meaning that something other than distance from the network is preventing them from taking up the service).

The policy conclusions in each case are very different, and hence the interest in making this distinction. The solution to a supply-side deficit is to make further investments to rollout the geographic reach of infrastructure networks. The solution to a demand-side deficit is to make policy changes that help to address potential barriers to service take-up, such as high connection charges or illegal tenure.

For various reasons, it could be questioned whether absolutely everyone in a geographic cluster with some coverage really has the opportunity to connect. First, although the geographic clusters are relatively small in urban areas, the distances may still be such as to prohibit connection. Second, even though the infrastructure is present, it may not have the carrying capacity required to service all residents in a particular geographic cluster without further investment and upgrade. Third, even if a household is physically close to a network with adequate carrying capacity, the household may choose not to connect simply because there is an acceptable alternative (such as a borehole) rather than due to any demand-side barriers with the service.

Box G.1: Coverage, Access, and Hook-Up Rates: Relationships and Definitions

Coverage rate = number of households using the service / total number of households
Access rate = number of households living in communities or clusters where service is available / total number of households
Hook-up rate = number of households using the service / number of households living in communities where service is available

Coverage = access rate × hook-up rate

Unserved population = 100 – coverage rate

Pure demand-side gap = access rate – coverage rate

Supply-side gap = unserved population – pure demand-side gap

Pure supply-side gap = supply side gap × hook-up rate

Mixed demand and supply side gap = supply side gap × (100 – hook-up rate)
Proportion of deficit attributable to demand-side factors only = pure demand side gap / unserved population
Proportion of deficit attributable to supply-side factors only = pure supply side gap / unserved population
Proportion of deficit attributable to both demand and supply side factors only = mixed demand- and supply-side gap / unserved population

Wodon et al. (2009) use a statistical approach to try and correct for these problems. They simulate the maximum connection rate obtainable in any primary sampling unit (PSU) based on that of the richest households in that PSU. If less than 100 percent of the richest households are connected, it suggests that something other than demand-side barriers is at work. Results for the demand-side deficit are presented both with and without this statistical adjustment. The methodology is less applicable to rural areas because the PSUs tend to be larger in size and population densities much lower.

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Appendix H
One WASH National Program: Institutional and Implementation Arrangements

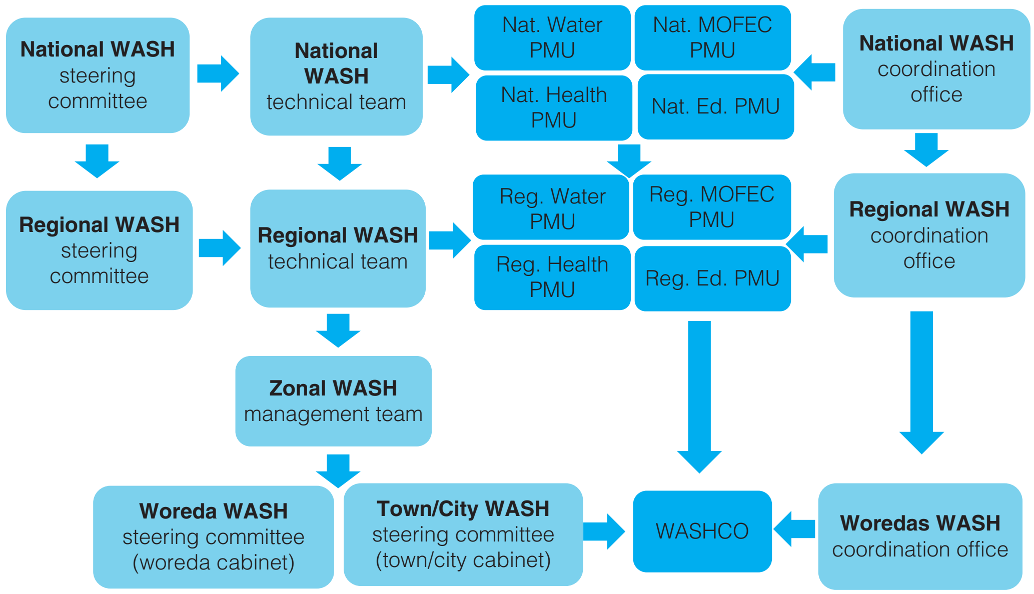
The WASH Implementation Framework (WIF) set out that planning, implementation, monitoring, and evaluation would be coordinated through establishment of water supply, sanitation, and hygiene (WASH coordination) structures at national, regional, zonal, woreda, and kebele levels. The coordination structure is guided by the steering committees and technical teams formed by the WASH sector ministries and corresponding regional sector bureaus, as illustrated in figure H.1. The four sector ministries have committed themselves to assign an appropriate official to the National WASH Technical Team (NWTT), to establish a project management unit (PMU) and to assign a WASH focal person to liaise between the PMU and the National WASH Coordination Office (NWCO) and to implement decisions of the ministries and the National WASH Steering Committee (NWSC). While there remains mandatory vertical communication within each WASH sector ministry and bureau, there also aims to be horizontal communication and linkage between different WASH sector ministries' and bureaus' PMUs, and between corresponding WASH coordination offices and PMUs based on signed memorandums of understanding (MoUs) between the sectors.

Despite significant and encouraging activities of the NWSC, some of the constraints affecting the execution of the decisions according to the guidelines include (a) delay of budget release and "no objection" from donors; (b) delay of major procurements and long processes; (c) and lack of regular and frequent meetings to deliberate on emerging issues. The NWCO has a critical role in ensuring policies, strategy plans, and decisions of the NWSC and NWTT are effectively communicated at all levels. While some progress has been made in establishing and operationalizing the One WASH National Programme (OWNP) coordination structure as set out in the WIF, there are also significant gaps in that need to be strengthened to fully operationalize the proposed structures and fully implement their envisaged role.

Regions have the authority and the responsibility to establish institutional arrangements at the regional and zonal levels that are best suited to their particular needs and circumstances. However, regional arrangements were expected to correspond with those at the federal level to ensure effective linkages. However, at regional authorities lack a uniform understanding of OWNP concepts on the different implementation modalities and guidelines among members of steering committees, technical teams, and PMUs. There are also mixed perceptions concerning the management and financing of the OWNP, as well as the relationship between the OWNP and the Consolidated WASH Account (CWA). CWA-funded activities are typically referred to in the regions as OWNP activities. The OWNP covers all national WASH activities regardless of the source of finance, but there is a need for wider awareness raising to build a proper understanding for the CWA and OWNP.

It has taken a significant amount of time to establish regional WASH coordination offices (RWCOs), and many regions still don't have fully functioning mechanisms. RWCOs have been slow to be established due to lack of clear understanding on the specific roles of the RWCO, limited guidance on the required number and professional mix of the staff, and sources of budget. Most of the regional steering committees have delegated the water

Figure H.1: Schematic of the OWNP Institutional and Implementation Arrangement



Note: MOFEC = Ministry of Finance and Economic Cooperation; OWNP = ONE WASH National Programme; PMU = project management unit; WASHCO = water supply, sanitation, and hygiene committee.

sector PMUs to take the responsibilities of the program coordination, on top of their regular duties and responsibilities.

The lack of regional OWNP strategic plans and absence of effective coordination and systems of accountability continue to be a hindrance to alignment. This is further compounded by the continuation of multiple (unaligned) steering and technical committees for each of WASH programs financed through different channels.

With regard to linkages and harmonization of WASH activities, woreda- and kebele-level program planning and implementation is mainly concentrated on the rural water supply development with little attention for institutional WASH and harmonization of household and community WASH activities. While WASHCOs play major role in expansion of water supply and provision of quality services, health extension workers (HEWs) are active in expansion of household level sanitation and hygiene activities. However, the availability of water supply is not integrated with the promotion of sanitation and hygiene services. Therefore, in general, integration and harmonization at woreda and kebele levels is grossly inadequate.

In towns, WIF structures have not been established with exception of PMUs in few World Bank–supported towns. The coordination structures do not exist and were a major factor for challenges in the implementation of urban sanitation projects.

Furthermore, participation of the community and the private sectors (for repair and maintenance as well as spare parts) is lacking. Community participation in most regions, woredas, and schemes is limited to planning and collection of contribution for repair and maintenance in times of needs. Communities also participate in setting affordable user charges, bylaws to alienate free riders, and support to the vulnerable groups. However, general assemblies, general meetings and discussions with the WASHCOs to deliberate on problems, the financial status of the schemes, implementation efficiency, and management effectiveness are very limited in almost all schemes.

Appendix I
Woreda-Level Financing

Block grants received by woredas are allocated by the woreda councils between sectors based on the priorities of the woreda, consistent with federal and regional priorities. Allocation of limited public resources among key sectors mainly depend on the magnitude of the problem; cost of achieving the targets in each sector; and federal, regional, and woreda priorities. Water supply, sanitation, and hygiene (WASH) is often not prioritized. Unlike policies toward roads, power, and education, WASH is not considered a productive investment that stimulates economic growth—which is a wrong approach. In addition, interventions in the water supply are dependent on the availability of water source, which is sometimes complex, costly, and beyond the capacity of local governments. Sanitation and hygiene activities, especially in rural areas, are mainly focused on education and behavioral change, which are not tangible compared to investment in physical assets.

Despite this, WASH was among the priority sectors classified as pro-poor in the Government of Ethopia's (GoE's) economic and social development plans (Sustainable Development and Poverty Reduction [SDPRP], A Plan for Accelerated and Sustained Development to End Poverty [PASDEP], and Growth and Transformation Plan [GTP]). As a result, the amount of public resource allocated for WASH has increased steadily over the last two decades. The findings of the World Bank's public expenditure review on WASH revealed that between 2008/09 and 2011/12 sector expenditure increased from 0.4 percent to 0.7 percent of GDP. The sector share of total expenditure increased from 2 percent to 3.5 percent and has been stable at about US$2 per capita for the periods 2008/09 to 2011/12.

Table I.1 reveals that per capita public expenditure (obtained from the BOOST data for 720 woredas) is relatively higher in regions where access to improved water supply was lower in 2007. Both the per capita expenditure and the change in access to improved water supply in 2011 (NWI) compared to 2007 are higher in Benishangul, Gambella, Amhara, and Afar regions. However, the average size of the per capita expenditure is very small. When reviewing the per

Table I.1: Average Per Capita Expenditure by Region in Ethiopia and Change in Access to Improved Water Supply

Region	Woredas (no.)	Average per capita capital expenditure, 2010–12	Access to Improved water supply, 2007 (%)	Access to Improved water supply, 2011 (%)[a]	Change (%)
Benishangul-Gumuz	20	33.49	15.9	59.7	43.8
Gambella	13	79.66	30.5	64.7	34.2
Amhara	138	11.47	24.9	51.6	26.7
Oromia	276	8.70	24.2	49.8	25.5
SNNPR	145	2.73	25.9	42	16.1
Afar	30	15.67	20.2	34.8	14.6
Tigray	45	5.06	51.8	52.7	1
Total	**720**	**9.42**	**25.1**	**48.5**	**23.4**

Source: World Bank based on BOOST data.
Note: SNNPR = Southern Nations, Nationalities, and People Region.
a. Findings of the National WASH Inventory conducted in 2011.

Table I.2: Ethiopian Woredas with Reported Capital Expenditure, 2010–12

Regions	Capex (no.)	Capex only in 1 year	Capex only in 2 years	Capex in all 3 years	Total
Afar	1	8	10	11	30
Amhara	15	8	29	86	138
Benishangul-Gumuz	4	6	8	2	20
Gambella	12			1	13
Oromia	30	5	30	211	276
SNNPR	41	38	29	37	145
Somali	52	1			53
Tigray	19	8	10	8	45
Total	**174**	**74**	**116**	**356**	**720**

Source: World Bank based on BOOST data.
Note: CAPEX = capital expenditure; SNNPR = Southern Nations, Nationalities, and People Region. Empty cells represented data that was not available.

capita figures it should be noted that there are significant variations in unit costs of providing the services depending on their specific situations, including remoteness, source of water, population density, availability and cost of labor, and construction materials. Reliability of data could also be a challenge since data are based on administrative reports rather than national surveys.

As shown in table I.2, out of 720 woredas with expenditure information, 174 did not allocate any capital budget for the three years (2010–12), 74 allocated in one of the three years, 116 in two of the three years, and 356 for all three years. However, the amount of the public expenditure allocated was very small, even in the 356 woredas that did consistently allocate budget during the period.

Having no capital expenditure allocated to water supply and sanitation services at the woreda level does not mean that there was no investment on improving coverage in these woredas. While the provision of water supply and sanitation services is decentralized to the woreda level, in practice the task is still largely performed by regional and zonal offices. Currently, most schemes are constructed by zones or regions (except small schemes such as hand-dug wells and on spot springs), with their budget proclaimed at the regional level. There is no relationship between per capita spending on water supply by the woredas and access to improved water supply.

While the shortage of resources to cover the huge service gap is a major constraint in the sector, the efficient allocation of resources to ensure sustainability of the existing service is an area that also needs to be explored. The non-functionality rate in rural water supply schemes are as high as 25 percent, and nonrevenue water (NRW) in the urban water supply system is about 40 percent.[1]

The findings of the public expenditure review on water supply has revealed that between 2008/09 and 2011/12, only 55 percent of the total government budget was allocated to capital budget, while in the WASH sector this proportion is significantly higher (81 percent). The proportion of capital budget for the WASH sector is relatively lower (80 percent) at local than at the federal levels, where it is 89 percent.

Note

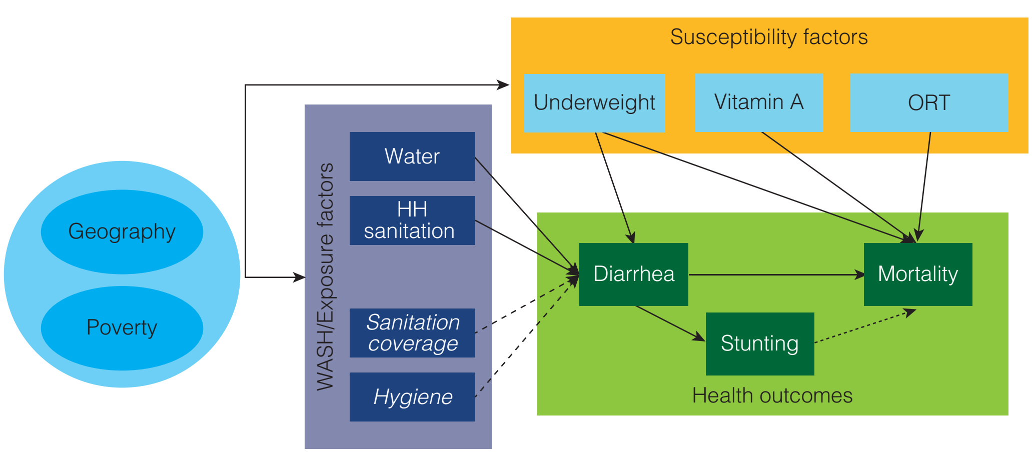
1. Recently conducted WASH Facility Survey covering 54 woredas and 50 towns in all the regions and Dire Dawa City Administration reveals that about 44.2 percent of the rural water supply schemes work for less than four hours per day, and 64.1 percent of rural water supply schemes failed at least once or more times in the last 12 months for an average of 51 days with frequency of four. The same survey indicates that about 44.6 percent of households consume less than 10 liters per capita, and almost a quarter of the samples consume between 10–15 liters. The average consumption of households benefiting from schemes with a downtime of less than five days is 1.2 times higher than schemes with a downtime of more 20 days. The average downtime contributes to variation in supply and consumption levels. The average consumption of households benefiting from schemes with downtime of less than five days is 1.2 times higher than schemes with downtime of more 20 days.

Appendix J
WASH and Health: Defining Exposure Risk Factors and Model for Analysis

To better understand the relationship between water supply, sanitation, and hygiene (WASH), nutrition, and health, this analysis has applied a WASH poverty risk model (WASH PRM) (figure J.1) to assess patterns of disease risk across economic and geographic subpopulations by combining rigorous estimates of the effects of exposure and susceptibility factors on disease with country-specific data on the distribution of these risk factors. The primary purpose of this model is to describe how diverse and interrelated risk factors may contribute to h
ow the national diarrheal disease burden is distributed between sub-population groups. The association or causality between WASH and these outcomes is not possible as the data is cross-sectional and prone to many biases, and is therefore not estimated.

The PRM model combines key susceptibility factors and exposure factors that are most relevant to the health outcome of interest: diarrhea. The conceptual framework for the WASH PRM is explained in figure J.1; "exposure factors" section includes WASH-related elements that influence the risk of diarrheal disease. Relative risks are developed from the literature for levels of these WASH services. Relative risks for individual exposure risk factors are combined into a single exposure index. The "susceptibility factors" section of the conceptual framework addresses individual risk factors that have been identified through rigorous evaluations and meta-analyses. Quantitative risk estimates for each factor are combined into a single susceptibility index. As described in figure J.1, we consider water supply and sanitation as "exposure" factors, that is, as independent variables that influence our dependent outcomes of interest (diarrheal disease, diarrheal mortality, and stunting).

Figure J.1: WASH Poverty Risk Model Conceptual Framework



Note: WASH/exposure factors in light blue are not included in the exposure index. HH = household; ORT = oral rehydration treatment; WASH = water supply, sanitation, and hygiene.

Under the Millennium Development Goal (MDG) target for water supply and sanitation, access to these two services was classified as improved or unimproved, with progress on improved services contributing to progress in meeting the MDG target. This binary classification of water supply and sanitation masks a gradient of ascending service levels that bring differing levels of health and other benefits. More recently, the WASH sector has moved to a service ladder approach that better describes water supply and sanitation access as a continuum of ascending levels assumed to bring ascending benefits. The new Sustainable Development Goal (SDG) to "ensure access to water supply and sanitation for all" by 2030 goes beyond unimproved or improved designations to call for safely managed water supply and sanitation services.

To describe the risk posed by inadequate water supply and sanitation access to different groups, it is important to consider multiple service level or exposure scenarios that distinguish between, for example, improved sanitation and a sewer connection, and allow for different relative risks of a given health outcome for each exposure level. Many systematic reviews pool different water, sanitation, and hygiene interventions to arrive at a single relative risk estimate for all interventions within a given category (water, sanitation, and hygiene), against a single counterfactual of no intervention, failing to account for differences in service level and the control.

Two previous efforts to assign relative risk (RR) to various WASH exposure scenarios applied literature-based estimates to an ascending level of single and then multiple WASH services, but distinguished only between one or two levels of water supply and sanitation service. For the WASH PRM, we will adopt the exposure scenarios and accompanying RR estimates proposed in a recent burden of disease analysis led by the World Health Organization (WHO). These RRs are determined using a meta-analysis based on a systematic review of various WASH interventions corresponding to exposure scenarios, or service levels.

We assign exposure scenarios based on the coverage of water supply and sanitation service levels using data from 2012 DHS (see figure J.1 for survey sites). We define service levels with a desire to align where possible with the World Bank Access Plus framework. We use three service levels for both water supply and sanitation that can be combined to describe exposure scenarios with varying degrees of diarrheal disease risk.

Water

We exclude point of use water treatment scenarios due to the challenges of estimating adequate compliance and the questionable reliability of the RR estimates (36). We use three exposure scenarios from the DHS to estimate water source coverage: (a) unimproved water; (b) off-plot or community-improved water source; and (c) on-plot improved (including piped) water source. Water sources were grouped into scenarios using DHS household-level data and JMP MDG water ladder definitions. Water source coverage was then estimated at the cluster (community) level using all households, then combined with the child-level data and used to calculate the exposure index.

Sanitation

We use all three exposure scenarios for sanitation proposed by Wolf et al. unimproved sanitation (including open defecation), improved no sewer (on-site), and sewer connection (reticulated, off-site). We define each scenario using the classification of toilet type and reported household sharing from DHS household-level data. Household sanitation access for each child was combined with child-level data to calculate the exposure index.

We derived sanitation definitions that adhere to the JMP MDG sanitation ladder. Category A includes open defecation and unimproved; any shared improved toilet or latrine; and pour or flush toilets that flush to "somewhere else." Category B includes unshared improved toilets or latrines and pour or flush toilets that flush to "don't know where." Category C includes unshared pour or flush toilets connected to a piped sewer.

Table J.1: Exposure Risk Model Parameters

7.1 Input	Value	Description	Reference
Water access relative risk		**2011 DHS Household File**	**2011 DHS ET**
A. Unimproved	1.00	"Dug well: unprotected well," "water from spring: unprotected spring," "tanker truck," "cart with small tank," "surface water (river, dam, lake, pond, stream, canal, irrigation channel)," "bottled water"	HV201
B. Off-plot improved	0.89	"Piped water to neighbor," "public tap/standpipe," "tube well or borehole" "dug well: protected well," "water from spring: protected spring" and "rainwater"	HV201
C. On-plot improved	0.77	"Piped into dwelling" or "piped to yard/plot," and "on premises" improved water source	HV201, HV235
Sanitation access relative risk		**2011 DHS Household File**	**2011 DHS ET**
A. No, unimproved and shared	1.00	"flush or pour flush toilet: flush to somewhere else," "pit latrine: without slab/open pit," "bucket toilet," "hanging toilet/hanging latrine," "no facility/bush/field"	HV205
B. Improved and unshared (excluding sewered house connection)	0.84	"Flush or pour flush toilet: flush to septic tank/pit latrine," "flush or pour flush: don't know where," "pit latrine: VIP/with slab," "composting toilet"	HV205
C. Sewered house connection	0.31	"Flush or pour flush toilet flush to piped sewer system"	HV205, HV225

Note: Reference refers to a variable in the DHS table (e.g., HV201).

Exposure Index

We calculated scores for the exposure index individually for each child based on the combined relative risks of each water supply and sanitation access scenario (equation J.1; table J.2), and then these values are averaged by cluster using survey weights included in DHS datasets. The value for each child is based on the household's access to water supply and sanitation facilities. After calculating the exposure index, we rescaled it, then adjusted it to the excess exposure risk due to inadequate WASH by subtracting 1.00 from the relative risk value.

(J.1) Exposure index:

$$ExpIndex_i = SanRR \cdot WatRR$$

Other Exposure Risk Factors

We present DHS data to characterize disparities in other hygiene factors related to diarrheal disease (table J.3). Our exposure index does not include these other exposure-related hygiene factors because while these are important for exposure, their contribution to exposure risk has not been characterized through rigorous studies. However, this does not undermine how important they are for limiting child exposure to diarrheal disease.

Improved hand washing and safe water treatment are defined using household-level DHS data (table J.3). A household has improved hand washing facilities if it meets three criteria present in the household-level data in the DHS: (a) having a designated place for hand

Table J.2: Exposure Scenarios and Assigned Relative Risk from Literature Estimates

	Scenario	Water	Relative risk	Sanitation	Relative risk	Combined relative risks
1	No improved water access, no improved sanitation access	A	1.00	A	1.00	1.00
2	Improved off-plot water access, no improved sanitation access	B	0.89	A	1.00	0.89
3	No improved water access, improved sanitation access	A	1.00	B	0.84	0.84
4	Improved off-plot water access, improved sanitation access	B	0.89	B	0.84	0.75
5	Improved on premises, improved sanitation access	C	0.77	B	0.84	0.65
6	Improved on premises, sewered sanitation	C	0.77	C	0.31	0.24

Notes: Relative risk figures from Wolf et al., 24.

Table J.3: Definitions of Other Exposure Risk Factors

Input	Description	Reference
Hand washing	**2011 DHS Household File**	**2011 DHS ET**
Improved	Designated place for hand washing, water with soap, mud, or ash present	HV230a-b, HV232a-b
Unimproved	Absence of either place, water, or soap/ash/mud	HV230a-b, HV232a-b
Water treatment	**2011 DHS Household File**	**2011 DHS ET**
Safe	“Boil,” “bleach/chlorine,” “solar disinfectant,” “water filter”	HV237a-b, d-e
Unsafe	“Strain through cloth,” “let it stand,” “other,” “don’t know”	HV237c, f, x, z
Child stool disposal	**2011 DHS Child File**	**2011 DHS ET**
Improved	Safe disposal into improved toilet or latrine (category B or C)	V465 and V116
Safe	“Child used latrine/toilet” or “put/rinsed in latrine or toilet”	V465
Unsafe	“Put/rinsed into drain or ditch,” “thrown in garbage,” “buried,” “left in the open,” “other”	V465
Population density	**GPW 2015 population / sq. kilometer adjusted with UN World Population Prospects**	**GPW**
Population density without sanitation	DHS cluster improved sanitation coverage (category B or C) and GPW 2015 estimates	HV205 and GPW

washing that is stocked with (b) water and (c) soap, mud, or ash. Improved or safe water treatment is defined by treating household water with an effective method for decontaminating drinking water. Safe or improved child stool disposal is defined using the child-level DHS data. Improved child stool disposal is when the respondent reports that the child either directly uses an improved toilet facility or child stool is rinsed or disposed of into an improved toilet facility (table J.3).

Population density estimates from the Gridded Population of the World (GPW) (37) were used to assess the effects of community-level sanitation. These provide 1 square kilometer resolution estimates of population density. We use GPW estimates that have been adjusted using UN World Population Prospects. We overlaid DHS cluster locations on GPW population density raster maps and extracted density estimates for each cluster. We also calculated "population density without sanitation" as a proxy measure for the relative amount of human waste potentially being released into the environment. We used the product of improved sanitation coverage and population density as a measure of community-level contamination. To calculate this variable, we combined population density cluster estimates with cluster improved sanitation (categories B and C, table J.1) coverage to describe the co-distribution of individual child and community sanitation risk (table J.3).

Defining Susceptibility Factors

The model includes risk factors related to susceptibility of diarrheal disease and mortality. These include susceptibility-related micronutrients (vitamin A) to effective treatment (e.g., oral rehydration treatment [ORT]) and undernutrition assessed by child weight-for-age (WFA) (table J.4).

Undernutrition. For undernutrition, we use relative risks (RRs) from Caulfield et al. (2003) in which they estimate the RR of cause-specific mortality (including diarrhea) for different levels of stunting (low height-for-age), wasting (low weight-for-height) and underweight (WFA). We estimate RRs based on WFA z-scores recorded for under-five children in the child-level

Table J.4: Model Parameters for the Susceptibility Index

Input	Relative risk	Description	Reference
Child underweight			
Normal	—	WFA z-score > −1 standard deviations (SD) from the mean	(38)
Mild risk	2.32	WFA z-score −1 to −2 SD from the mean	(38)
Moderate risk	5.39	WFA z-score −2 to −3 SD from the mean	(38)
High risk	12.50	WFA z-score < −3 SD from the mean	(38)
Oral rehydration treatment (ORT)			
Does not receive ORT			(39)
Receives ORT	0.07	Protective, reduces risk of mortality by 93%	(39)
Vitamin A dose			
Received vitamin A dose	—		(40)
Diarrheal mortality risk reduction from receiving ORT	0.72	Protective, reduces risk of mortality by 28%	(40)

Note: ORT = oral rehydration therapy; WFA = weight-for-age.

DHS data (table J.4). RRs are assigned to different levels of WFA based on standard deviations (SDs) below the global mean of the z-score distribution (−1 to −2 SD, −2 to −3 SD, and less than −3 SD) compared to normal (greater than −1 SD) Caulfield et al. For the diarrheal risk model, we use the estimates for low WFA on diarrheal mortality as a likely measure of long- and short-term undernutrition effects. We use reported RRs for each level to estimate a piece-wise linear risk function that provides a continuous estimate of excess risk as WFA z-scores decline.

ORT. There is substantial evidence of the effect of ORT on the severity and duration of diarrhea. Based on 157 studies, Munos et al. (2010) estimates a 93 percent reduction in diarrhea mortality with ORT use (prepackaged or home remedy). We combine this estimate with an estimated probability of receiving ORT, calculated from child-level DHS data (table J.4). ORT data are available only for children who have had a diarrheal episode in the previous two weeks. However, if analyses were restricted to these observations, the coverage would be very sparse and likely bias or underestimate the occurrence of diarrhea. Rather than including whether a child received ORT for a recent diarrheal episode (during the last two weeks), we estimate the propensity for receiving ORT given household wealth quintile, maternal education, region, setting, and child's age. Values for children without a recent episode are imputed using a logistic regression model built on data from children who did have an episode. Imputing values for all children results in a more widespread estimate of the likelihood of receiving ORT.

Vitamin A. Imdad et al. (2011) examine the effect of vitamin A supplementation on diarrhea mortality, as well as outcomes related to pneumonia and measles. Based on 12 studies with data on diarrhea specific mortality, they estimate a pooled effect of ~30 percent reduction due to vitamin A supplementation (RR=0.70; CI: 0.58–0.86) among children 6–59 months of age (40). We incorporate this estimate in the susceptibility estimates using child-level DHS data on whether or not the child received a vitamin A dose.

Susceptibility Index

We calculate the scores for the susceptibility index individually for each child based on the combined relative risks of each of the three susceptibility factors (table J.5). The susceptibility index ($SusIndex_i$) is designed to be proportional to the excess risk associated with all of the factors (J.1).

(J.1) Susceptibility index:

$$SSusIndex_i = \prod_k \sum_{i,j} RR_{j,k} RiskFactor_{i,j,k}$$

Where $RR_{j,k}$ is the relative risk associated with the j^{th} level of risk factor k. $RiskFactor_{i,j,k}$ is the level of that risk factor for individual i. For vitamin A supplementation, there are only two levels (yes or no) and $RiskFactor_{i,j,k}$ serves as a dummy variable. For the other risk factors, the levels are continuous. Susceptibility values are estimated for each child subpopulation using appropriate survey weights included in DHS datasets.

Combined Risk Index

Susceptibility ($SusIndex_i$) and exposure risk ($ExpIndex_i$) are combined into the overall risk index ($RiskIndex_i$), which is simply the product of the two indexes (equation J.3). We calculated risk index scores individually for each child under five years of age and then aggregated into subpopulation estimates.

Table J.5: Summary of Susceptibility Index Calculation

7.2 Risk factor	Relative risk description	Data source	Calculation
Underweight	Having a low WFA significantly increases a child's risk of dying from diarrheal disease. WFA is assessed on how far a child is above or below the international standard. The more standard deviations below the average, the greater the risk.	WFA is collected and reported in the DHS.	Relative risk for different categories are linearized to create an individual value for the child (from 1 to 12.5).
Oral rehydration	Receiving timely rehydration can greatly reduce the mortality from diarrheal disease (by 93%). The relative risk of diarrheal mortality for ORT is 0.07 (RR_ORT).	DHS has information on whether children receive ORT (PrORT) following diarrhea for some children. We estimate the probability of receiving ORT for all children using data from those that have it (adjusting for age, sex, wealth and region).	Based on the probability of getting ORT and the relative risk, ranging from 0.07 to 1.0. 1 - (PrORT x (1 - RR_ORT)).
Vitamin A	Receiving vitamin A supplementation has been shown to reduce the risk of diarrheal mortality in children. The relative risk is 0.72 (a 28% reduction) (RR_vitA).	DHS has information on whether children have received vitamin A supplementation (vit_A).	Based on whether they received vitamin A and its protective effect. 1 - (vit_A x (1 - RR_vitA)).

Note: ORT = oral rehydration therapy; WFA = weight-for-age.

(J.2) Risk index:

$$RiskIndex_i = ExpIndex_i \cdot SusIndex_i$$

Data Analyses

Data on the distribution of diarrheal susceptibility and exposure risk factors come from available DHS surveys.[1] Demographic and health surveys are implemented countrywide in middle- to low-income countries and survey a wide range of health and socioeconomic characteristics. Surveys are released with data on geographic locations, and include both household- and individual-level datasets. Households are selected using stratified sampling methods that require accounting for complex survey design.

Density plots. These graphs show the distributions of variables of interest using probability densities. The area under each curve is equal to one, and represents the relative density of probability that a member of the wealth quintile has the corresponding value along the x-axis.

Concentration curves. These graphs show the distributions of outcomes across a ranked cumulative fraction of the population—in this study, socioeconomic status. The x-axis shows the cumulative wealth fraction from the poorest percentiles on the left, to the entire population on right and shows the fraction of a given outcome (y-axis) associated with the population up to each cumulative wealth level. This is plotted against a 45-degree line of equity, in which the poorest 40 percent have 40 percent of outcomes, extending all the way up the wealth continuum. While they do not show actual coverage values for risk factors, they do highlight where disparities in risk factor coverage are most prominent.

Scatterplot matrixes. The lower half of these figures show a series of pairwise x-y scatter plots showing the co-distribution of different WASH risk factors, population density, and indexes for both urban and rural children. The upper half shows two-dimensional contour plots of the pairwise co-distributions of variables and indexes from the WASH PRM. Many of the individual risk factors are categorical and therefore not easily represented. In these cases, scatters show the cluster-level proportions and means, rather than individual values.

Poverty and economic status. Asset-based wealth and consumption metrics both reflect urban and rural poverty differently. The differences in both lifestyle and access to assets between urban and rural populations can be masked when wealth quintiles are calculated at a national level. Asset-based wealth metrics rely on individual goods (e.g., bicycles) or construction materials (e.g., thatch roofs), which have very different meaning and value in rural compared to urban settings. National quintiles can obscure the condition of the urban poor population, which is grouped into the third or fourth national quintiles. While their assets may group them into higher wealth quintiles, when compared to rural populations, they may not experience a higher standard of living equal to their higher ranking. Asset-based indexes (as are used in DHS to determine household wealth) result in rural households being grouped into the middle and lower national quintiles, while urban households are grouped into the middle and upper quintiles. Failing to account for urban and rural differences can obscure important underlying patterns between wealth and health. We computed national, urban, and rural wealth quintiles, and ranked urban and rural households separately by wealth quintiles. The categorization of quintiles for urban and rural populations is based on the distribution of the asset scores within the urban and rural populations, respectively, rather than the national distribution, thus they must not be interpreted as equivalent.

Geospatial analyses. One of the key objectives of the WASH PRM is to show the geographic distribution and co-distribution of risk factors and impact. This includes mapping individual risk factors and cumulative measures (e.g., exposure, susceptibility, and risk indexes). Our maps identify regions that experience high levels of exposure, susceptibility, diarrheal risk, and other important outcomes. We show these outcomes at national and regional scales, and for different economic levels (bottom 40 percent [B40] and top 60 percent [T60]). Regional- and cluster-level average values are calculated using the appropriate DHS survey weights.

We interpolated exposure, susceptibility, and risk indexes for the national-level maps, as well as for the B40 and T60. We calculated cluster-level averages of the three indexes. Using ARCGIS 10.2.2, we utilized empirical Bayesian kriging to interpolate a high resolution (5 square kilometer) risk surface. Standard kriging approaches use a regression-type linear model to predict values at unmeasured locations on a surface using an average of values near the point in question. Empirical Bayesian kriging uses the underlying sample distribution to inform the model's priors and covariance functions, whereas most other kriging measures assume underlying Gaussian distribution, which is often not the case in datasets. These high-resolution maps provide an initial rapid assessment of important trends in diarrheal disease-related factors.

DALY burden of inadequate WASH. The WASH PRM estimates the distribution of child diarrhea and enteric infections due to inadequate WASH. The estimates also account for variability in child susceptibility through undernutrition or lack of medical care. These have been expressed as measures of the risk index. However, in this section these estimates are translated into the more commonly used measures of disability-adjusted life years (DALYs), developed and used by the Global Burden of Disease project (GBD).

DALYs are a common health metric that combines both the years of life lost (YLL) due to a particular cause or risk factor as well as the years lived with disability. For diarrhea and enteric disease among children under five years of age, the vast majority (approximately 90 percent) of the DALY burden is due YLL due to premature mortality. A single DALY can be considered as one year of healthy life lost. As a summary measure that can be calculated across diverse causes or risk factors, including those that might cause death (such as road traffic accidents) or those that do not cause death but may cause chronic disability (e.g., back pain or trichiasis). As such, DALYs permit comparison between diverse health conditions and provide a useful summary statistic of disease burden for a given population.

Here, we use DALYs to provide a summary estimate for the distribution of the enteric disease burden attributable to inadequate WASH by subpopulation groups. For this exercise, we use DALY estimates from the 2013 GBD, which are available online.

Health burden causes are broken down in the GBD into different categories of communicable and noncommunicable diseases. Here we use the estimates for diarrheal disease (category A.2.1 from the GBD data portal website; and intestinal infectious diseases (category A.2.2 from GBD data portal website). It is important to point out that this captures the burden of short-term morbidity and mortality, but does not account for any potential of enteric infections on undernutrition or long-term consequences.

We start by translating the WASH PRM risk index into a DALY burden rate (DALYs per 100,000). The WASH risk index represents the relative *excess* risk associated with inadequate WASH, and the first step is to convert it into a measure of overall risk of diarrhea and enteric infections (and not just the excess due to poor WASH). This involves recalculating an overall exposure index that is not adjusted for the excess risk. This is done by using the original RR numbers from the literature and not subtracting 1 from the RR to create an excess RR. This has the effect of turning the exposure index (risk index) into a measure of the overall enteric disease risk, rather than just the portion attributable to inadequate WASH.

The second step is to convert this revised enteric risk index into a DALY equivalent. We make the assumption that the relative distribution of the risk index is an appropriate estimate of the distribution of the DALY burden. Using the GBD estimate as our national burden envelope, we create a risk-burden multiplier using equation (J.4):

(J.3) Risk-burden multiplier:

$$RBMult = \frac{NatEnterDALY}{\overline{\overline{EntRiskInd_i}}}$$

This establishes a ratio between risk index and DALY burden that maintains the national GBD burden estimate. We then use the multiplier to estimate an individual-level expected DALY burden for each child. These values can then the aggregated by geographic and economic subpopulations. See equations (J.5) and (J.6).

(J.4) Total enteric DALY burden:

$$EntDALY_i = RBMult \cdot EntRiskIndex_i$$

(J.6) Inadequate WASH-attributable enteric DALY burden:

$$WASHDALY_i = RBMult \cdot WASHRiskInd_i$$

$EntDALY_i$ represents the burden for individual *i* from diarrheal and enteric infections based on the individual exposure and susceptibility variables. The sum of $ENTDALY_i$ over the population is the same as the GBD diarrheal and enteric infection burden. $WASHDALY_i$ represents the portion of this burden associated with inadequate WASH service levels. As with the GBD burden, these individual estimates are rates expressed as DALYs per 100,000 children.

These burden estimates for individual children are then aggregated to subpopulation levels (e.g., region, urban or rural residence, and wealth quintile) using survey statistics as above. The appropriately weighted means for the subpopulations represent the expected DALYs per 100,000 children per year. For these measures, we focus on the distribution of the total enteric burden and burden associated with inadequate WASH.

Note

1. All statistical estimates presented and imputations were calculated and combined into the WASH PRM using complex survey design in STATA 14 (StatCorp LP, College Station, TX). All data representations in plots were made in R statistical software using the ggplot2 package, authored by Hadley Wickham, and associated extensions (41). All maps were rendered in ArcGIS 10.22 (ESRI, Redlands, CA) using model outputs.

References

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Appendix K
WASH and Health: Distribution of Exposure and Susceptibility

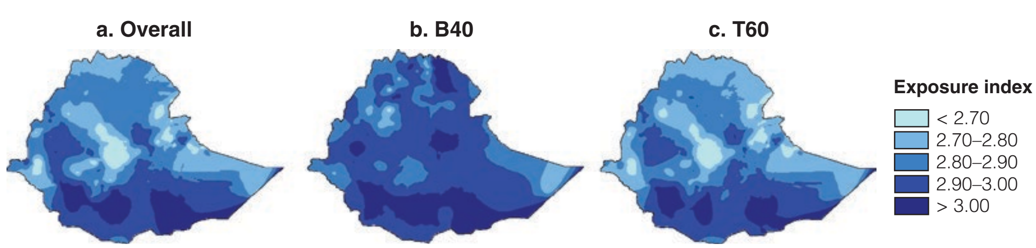
In urban and rural settings, exposure variables related to water supply, sanitation and hygiene (WASH) are strongly associated with economic status with a large disparity between the urban rich and poor. The richest households in Ethiopia have up to twice the access to improved water sources than the poorest, and are up to 20 percent more likely to report safe water treatment. The poorest 40 percent of households have an inequitable cumulative share (20 percent or less) of improved child stool disposal, improved sanitation, and safe water. In urban and rural settings, WASH-related exposure variables are strongly associated with economic status with a larger disparity between the urban rich and poor populations.

Panels a–c of map K.1 show a scale spatial resolution map (at 5 square kilometers) of the exposure index value distribution across children under five nationally and by economic groups. Southern and central Ethiopia have the highest exposure indices across all three maps (>2.90). Central Ethiopia has the lowest exposure risk, which ranges from less than 2.70 among the T60 to between 2.70 and 2.90 among the poorest 40 percent of households. While panels a–c of map K.1 are based on the variables included in the exposure index, there are substantial disparities in other exposure-related variables not included in the index (e.g., hand washing, water treatment, and safe disposal of child fecal matter). Including these variables would result in greater disparities and heterogeneity.

WASH exposure variables are associated with wealth and with each other. That is, poor households are more likely to have multiple WASH conditions that increase their exposures to enteric pathogens. Since poor households are often within poor communities, they are also more likely to be surrounded by poor sanitation conditions. For some risk factors, patterns differ greatly between urban and rural settings. In Ethiopia, higher proportions of urban households have access to improved water supply and sanitation than rural households; as a result, children in urban communities have a lower susceptibility than children from rural communities.

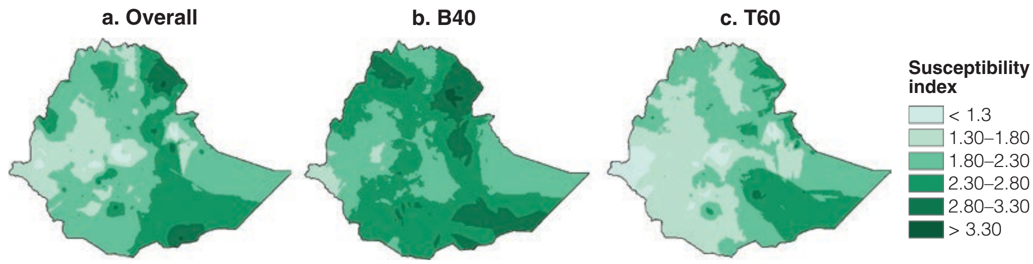
Panels a–c of map K.2 are susceptibility index maps that have common features with the agro-ecological belts of Ethiopia. The country's agro-ecological belts differ in rainfall, growing season,

Map K.1: Exposure Index Values in Ethiopia for Populations of Children under Five, 2011



Source: DHS 2011.
Note: Maps are at 5 km^2 resolution. B40 = below 40 percent of wealth index; T60 = above 60 percent of wealth index.

Map K.2: Susceptibility Index Values in Ethiopia for Populations of Children under Five, 2011



Source: DHS 2011.
Note: Maps are at 5 km^2 resolution. B40 = below 40 percent of wealth index; T60 = above 60 percent of wealth index.

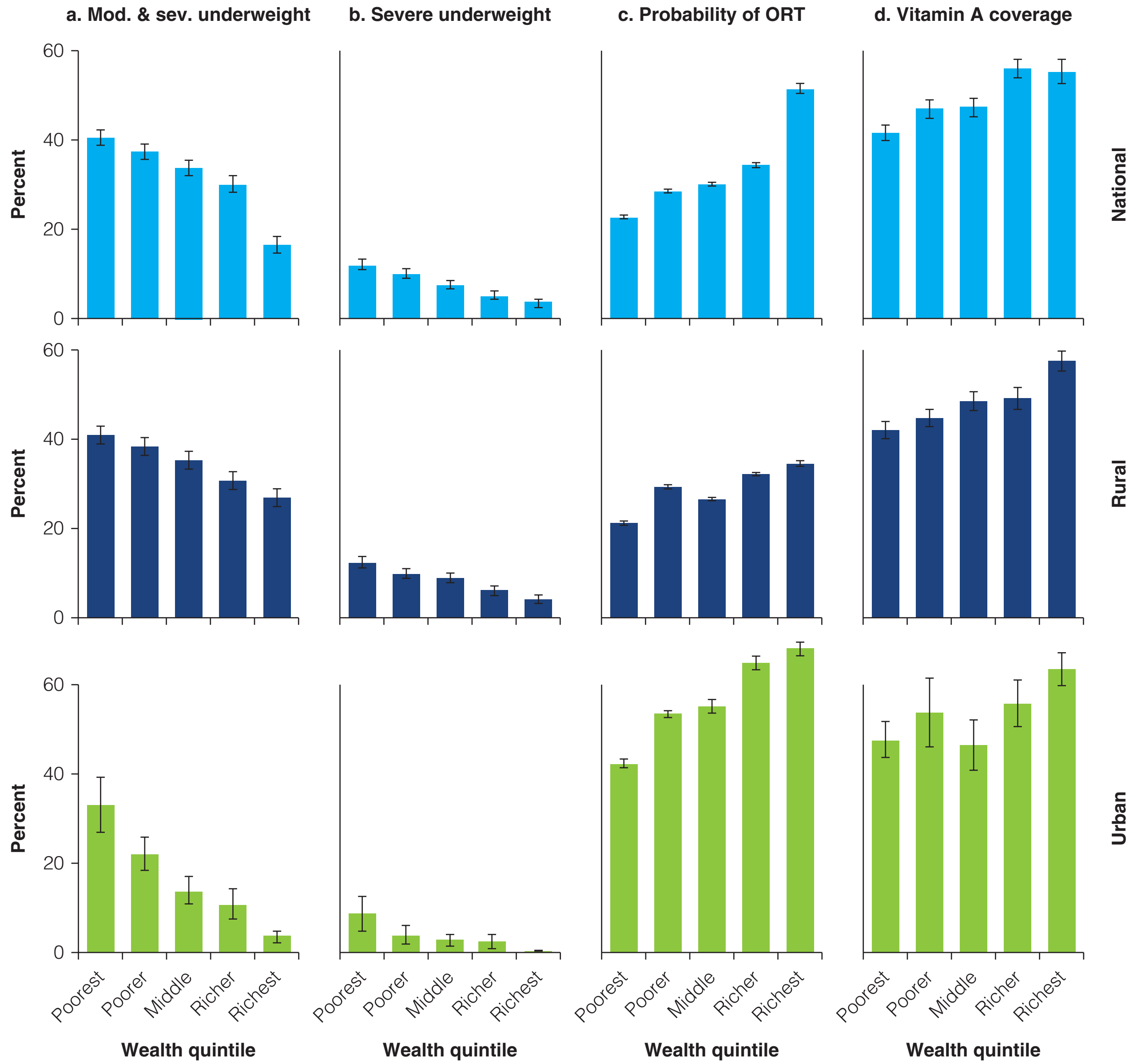
soils, and elevation. These factors may affect food availability, economic status, livelihood, and other factors. Areas with the highest child susceptibility index values are concentrated in the southeast and northeast, while the children with the lowest susceptibility index values are concentrated in the west in the overall map (panel a) and the T60 population (panel c). For the B40 children population, there are larger areas of the higher susceptibility index values (>2.30) in the north and south, and to a lesser extent in the center. In the T60 children, there is a large area with relatively higher (2.30–2.80) susceptibility index values in southeastern Ethiopia, and on the northeastern edge.

Child susceptibility variables are associated with wealth and each other. That is, children in poor households are more likely to be underweight and have a lower probability of receiving ORT. In both urban and rural settings, children in poorer households are more vulnerable to the risks posed by poor WASH due to low nutrition and access to key health interventions (ORT and vitamin A). The urban rich have the lowest concentration of underweight children, in comparison to the urban poor and the rural rich and poor. Children in poor households are up to 2.7 times more likely to be underweight and five times more likely to be severely underweight. The B40 has more than 45 percent of the cumulative share of being underweight in comparison to richer children. However, the upper wealth quintiles also have an inequitably higher share of underweight children.

Children in the bottom 20 percent (B20) rural households are 1.3 times more likely to be underweight and 1.9 times more likely to be severely underweight than their B20 urban counterparts. Children in urban households have two to three times the probability of receiving ORT, as compared to rural children. There was not a large disparity in regards to preventative (vitamin A) services, but there was for curative (ORT treatment) services between urban and rural populations. Children in urban households have two to three times the probability of receiving ORT treatment, as compared to rural children.

In general, susceptibility is negatively associated with wealth; the poorest and most vulnerable households are also more likely to live in communities with higher exposure risk, as set out in figure K.2, panels a–c. Children in poor households have higher exposure and susceptibility than children in rich households, with the B40 having approximately 50 percent of the cumulative share of the susceptibility and risk. Nationally, poorer children (B20 and B40) have approximately 1.5 to 3.6 times the risk than richer children (T20 and T40), and this pattern emerges at the community level. In general, children in rural populations have a higher risk than those in urban populations; poor rural children (B20 and B40) have 1.6 to 1.7 higher risk index values than poor (B20 and B40) urban children. The overall risk is concentrated among the riskiest children, even when setting is controlled for. There are likely other previously uncovered factors contributing to this pattern.

Figure K.1: Distribution of Susceptibility Factors by Economic Level for Children under Five in Ethiopia, 2011



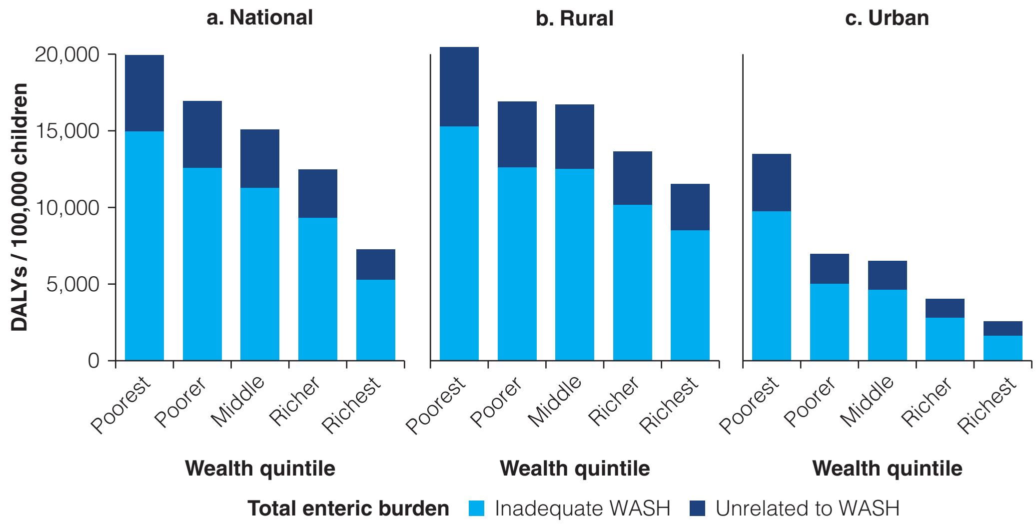
Source: DHS 2011.

Note: Children who are >2 standard deviations less than the global mean weight-for-age (WFA) for their age are considered underweight. Children who are >3 standard deviations less than the average WFA are considered severely underweight. ORT = oral rehydration therapy.

DALY Burden of Inadequate WASH in Ethiopia

In Ethiopia, the national enteric burden associated with inadequate WASH is 11,135 DALYs / 100,000 children per year, which is approximately 75 percent of the Global Burden of Disease (GBD) enteric burden estimated for the country. Panels a–c of figure K.2 show the calculated total enteric burden rate divided into the fraction associated with having inadequate WASH and burden rates unrelated to WASH by wealth quintile for national, rural, and urban populations of children under five. It is important to clarify aspects of what is meant by associated and unrelated to inadequate WASH. First, some enteric infections are not preventable with improved WASH.

Figure K.2: WASH-Related DALY Enteric Burden for Children under Five in Ethiopia, 2011



Source: DHS 2011.
Note: DALY = disability-adjusted life year; WASH = water supply, sanitation, and hygiene.

For example, almost all children under five experience rotavirus infection, but improvements in WASH do not prevent the infection. These are unrelated to inadequate WASH in that they would not be prevented with improvements. Second, the DALY burden associated with inadequate WASH here accounts for both the level exposure due to inadequate WASH and children susceptibility due to other factors. That is, the DALY burden associated with inadequate in a particular subpopulation reflects both exposure and susceptibility in that subpopulation. Child susceptibility (e.g., undernutrition and likelihood of ORT) affects both the WASH associated and the unrelated burden.

The health burden of inadequate WASH is disproportionately borne by poorer children and those in vulnerable geographic areas. Nationally, the WASH enteric burden for the poorest quintile is about three times greater than the enteric burden for the richest quintile. WASH-related enteric burden is lower within urban than in rural populations, but the disparities in both are equivalent. Burden for the poorest rural communities is 1.8 as high as the burden for the richest, and in urban communities the burden is 5.4 times higher for the richest than the poorest. The highest burden associated with inadequate WASH among the poor households is due to a conjuncture of vulnerabilities. They are less likely to have good WASH services, and those who do not are also more likely to be undernourished and without access to care. Child health vulnerabilities magnify the effects of inadequate WASH among poor populations.

It should be noted that this analysis, like the underlying GBD estimates, accounts for the impact of inadequate WASH on acute morbidity and mortality from enteric infections. It does not account for the effect these infections may have on undernutrition and its chronic sequelae. The findings in this report on the relative quality of WASH service in Ethiopia suggest that the estimates of disease burden are the lower bound and actual WASH-related disease burden is likely to be higher.

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