WASH
Poverty Diagnostic | SERIES

Reaching for the SDGs

The Untapped Potential of Tanzania's Water Supply, Sanitation, and Hygiene Sector

TANZANIA

WORLD BANK GROUP

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Abbreviations

B40	bottom 40 percent of the wealth distribution
BCC	behavioral change communications
BMI	body mass index
CBO	community-based organization
cDC	Centers for Disease Control and Prevention
COWSO	community-owned water supply organization
CQ	core question of WASH Poverty Diagnostic
CWIS	city wide inclusive sanitation
CWS	City Water Services, a private company
DAWASA	Dar es Salaam Water and Sewerage Authority
DAWASCO	Dar es Salaam Water and Sewerage Corporation
DED	district executive director
DHS	Demographic and Health Survey
DT WSSA	District and Township Water and Sanitation Service Authority
DU WSSA	District Urban Water and Sanitation Service Authority
EED	environmental enteric dysfunction
ECD	early childhood development
EWURA	Energy and Water Utilities Regulatory Authority
FSM	fecal sludge management
GoT	Government of the United Republic of Tanzania
GNI	gross national income
GP	Global Practices of the World Bank
GWPD	Global WASH Poverty Diagnostic
HBS	Household Budget Survey
HCF	health care facilities
HOI	Human Opportunity Index

IBNET	International Benchmarking Network for Water and Sanitation Utilities
ISP	informal service provider
JMP	Joint Monitoring Programme
LGA	local government authority
LGCDG	local government capital development grant system
LGI	local government institution
LGRP	local government reform program
LIS	low-income settlement
MDG	Millennium Development Goal
MICS	Multiple Indicator Cluster Survey
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly, and Children
MOWI	Ministry of Water and Irrigation
NAWAPO	Tanzania's National Water Policy of 2002
NBS	National Bureau of Statistics
NGO	non-governmental organization
NSC	National Sanitation Campaign
NWSDS	National Water Sector Development Strategy
PO-RALG	President's Office-Regional Administration and Local Government
PO-PSM	President's Office-Public Service Management
SDG	Sustainable Development Goals
SUN	scaling up nutrition
T60	top 60 percent of the wealth distribution
TRT	treatment on the treated
TWPD	Tanzania WASH Poverty Diagnostic
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UWSA	Urban Water and Sanitation Authority
VWC	village water committee
WASSA	Water and Sanitation Sewerage Authority

WASH	water supply, sanitation, and hygiene
WB	World Bank
WHO	World Health Organization
WSDP	Water Sector Development Program
WSP	Water and Sanitation Program (World Bank)
WSS	water and sanitation services
WSSA	Water and Sanitation Service Authority
WUC	water user committee

Tanzanian WASH Sector at a Glance

Access to safe, functional, and improved water points remains too low.

Only **60%** of Tanzanians get their drinking water from an improved source.

In 2016, **40%** of water points were reportedly **non-functional,** with many failing in the first year after construction.

About **two-thirds** of all piped water users in urban areas reported that they were **unable to access water** for at least one day in the previous two weeks.

The sanitation sector achieved gains in coverage in recent years, but still has a long road ahead.

Though almost all Tanzanians practice fixed-point defecation, over **80%** of rural Tanzanians rely on **rudimentary, unimproved sanitation** facilities.

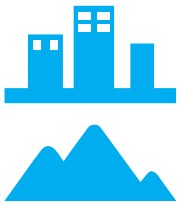
In urban areas, despite a **13%** increase in total improved sanitation, overall coverage of sewerage networks remains **low** with less than **2%** coverage in 2016.

Hygiene promotion and WASH in schools and hospitals remain neglected goals.

About **22%** of households and **75%** of schools lack a functional hand-washing facility with available soap and water.

Over **half** of health facilities report routine water shortages, which can interfere with hygienic care.

Rurality and wealth have a notable impact on access to WASH services.



Rurality explains **45%** of lack of access to improved water, while poorer wealth status explains **50%** of lack of improved sanitation access.

Only **13%** of the population practices open defecation. However, of those, **75%** are in the **B40** of the wealth distribution.

Poor WASH undermines public health and human development.

Waterborne diseases stemming from poor WASH are an issue of concern. In 2017 some **4,985** cholera cases, including **99** deaths, were reported in Tanzania Mainland and Zanzibar.

Lack of WASH can interrupt healthy childhood development by increasing risk of enteric infections and reducing retention and absorption of essential nutrients. In Tanzania, **35%** of children under age five are stunted.

Executive Summary

Tanzania is the fourth most populous country in Sub-Saharan Africa, home to more than 55.6 million people.[1] The country's macroeconomic outlook is positive, with GDP growth of 6.5 percent per annum over the past fifteen years and significant reductions in poverty since 2007.

Despite this progress, 40 percent of its population, some 21 million people, lack access to improved drinking water and more than double that figure, almost 43 million people, lack access to improved sanitation. The country recently fell a long way short of reaching its Millennium Development Goal (MDG) targets for water and sanitation, which was "to halve the proportion of people without improved drinking water and sanitation in 1990 by 2015." Now, the new Sustainable Development Goals (SDG) aim to reach *universal* access to safe water and sanitation by 2030, an aspiration that appears even more daunting.

"Reaching for the SDGs: The Untapped Potential of Water Supply, Sanitation, and Hygiene in Tanzania" is a summary report of the findings of the Tanzania WASH Poverty Diagnostic (TWPD) study led by the World Bank's Water and Poverty Global Practices team. TWPD identifies the nature of challenges of water supply, sanitation, and hygiene (WASH) access in Tanzania and proposes ways to prioritize those challenges in moving forward to meet the new SDGs. It concludes that WASH must improve not only for the sake of the sector itself, but also because of the broader knock-on effects that it has on crucial dimensions of human development and poverty reduction.

TWPD discusses the country's current development and poverty context before moving on to the ways in which poverty and WASH overlap. It then examines the different dimensions of WASH deficiencies in the country, and how these differ along economic and geographic lines. Next, it delves into specific linkages between WASH and human development, with a focus on stunting—a nutrition issue of immense importance in the Tanzanian context. It then provides an overview of the bottlenecks in the institutional and policy context that thus far have been constraining greater progress in the sector. Finally, the report offers recommendations on how to speed progress toward national and global objectives with a focus on the bottom 40% of the wealth distribution (B40).

This Executive Summary provides an overview of the key messages and recommendations of the work conducted.

Key Messages

Message 1: Tanzania Faces Ambitious SDG Targets for Water and Sanitation against a Backdrop of Low Coverage and Slow Progress during the MDG Era

The SDGs call for universal access to safely managed water and sanitation by 2030. Beyond providing technologically improved water and sanitation facilities, the country will also need to meet rigorous standards on service quality. For instance, to have safely managed water, a household must have access to a technologically improved water source that is on premise and delivers uninterrupted and clean water, free of chemical and bacterial contaminants. To meet the sanitation target, a household will need an unshared, improved sanitation facility that has regular fecal sludge management and is equipped with a handwashing station with available soap and water (JMP 2017).

However, Tanzania's performance during the MDG period sets a difficult task for meeting the ambitious SDGs. Globally, Tanzania is among the 17 countries that could not meet the water

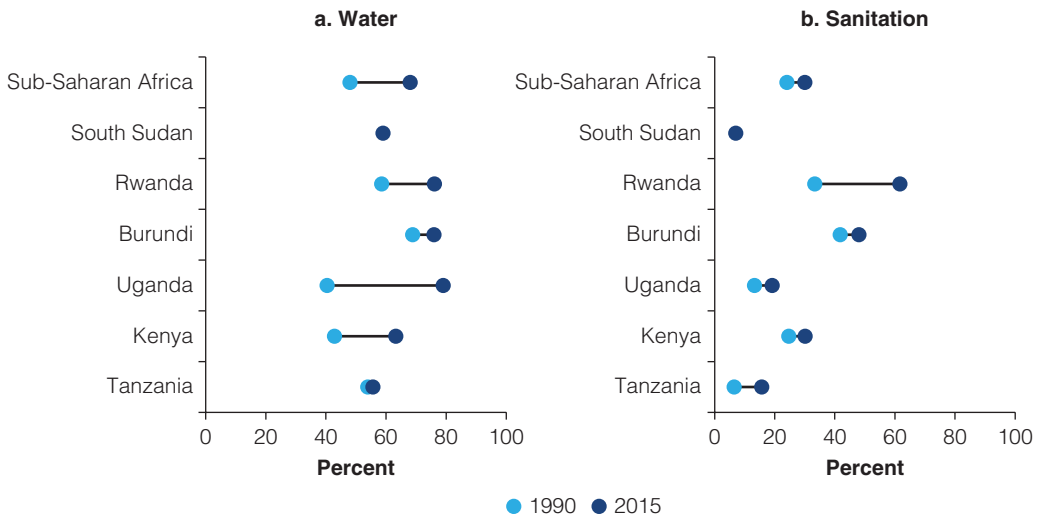
target and among the 69 that missed the sanitation target. Compared to its East African neighbors and the Sub-Saharan region, Tanzania had the smallest gains in improved water coverage during the MDG period and, despite making progress in sanitation, had the second-worst improved sanitation coverage (figures ES.1a and ES.1b). Tanzania is the second-largest economy in the East African Community (EAC) and has comparative advantages that could support strong economic growth: it is a resource-rich coastal hub and has good demographic dividends and political stability. Its shortcomings in the water and sanitation sector are somewhat surprising. Slow progress during the MDG era may make the SDG targets seem out of reach, but now the country has the opportunity to revise and revitalize efforts to ensure that all Tanzanians live in a safe WASH environment that bolsters their quality of life.

Message 2: Improved Water Services Are Largely Underdeveloped for Rural Dwellers and Unreliable for Too Many Urban Inhabitants

National improved water coverage is only 60 percent, meaning that some 21 million people lack access to a water source that is built with technology that prevents contaminants from entering the system. (See figure ES.2.) Rural areas have the worst improved water coverage—48 percent compared to 87 percent in urban areas. Many rural Tanzanians instead rely on traditional open-dug wells (24 percent) or surface water (18 percent). In urban areas, people who cannot access tap or borehole water may turn instead to costly, informal tanker trucks or water vendors.

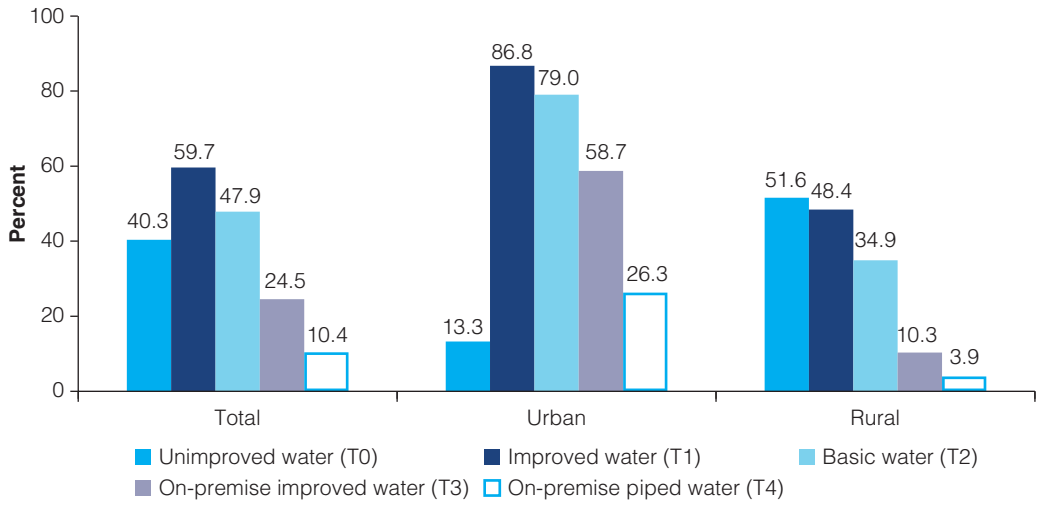
Furthermore, just 48 percent of the population has access to an improved water source that has a collection time of 30 minutes or less, and only about 25 percent have access to a water source on their household premises. Without proximal access to an improved source, many Tanzanians, particularly rural women, must travel long distances to retrieve water for drinking and other domestic needs, taking away valuable time from productive activities. On average, Tanzanians spend 36 minutes per trip to collect water. Assuming that water collection is a daily activity, with at least two trips per day, a household on average devotes more than eight hours per week to collecting water.

Figure ES.1: Changes in Access to Improved Water and Sanitation in the East African Community and Sub-Saharan Africa, 1990 and 2015



Source: World Development Indicators (database) 2017. http://databank.worldbank.org/data/home.aspx.

Figure ES.2: National, Urban, and Rural Water Access, by Tiers of Service



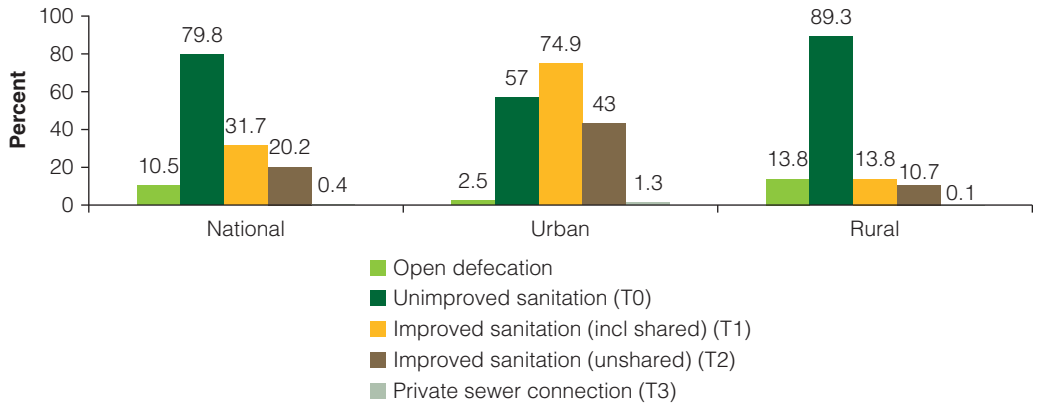
Source: DHS 2016.
Note: Box ES.1 provides a full explanation of JMP definitions on tiers of service for water and sanitation.

Though urban dwellers tend to have better access to improved water services close to their homes, they too face challenges of unreliable service, high dependence on informal providers, and low water quality. For instance, two-thirds of piped water users report an interruption in service at least once every two weeks. These problems stem from financial and service delivery problems at the urban utilities. For example, DAWASCO, Dar es Salaam's utility, suffers from high rates of non-revenue water, consistently exceeding 50 percent over the past three years. Figures like these may reduce the utilities' ability to invest in expanding and improving services for the sprawling urban population. In Dar es Salaam, 18 percent of the bottom 40 rely on informal tanker trucks.

Message 3: The Longstanding Neglect of Sanitation Leaves 80 Percent of the Population Relying on Rudimentary and Unsafe Facilities

Improved sanitation reaches a mere 20 percent of the population nationwide (figure ES.3), meaning that the vast majority of Tanzanians, some 43 million people, are relying on rudimentary, unimproved facilities. At the same time, there are pockets of open defecation highly concentrated in the northeast of the country, with a total of 14 percent of the rural population (5.1 million people) lacking a toilet. In urban areas, less than 2 percent of the population has a sewer connection. **Without a national policy on sanitation and clear designation of an agency to guide the rural sanitation sector, there is limited political will and coordination to effectively scale up sanitation interventions.** Rural sanitation has benefited from some successful campaigns to reduce open defecation, but there is little progress in transitioning households to using technologically improved sanitation facilities. Thanks to sanitation champions such as the late President Julius Nyerere, open defecation was successfully reduced through initiatives such as the 1973 *Mtu Ni Afya* ("Health Man") campaign. New campaigns such as *Choo Bora* ("A Good Toilet is Possible!")—using behavioral change communication (BCC) and sanitation marketing approaches to encourage the uptake of improved latrines—have achieved some success in pilot districts (World Bank 2017). But large scale-up of improved sanitation remains unachieved.

Figure ES.3: National, Urban, Rural Sanitation Access, by Tiers of Service



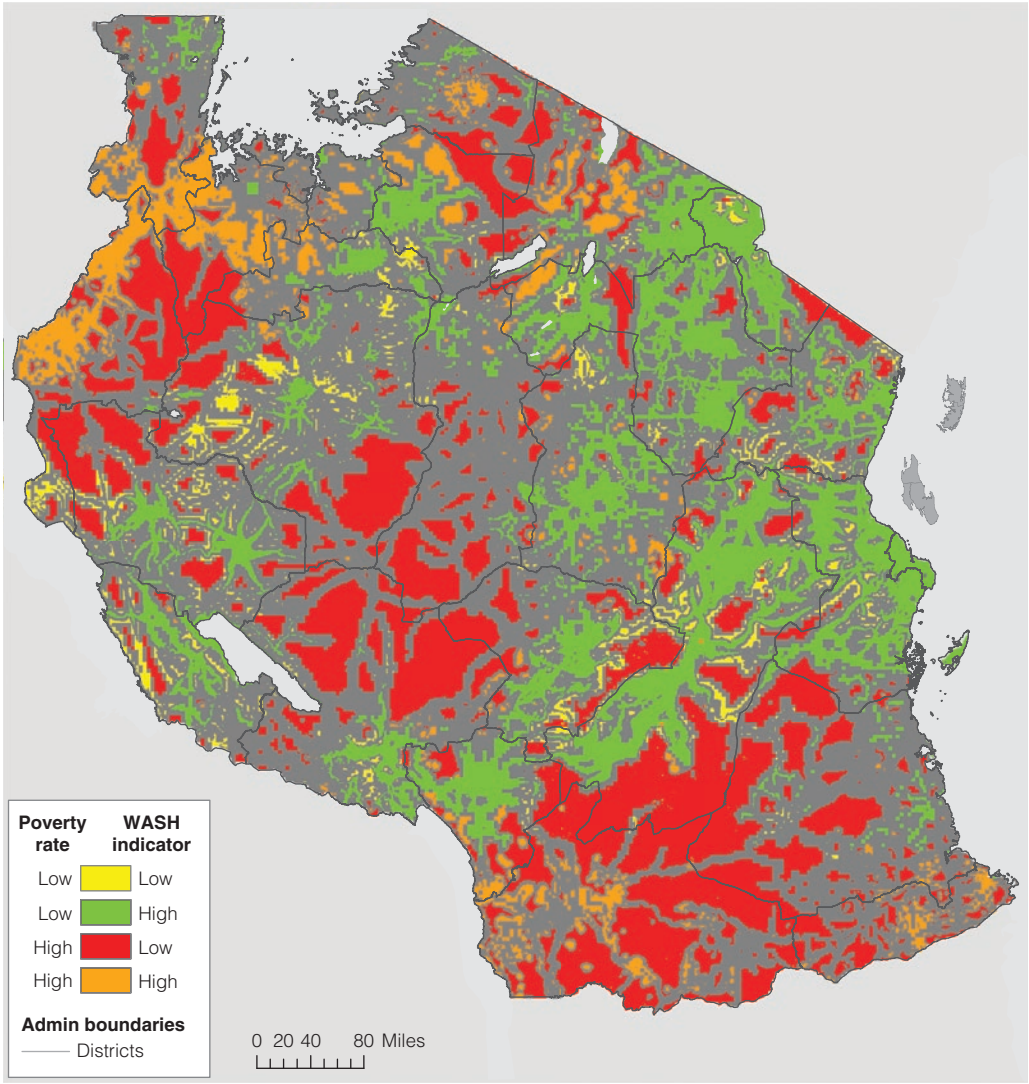
Source: DHS 2016.
Note: Box ES.1 provides a full explanation of JMP definitions on tiers of service for water and sanitation.

In contrast, provision of urban sanitation services is delegated to too many organizations, with low accountability, and often misaligned responsibilities and functions. Responsibility for the operation of sanitation and hygiene facilities (cess pit emptying, cleaning of public latrines, solid waste collection, etc.) is divided among a plethora of organizations at all levels. Concerning oversight, five ministries— water, environment, health, education, and local government—have some responsibility for sanitation. Implementation is delegated to parastatal organizations, the private sector, NGOs, and CBOs. However, these organizations typically face limited capacity to implement at a large scale. This leaves the majority of Tanzanian cities with minimal treatment of sewerage. Dar es Salaam discharges it directly into the Indian Ocean and the Msimbazi River. While wastewater stabilization ponds do exist in the city, recent reports found that five out of seven of these were malfunctioning. Tanga port has a similar problem: 2,164 cubic meters of raw sewage are discharged directly into the Indian Ocean each day.

Message 4: Rurality and Poverty Are the Primary Drivers of Low WASH Coverage. The Sustained Deprivation of WASH Signals that Business-as-Usual Investments Are Not Showing Sufficient Return for the Country's Rural Majority Population

Spatial analysis shows substantial overlaps between rurality, high poverty rates, and low WASH coverage. Red patches on map ES.1 show overlap in high poverty and low improved water coverage in the dry season in Ruvuma in the South, Katavi and Mbeya in the West, and parts of Tabora and Kigoma in the North. Such patterns could be due to the fact that more than 90 percent of the poor live in rural regions. Business-as-usual investments are not overcoming service delivery barriers associated with rurality and poverty. The urban-rural disparity in WASH services is stark, with minimal progress in closing this gap during the MDG period. In Tanzania and in many countries throughout the world, urban households are better off than their rural counterparts because they have superior endowments in measures such as education, assets, and institutions (World Bank 2015). Implementing services for urban dwellers is typically easier than for rural residents, but with 70 percent of the national

Map ES.1: Cross-Mapping of Poverty Versus Percentage of Population with Access to Improved Water in Dry Season

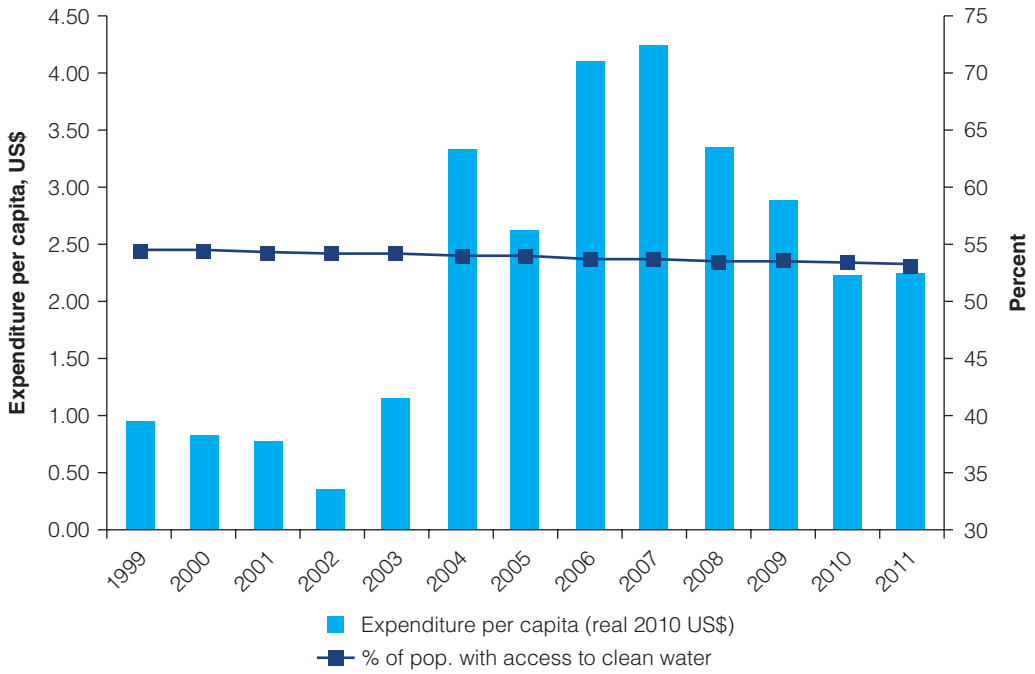


Source: Gething 2017.

population living in rural areas, the vast majority of whom are poor, the country needs to give special attention to designing interventions that can reach the poor as well as be sustainable in rural settings.

Despite large-scale investments in expansion of rural water services, coverage rates have not shown corresponding increases (figure ES.4). Of the 83,000 rural water points recorded in the national water point census as of 2014, 40 percent were found to be non-functional, with the likelihood of failure highest at 20 percent, their first year of operation. A more in-depth analysis of this water point data has shown that technology choice, hydrology, management, and location-based factors are to varying degrees responsible for the failures. Going forward, the country would do well to learn from these experiences to ensure that future investment provides more sustainable results.

Figure ES.4: Spending on Water versus Access



Source: Carlitz 2016.

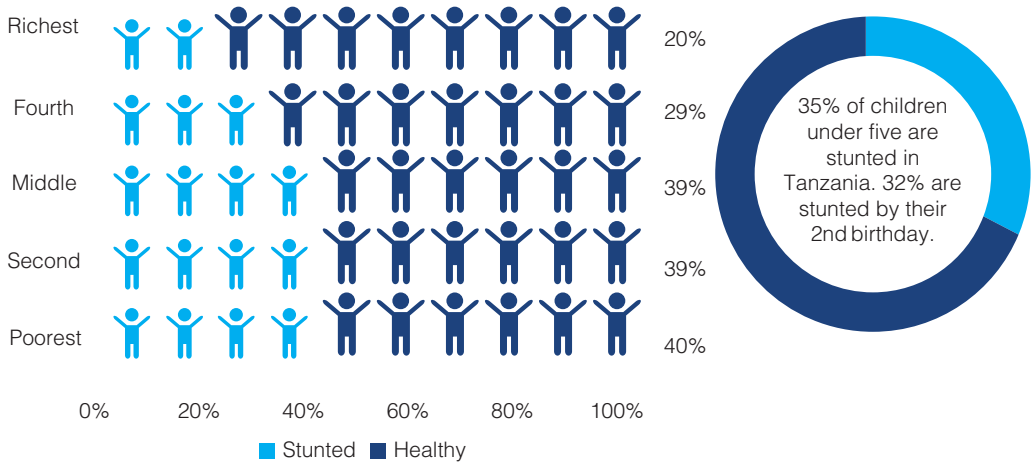
Message 5: WASH Investments Can Lead to Broad Knock-On Effects on Productivity and Human Development in Tanzania

Adequate WASH conditions are a cornerstone for improved human development and accelearated poverty reduction in Tanzania. In view of the multifaceted harmful effects of inadequate WASH, ensuring WASH access is critical for meeting multiple objectives across sectors. SDG 6 and its six targets are inextricably linked with a number of the other SDGs and targets including ending extreme poverty (1.1); ending forms of malnutrition (2.2); reducing infant mortality (3.2); and improving educational attainment (4.1).

Improving WASH can go a long way toward reducing stunting and enhancing life in a child's early years. It is not just a matter of preventing the onset of water-borne illness and diarrheal disease. One of the most unexpected impacts of inadequate WASH is its contribution to chronic intestinal infection, which can lead to higher rates of stunting, a marker of undernutrition for children under five (figure ES.5). Stunting is not just about physical stature. It also hinders healthy early childhood development. Getting insufficient nutrients can limit a child's cognitive capabilities, leading to lower schooling, earnings, and overall productivity later in life.

WASH beyond the household—in public spaces such as schools and health centers—holds particular importance for human development outcomes. One in three health centers in Tanzania does not have improved WASH facilities, which means that patients could pick up other infections during visits. In schools, substandard WASH can lower learning. Poor sanitation discourages girls from attending school during menstruation, and a lack of on-premise water takes time away from learning as teachers and pupils carry water back to school. It also reduces the likelihood of hand washing in an environment where children face high risk of picking up germs from one another and their surroundings during play and other interactions.

Figure ES.5: Proportion of Children under Age Five Stunted in Tanzania, by Wealth Quintiles



Sources: DHS 2016; World Bank 2017.

Message 6: There Are Shortcomings in the Institutional Dynamic and Policy Framework that Limit Progress in the WASH Sector

A history of centralized delivery and the politicization of water have been the backdrop for different types of failings in rural and urban contexts. An incomplete decentralization process has led to a misalignment of roles and responsibilities as well as functions and functionaries affecting accountability relationships which in turn has adversely affected service delivery. Decentralization efforts in rural areas have created the institutions at local and community level in a *de jure* sense. However, the *de facto* centralized tendencies have often led to confusion of the respective roles and responsibilities in practice. For instance, Local Government Authorities (LGAs) are not being held accountable for providing technical assistance and financial support to community water committees (COWSOs) when needed due a lack of clarity in determining when such support is warranted. This is one of the factors that has led to the prevalence of non-functional water points across the rural landscape.

Donor interventions tend to focus less on institutional shortcomings and thus perpetuate existing dynamics. Misplaced focus in the water sector on new infrastructure construction rather than on maintenance also stems from the fact the donor contributions are structurally biased towards capital investments. The political capital gained from building new water points, rather than ensuring the maintenance or sustainability of existing ones, has traditionally been both the more popular and the easier approach. Tanzania as a historic "donor darling" has long been a recipient of aid and thus only more recently have sustainability considerations been more fully taken into account. Donors are now increasingly recognizing the importance of ensuring that the existing institutional structures also need strengthening, to ensure accountability and deliver improved services. They are also encouraged to "celebrate maintenance" to shift norms in the sector that have led to unsustainable infrastructure.

Political and electoral considerations often tend to dominate new construction decisions, leading to suboptimal public works. For instance, though the construction of new water points should be allocated according to an established formula agreed upon within the Ministry's official documentation, quantitative analytical studies which have contributed to this diagnostic have

confirmed commonly discussed politicization of water, finding a significant correlation between allocation of funds and election cycles driven in part by favoritism and clientilistic practices (Carlitz 2017).

Sanitation meanwhile has seen the opposite problem, with an absence of national policy and few actors willing to champion the cause in the political space. Sanitation received prominence during the years of the Julius Nyerere government which helped Tanzania to make a significant dent in open defecation prevalence. However in the present day, institutional arrangements for sanitation in both the urban and rural contexts are characterized by a lack of "champions" to bring the issues front and center of the political agenda. A lack of appreciation of the potential for return on investment and the division of responsibilities for oversight between so many

Box ES.1: The Importance of Data

The Tanzania WASH Poverty Diagnostic has drawn on data from several sources to document as far as possible the country's history and current conditions in terms of water supply, sanitation, poverty and health. Data sources include household surveys (primarily Demographic and Household Surveys [DHS] from 1996 to 2016); Joint Monitoring Programme (JMP) data on the MDG targets since 1990; the Rural Water and Sanitation Survey (RWS) collected under the supervision of the World Bank and the Water and Sanitation Program until 2014; poverty data calculations from the National Bureau of Statistics in collaboration with the Poverty Global Practice World Bank; and the Tanzanian Ministry of Water and Irrigation's Water Point Mapping data from 2014.

Gaining an understanding of the overall picture through analyses of different data sources has sometimes been a challenge in and of itself because they provide different lenses on common problems. Lack of consistent and reliable data is a particular limitation in Tanzania in establishing trends over time and fixing attainable targets across sectors. There is also a need for representative household data at the district level to better undertake inferences at the level of local government authorities, the lowest administrative units) with more statistical precision. As for the WASH sector, SDG monitoring requires reliable water quality estimates at the district level. Water Point Mapping data from the Ministry of Water and Irrigation has also been undergoing iterations of cleaning in order to ensure the information is accurate.

Reliable data collection, verification, harmonized indicators in line with national targets, and data entry are key to providing concrete insights to stakeholders in a technical and politically neutral manner. In Tanzania, the collection and use of Water Point Mapping data in particular are on their way to being institutionalized. The data have been undergoing iterations of cleaning in order to ensure accuracy. Regular updating using improved technologies should be integrated into the mapping process.

different actors has led to a disordered institutional set up. The result of this is manifest in the absence of a clear national sanitation policy which needs to be addressed.

Finally, in spite of the availability of financial resources, considerable capacity limitations to plan, implement and monitor water supply programs plague the sector, thus affecting the expansion of safe access. For instance, the rural water supply and water resources sub-sectors were able to utilize only 52 percent and 46 percent respectively of all the allocations they received in FY 15-16 while sanitation sector was unable to use almost any of its financial allocations. Any new initiatives need to focus on improving the capacity of the institutions and policy framework in the sector so as to translate available finances into improved and cost-effective service delivery. If Tanzania brings these lessons into new initiatives, it has the potential to become an example which other countries can emulate.

Recommendations for Moving the WASH Sector Forward in Tanzania

Challenge #1: Creating a Roadmap toward Meeting Tanzania's SDGs for Water Supply, Sanitation, and Hygiene as well as other WASH-Relevant Goals

Recommendation 1: Integrate the SDG framework into poverty-reduction strategies and WSS programmatic approaches such as Water Sector Development Program (WSDP) II. Tanzania's National Strategy for Growth and Reduction of Poverty (MKUKUTA), first adopted in 2005, provides for embedding the MDG targets in poverty reduction efforts. The plan, which gave high priority to eradicating extreme poverty and promoting broad-based growth, has had significant effect, with national basic needs poverty declining from 34.4 to 28.2 percent between 2007 and 2011/12. The integration of the SDG targets into the WSDP II framework would be the first step to getting Tanzania on track toward the SDGs for WASH. We can consider the SDGs as providing Tanzania with a clean slate, promising a new beginning as the global community transitions from infrastructure to service oriented goals. Despite a lack of progress in the MDGs, the SDGs provide a new, more accurate set of definitions and standards to aim at. These new standards acknowledge water quality, safe waste disposal, and the importance of WASH in public spaces, particularly schools and health centers. Putting Tanzania's national statistics into the SDG framework can provide a helpful stepping stone toward this integration.

Challenge #2: Enhancing the Sustainability of Rural Water Services

Recommendation 2: In making further investment in rural water and sanitation de-emphasize construction and "celebrate maintenance" to enhance sustainability in the future. Part of the reason why so many rural water points failed has been the excessive focus on new construction, which led to the installation of water systems that the local communities do not have the capacity to manage. Data analysis of 83,000 water points as part of this WPD shows that 60 percent of failures in the first two to four years resulted from the wrong choice of pump type, suggesting that the choice of an appropriate technology is a key reason for water point failure. The limited management capacity of small and often poor communities in the B40 and lack of proper backstopping arrangements also contributed to the frequent water system breakdowns. All this has translated into large quantities of money being invested with lower than anticipated returns.

For these reasons, programs to enhance sustainability of rural water schemes should consider the following three steps. First, programs should ensure that technology choice takes into account the capacity of the community or their technical service provider to operate and maintain the system. Second, donors and governments should shift their focus from construction to the "celebration of maintenance," focusing on the effective oversight of water scheme choice, construction and maintenance by central and local government and communities. Third, donors and the client should work together to further institutionalize the collection, verification, and use of data in analysis for policy planning and investments. Together, these steps will bring a welcome result for all parties involved, a higher return on funds invested in future.

Challenge #3: Improving Reliable and Affordable Access to Safe Water in Urban Areas

Recommendation 3: Address utility inefficiencies, the growth in dependence on informal private providers, and the need for expanded regulation. In urban areas, in particular in the major city of Dar es Salaam, a history of "hydraulic exclusion" that begun back in the colonial period shapes the dynamic of expansion of the water network to this day. Tanzanian cities typically have a small core area with a long-standing piped water network while large areas of the periphery are forced to rely on non-networked solutions, particularly in low income areas. Those most reliant on informal service providers (ISPs) are the poor, who often face the highest costs, despite their lower ability to pay. The ISPs are not subject to regulation. Therefore the quality of water they provide is unknown. Unregulated wells may also be depleting groundwater sources in disregard of broader water resource management concerns. Finally, ISPs often take their water supply from the utilities, thereby further reducing the utilities' revenue at the same time as taking their customers.

The first priority for Tanzania's urban utilities in expanding reliable water networks to the urban periphery is to reduce their rates of non-revenue water and enhance their fiscal management. Their service expansion can then be both poor-inclusive and financially sustainable. Despite ranking quite highly in terms of their capacity to serve the poor compared to other urban utilities in Sub-Saharan Africa (van den Berg and Danilenko 2017), Dar es Salaam's DAWASCO has only recently begun recovering from consecutive years of 50 percent-plus levels of non-revenue water (Triche, Kariuki, and Makino 2012). DAWASCO has tried to employ pragmatic solutions in expanding improved coverage, using tanker trucks and standpipes for areas further out of the original network remit. But in order to ensure that network expansion does not mean unreliable supply, it first needs to ensure it has the revenues to pay for network maintenance.

In the medium to long term, both the utility and the population will benefit greatly from reduced reliance on informal providers. Though at present, 58 percent of the Tanzanian population pay nothing for water according to available data, 10 percent were devoting more than 5 percent of their total household expenditures to it in 2012. This was the highest in a recent JMP study (WHO 2017) of 11 countries worldwide. (The international standard is a maximum of 2 percent.) In Dar es Salaam, the B40 recently overtook the T60 in portion reliant on tanker trucks for their supply. Because water from informal vendors can cost as much as five times more than utility water, the integration of their customers into utility networks will ultimately mean greater revenue for the utility as well as lower cost basic services for the poor. In the short term, placing informal providers under the umbrella of regulatory institutions would begin to meet concerns of water quality and safety concerns. A longer-term approach would have the urban utilities strategizing to increase their recovery of costs and expand their network services to areas that are now informally served.

Challenge #4: Transitioning 89 Percent of Tanzania's Rural Population from Unimproved to Improved Sanitation Facilities

Recommendation 4: Formulate more coherent policy, more clearly define and assign responsibilities for sanitation, and identify sanitation champions. This report highlights that a key constraint on the success of previous sanitation interventions in rural areas has been the lack of a coherent policy and institutional framework. Responsibilities are currently divided between many different ministries. Though the Ministry of Health is meant to take the lead, its other responsibilities appear to be crowding out its ability to act on sanitation. As the evidence presented in this diagnostic shows, sanitation needs a clearer focus at the heart of health policy if coverage is to substantially increase. This should include learning lessons from past interventions on successes and failings and recognize the need for larger financing mechanisms, whether market-based or public sector. Demand creation needs to go beyond community-led total sanitation and toward encouraging the transition from unimproved to improved facilities. On the other side of the equation, there is a need to provide affordable and desirable supply of sanitation equipment and facilities. This may mean encouraging the involvement of private sector actors by making them aware of the potential financial returns and strengthening their capacity to meet demand for those who have varying capacities to pay. Meanwhile, a public sector approach may involve integration of sanitation interventions into social protection programming such as the Tanzania Social Action Fund (TASAF), which aims to aid the country's poorest citizens. Tanzania already has case studies of successful sanitation marketing (Cardosi, Mwambuli, and Indodi 2010), as well as evaluations of implementation challenges (Share Consortium 2016). The challenge of scale-up needs particularly close examination for both public and private efforts.

The setup of a clearer institutional structure, with an identified champion at its helm, would greatly aid the transition from unimproved to improved sanitation as part of a national strategy, integrated with health. A nodal institutional arrangement would help to clearly define responsibilities for sanitation regulation and provision.

Challenge #5: Making Sanitation Safer in Urban Areas through Onsite and Offsite Sanitation Solutions that Include Fecal Sludge Management

Recommendation 5: In urban areas, adopt citywide sanitation approaches that recognize that different solutions are suitable in different contexts. Diverse experiences across developing country contexts suggests that citywide inclusive sanitation would succeed in Tanzanian cities, with their rapidly expanding population mostly in low-income areas. Donors and other country governments can share knowledge on the most effective designs, mixing onsite and offsite sanitation solutions in urban contexts. In cities with densely populated informal settlements where sewerage pipes are either too expensive to lay or disruptive of existing infrastructure, onsite improved sanitation solutions such as DEWATS can be employed in order to ensure that waste is safely disposed of and treated. Such solutions are poor-inclusive, well suited to cities such as Dar es Salaam that have a history of extremely limited networked sanitation. Sewerage network expansion remains extremely low at under 2 percent nationally, and as most public funds continue to be invested in cities, the result is that the wealthy are being served before the poor. Facilities for wastewater treatment also need urgent investment attention. In Dar es Salaam, for example, five out of seven wastewater stabilization ponds were found to be malfunctioning. Without proper treatment, expansion of networks will create environmental and health-related hazards.

The unimproved to improved facility transition also needs to occur for at least 25 percent of the urban population who lack improved access. During the rainy season, flooding can lead to

the overflow of unimproved latrines, their contents easily contaminating drinking water. With the World Health Organization reporting some 4,985 cholera cases, including 99 deaths in Tanzania Mainland and Zanzibar in 2017, waterborne diseases are still very much a concern. These illnesses hit Low Income Areas the hardest.

Challenge #6: Enhancing Early Childhood Development through WASH Services

Recommendation 6: Design WASH interventions with a "nutrition-sensitive" lens and seek to integrate WASH into multi-sectoral strategies addressing education, health, and nutrition outcomes. Better WASH conditions can help children thrive and fulfill their full potential to be engaged and productive citizens and leaders of the future. As this diagnostic demonstrates, substantial evidence in Tanzania supports the link between unimproved sanitation and stunted growth in children under five, particularly in their first 1,000 days. With unimproved sanitation so common in both urban and rural areas of Tanzania and the harm to health so clear, this diagnostic recommends the integration of WASH into health, education, and nutrition strategies for early childhood development. In addition, the country needs committed financial allocations and robust expenditure strategies to fully implement the National Sanitation Campaign (NSC). The diagnosis reveals that WASH interventions are most effective in combination with other strategies that include enhancing the mother's wellbeing. There is room for more exploitation of synergies with large countywide social protection programs such as the Tanzania Social Fund (TASF) to expand sanitation to distant villages and the extreme poor.

For instance, designing WASH interventions with behavior-change components that address handwashing, household water treatment, food hygiene, open defecation, and other behaviors that affect exposure to fecal bacteria could help reduce enteric infections that lead to undernutrition. Further gain would come from monitoring indicators beyond infrastructural access, such as behaviors and water quality deficiencies that contribute directly to the contracting of enteric infections and waterborne diseases. Targeting WASH interventions to areas that have high prevalence of stunting or expectant mothers and children would be nutrition-sensitive. Through cross-sector interventions like these, the country could move more quickly toward other SDGs such as Goal 6 relating to child health.

Challenge #7: Improving the Slow, Inefficient, and Unreliable Financial Flows between National and Local Institutions

Recommendation 7: Facilitate efficient, transparent, and predictable financial flows between WSS actors—from donor, to government, to community—to promote sustainable governance. Primarily in rural WSS interventions, the diagnostic has uncovered a mismatch between the investments made and the level of change achieved. Within the Tanzanian government, a more transparent, rapid, and simple flow of funds and data between all levels of government would ensure more efficient service provision to the end user. These financial flows would be aided by clarity of institutional role on the ground.

Following a political economy analysis, the WPD recommends a facilitation of financial flows between all levels of the "sustainability chain," that is, from donor to government and from national offices down to local and community providers. This could be achieved through three basic steps. First, continue to strengthen the relationship between donors and government in order to facilitate communication and data flow and raise data quality. Second, work for clearer communication between central government, LGAs, and communities, which would help to ensure that funding and technical support moves when required from one to another. Third, invest more in tracking of financial flows between all levels to garner more accurate measurement of impact and a clearer understanding of "what works."

Tanzania's WASH challenges in the SDG era may seem daunting. The WASH Poverty Diagnostic seeks to provide relevant analysis that can help create a solid foundation for first steps toward the goals.

Note

1. Data are from World Development Indicators (database). 2016. World Bank, Washington, DC. http://databank.worldbank.org/data/home.aspx.

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Chapter 1
Introduction

Investing in WASH for Better Human Development and Faster Poverty Reduction

Lack of access to basic water supply, sanitation, and hygiene (WASH) services is a major shortcoming in the United Republic of Tanzania's developmental success. Though the country has achieved significant economic growth and rising household incomes in recent years, it falls behind in expanding and sustaining basic WASH coverage. As the fifth-most populous country in Sub-Saharan Africa, Tanzania is home to more than 23 million people who retrieve drinking water from technologically unimproved sources and 41 million people who use unimproved sanitation facilities. Moreover, the country did not meet the Millennium Development Goal (MDG) target of halving by 2015 the 1990 proportion of people lacking access to improved water and sanitation. That made Tanzania one of just 17 countries to miss or have only limited progress toward its targets. According to 2016 estimates, improved water coverage stands at 59 percent, having increased a mere 2 percentage points since 1990. The proportion of people who have access to improved sanitation has risen by 13 percentage points since 1990, but today the overall figure stands at just 20 percent.

The overall slow progress in the WASH sector hinders human development and poverty reduction strategies. Established in 1998, Tanzania's National Strategy for Growth and Reduction of Poverty (MKUKUTA) aims to eradicate poverty and promote broad-based growth. In a sign of success for the strategy, the proportion of people living below the national poverty line declined from 34 percent in 2007 to 28 percent in 2012. However, a large proportion of Tanzanians live only slightly above the national poverty line, making them highly vulnerable to shocks and becoming impoverished once again. Furthermore, overall human development is comparatively weak in Tanzania. On the Human Development Index (HDI),[1] Tanzania scores a low 0.531, ranking it 151 out of the 181 countries examined worldwide.

Poverty vulnerabilities and low human development are worsened by a lack of access to basic services and opportunities. Development cannot be measured just by household income and expenditures. It is also determined by factors such as social mobility, health, quality of life, and human capital. Adequate WASH is a crucial component of basic necessities that allow a person to thrive in life. For instance, outbreaks of cholera and other waterborne illnesses can overburden health systems and increase premature deaths. Emerging evidence also identifies chronic exposure to poor sanitation as a cause of undernutrition, resulting in irreversible deficits in growth and early childhood development. A less dramatic, but still substantial effect is a child missing a day of school due to diarrheal disease or any of the other illnesses that poor sanitary conditions cause. For those who can manage to stay healthy, valuable time can be lost to caring for household members stricken with the illnesses or simply to the daily, lengthy excursions to find water to take back home. It is no surprise that people who remain without WASH access are primarily vulnerable groups living in the poorest regions of the country and members of the bottom 40 of the national wealth distribution.

The new Sustainable Development Goal (SDG) era is an opportunity for Tanzania to move its WASH sector forward by not only expanding basic access to WASH, but also by investing in higher-quality WASH services that have complementary benefits for improving human development and eradicating poverty. SDG-6 challenges countries to reach *universal* access to safely managed water and sanitation by 2030. Unlike the previous MDG targets, the SDG's safely managed water and sanitation targets measure multiple indicators of service quality. For example, the "safely managed water" indicator not only factors in household access to an improved technological source, but also measures whether such sources are free of bacterial and priority chemical contamination, are available when needed, and are located on a household's premises for convenient access. The "safely managed sanitation" indicator measures whether households can access an unshared improved sanitation facility whose excreta will be safely disposed of and treated. For the first time, hygiene practices are included in the monitoring program, which will collect data on whether households have a handwashing station with soap and water. Finally, WASH monitoring will expand beyond the household and into schools and healthcare facilities, where the young and hospitalized can be especially vulnerable to unsanitary environments. On the whole, SDG-6 is an attempt to break away from the "business-as-usual" provision of water and sanitation infrastructure. Instead it holds that future strategies should take a holistic approach to creating safe WASH environments that effectively relieve multiple burdens of poverty and bolster human development.

Background and Objectives of the Tanzania WASH Poverty Diagnostic

The Tanzania WASH Poverty Diagnostic (TWPD) is a data-driven exercise that benchmarks key WASH indicators and builds sector knowledge relevant to meeting the new SDGs. As Tanzania seeks to achieve the more ambitious SDG targets, it is more important than ever to assess the current state of WASH service delivery in order to inform evidence-based strategies that target gaps in service delivery. The objectives of the diagnostic are to (1) highlight the priority gaps in WASH access; (2) identify those regions and population groups that are most deprived of higher-quality WASH services; (3) demonstrate how investment in WASH can aid poverty reduction and human development strategies; and (4) identify the major institutional constraints that hold back effective WASH service delivery. The Tanzania WASH Poverty Diagnostic is part of a larger Global WASH Poverty Diagnostic (GWPD) initiative being implemented in 18 countries across regions. Among African countries, the study is being conducted in Niger, Nigeria, Mozambique, Democratic Republic of Congo, Ethiopia, and Tanzania. The motivation behind GWPD is to begin a global benchmarking and knowledge platform that focuses on WASH service delivery inequities of the bottom 40 percent, so as to guide World Bank operations and strategy. The central framework is defined by four core questions (CQs), each intended to examine WASH through a pro-poor lens but to be general enough to be adapted to a unique country context. As a result, the global framework has steered the analytical work of the TWPD.

Below are the four CQs and a brief explanation on their methodological adaption to the Tanzanian context.

CQ-1: Who and Where are the Poor?

The first question attempts to provide basic poverty statistics and show spatially where the poor are located in Tanzania. An understanding of the poverty context forms a basis for informing pro-poor strategy in the WASH sector. TWPD examines localized levels of poverty by mapping areas where there are a high proportion and number of people living below the national poverty line according to Household Budget Surveys. This was carried out using geo-statistical mapping at the lowest levels of estimation possible for pixel-level maps.

CQ-2: What is the Level of Access and Quality of WASH Services Experienced Across Regions and Populations, Including the Poor?

The second question analyzes WASH coverage at localized levels and for poorer populations and other sub-populations. TWPD examines various tiers of WASH access guided by national goals and SDG targets, and proposes indicators for providing safe and universal WASH. Data are aggregated from various secondary sources including the Household Budget Survey (HBS), census, Demographic and Health Surveys (DHS), and Multiple Indicator Cluster Surveys (MICS). Geospatial mapping is conducted to illustrate the high spatial variability of access.

CQ-3: What are the Linkages and Synergies Between WASH and Other Sectors?

The third question aims to provide evidence on the necessity of improving WASH to raise human development and lower poverty. The use of this type of knowledge is largely to aid advocacy for investment in WASH, but it also gives insight into the effectiveness of WASH interventions and how they can be better designed to improve development outcomes in such fields as health and nutrition.

CQ-4: What are the WASH Service Delivery Constraints and Potential Solutions to Improving Services to the Poor?

The final question examines the major institutional gaps that inhibit quality WASH service delivery for the bottom 40 and its sub-populations. CQ-4 is answered using desk studies. The diagnostic seeks to place all the evidence gathered in an operationally relevant framework by assessing institutional set-up and identifying bottlenecks that should be removed to improve

SDG-6 targets	
6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all
6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
6.3	By 2030, improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
6.4	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
6.5	By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes
6.7	By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling, and reuse technologies
6.8	Support and strengthen the participation of local communities in improving water and sanitation management

WASH service delivery. This component holds particular relevance for Tanzania because of the low levels of improvement over time in WASH services.

The report summarizes the primary findings of the four core questions. It is divided into eight chapters. The first chapter provides a basic poverty assessment in order to establish the country context and better understand its intricacies of poverty. Chapters 2-4 assess access to water, sanitation, and hygiene, adhering to the new SDG service dimensions when possible and disaggregating access levels by regions and population groups. Chapter 5 examines the issues around WASH in schools and health care facilities. Chapter 6 lays out the linkages between WASH and human development, primarily focusing on how poor WASH worsens undernutrition, including presentation of new econometric evidence that illustrates the links between poor WASH and stunting. Chapter 7 gives an overview of the key institutional challenges that inhibit efficient WASH service delivery. Finally, chapter 8 provides overall recommendations for moving the WASH sector forward and meeting the new SDGs.

Note

1. The HDI is a summary measurement of life expectancy, levels of education, and gross national income (GNI).

Chapter 2
Country and Poverty Context

Country Context

With a GDP of US$44 billion, Tanzania is the sixth-largest economy in the Sub-Saharan Africa region. Among the six East African Community (EAC) members,[1] Tanzania is the largest in geographic size and population, and the second-largest in economic size, behind Kenya (World Bank 2017). The country has regional comparative advantages that support strong economic development, including its location as a coastal country and ability to serve as a regional hub, its endowment of rich and diverse renewable and non-renewable resources (such as high-quality agricultural land, marine life, minerals, forestry), and a relatively stable political climate with few conflicts. Tanzania is classified as a low-income country but is close to reaching middle-income status, as its per capita gross national income (GNI) slowly rises from US$910.

Tanzania benefited from positive macroeconomic growth over the past 15 years. The country's macroeconomic performance in the past 15 years has been robust, with GDP growing at an average of 6.5 percent per annum with relatively small year-to-year fluctuations (World Bank 2015). This figure is above the Sub-Saharan average of 4.8 percent in the same period. Dynamic sectors such as finance, communication, tourism, and construction helped move the economy forward. Nonetheless, the agricultural sector, the mainstay of more than 70 percent of Tanzanian households, has grown only slowly and is less productive compared to other sectors Furthermore, growth over the past half decade has been largely driven by consumption rather than investment. The public investment to GDP ratio remains low and stagnant (World Bank 2015).

With an economy that is dependent on agriculture and natural resources, Tanzania is particularly vulnerable to resource depletion and climate change. The country has a complex landscape with high variability in spatial climate. Climatic conditions are projected to gradually deteriorate, with temperature rising by 1–3°C in the next 50 years. Climatic variability is already causing significant economic costs by weakening agriculture, energy, human health and natural resources, thereby holding back growth and poverty reduction prospects. The country's poor and vulnerable groups are particularly prone to extreme climatic events. With the cost of adapting to climate change rising, Tanzania has taken some initial steps in this direction, but much remains to be done in terms of clearly identifying priority investments required for building up

KEY POINTS

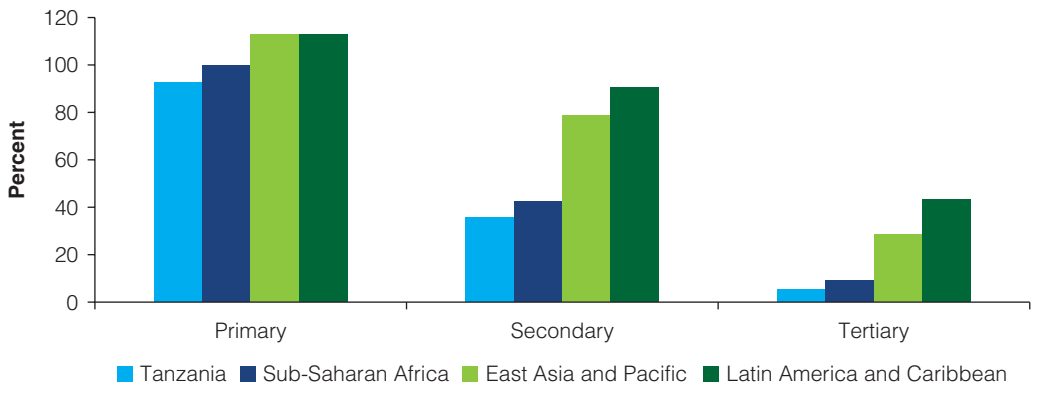
Tanzania has achieved robust macroeconomic growth in the past 15 years. GDP has expanded by an average of 6.5 percent per year.

The country has achieved significant reduction in poverty since 2007. The proportion of people living below the national poverty line decreased from 34.4 to 28.2 percent between 2007 and 2012.

A large proportion of the population lives just above the poverty line. These people remain vulnerable to falling back into poverty.

The bulk of the poor live in rural areas. About 84 percent of the poor reside in countryside areas, amounting to 10 million people in 2012 (World Bank 2017). In urban areas the headcount is 1.9 million.

Figure 2.1: Gross School Enrollment in Tanzania and Other Regions



Source: World Bank 2015.
Note: Regional aggregates for year 2011 and Tanzania estimates for 2012.

resilience to climate change. The Tanzanian economy is highly dependent on natural resource-based sectors, notably tourism, agriculture, fisheries, and mining. At the same time, the vast majority of the poor are particularly reliant on natural resources for their livelihoods. This high dependence is placing excessive pressure on ecosystems, threatening sustainability, and endangering the livelihoods of the poor and vulnerable communities.

Overall human development is comparatively weak in Tanzania. On the Human Development Index (HDI),[2] Tanzania scores a low 0.531, ranking it 151 out of the 181 countries examined worldwide (UNDP 2014). In education, gross enrollment rates at all levels of schooling are lower than the average for Sub-Saharan countries and below other developing regions (figure 2.1). Health burdens are also holding back gains in human capital. Rates of maternal mortality, undernutrition, malaria, and HIV/AIDS are particularly high for the region. Tanzania met its MDG target for child mortality but missed its target on reducing maternal mortality. That measure (per 100,000 births) declined from 578 in 2004/05 to 432 in 2012. Stunting, which reflects chronic malnutrition, remains consistently high at 34 percent, classifying the country as a priority Scaling Up Nutrition (SUN) area. Tanzania also continues to be one of the world's most badly malaria-affected countries—an estimated 10 million cases occurred in 2010. HIV/AIDS prevalence, estimated at 5.1 percent of the population aged 15–49 years (World Bank 2017), is above the Sub-Saharan African average. Low skills and education in the labor force create additional constraints to business enterprise growth in Tanzania. Promoting human capital, including fostering healthy early childhood development, is recognized as a key strategy in the country's sector development plan.

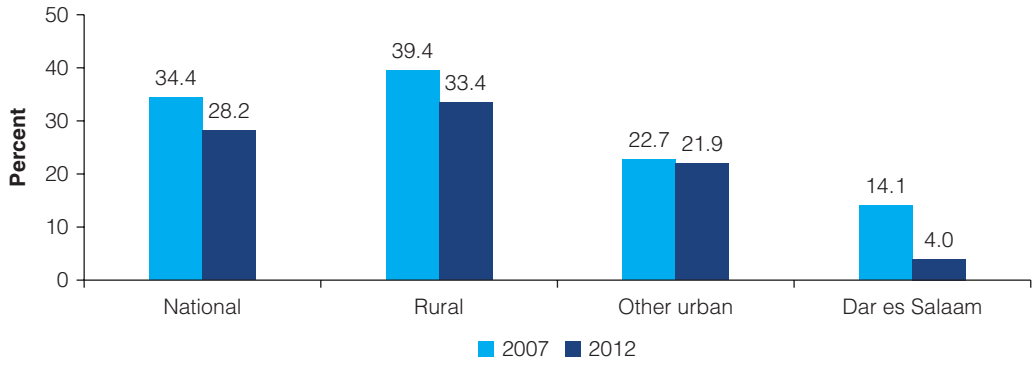
National Poverty Trends

The country has achieved significant reduction in poverty since 2007. Tanzania's National Strategy for Growth and Reduction of Poverty (MKUKUTA) gives high priority to eradicating extreme poverty and promoting broad-based growth. It has started to show significant effect with a decline in national basic needs poverty (box 2.1) from 34.4 to 28.2 percent between 2007 and 2012 (figure 2.2). Meanwhile, extreme poverty declined from 11.7 to 9.7 percent (World Bank 2015). This is the first significant reduction in over 20 years. Measured by the international poverty line of US$1.90, poverty prevalence is higher but

Box 2.1: Poverty Measurements: Poverty lines and Headcount Rate

- **National poverty lines** are calculated using the Cost of Basic Needs (CBN) method based on Household Budget Survey (HBS) data. The CBN calculates (1) the cost of a fixed food bundle corresponding to minimum nutritional requirements for a diet of 2,122 calories per day per person and (2) the cost of a lower non-food allowance for other basic needs.
- **The upper national (basic needs) poverty line** represents the threshold for being considered poor and is set at the sum of the food bundle cost and the non-food allowance cost. The national basic needs poverty line is T Sh 36,482 per adult per month.
- **The lower national (food) poverty line** represents the threshold for being considered extremely poor and only considers the food bundle costs. The national food poverty line is T Sh 26,085 per adult per month.
- **The international poverty line** is US$1.25 per capita per day (in 2005 PPP exchange rate) and allows comparison with other countries.

Figure 2.2: Reductions in Poverty Rates, 2007–12

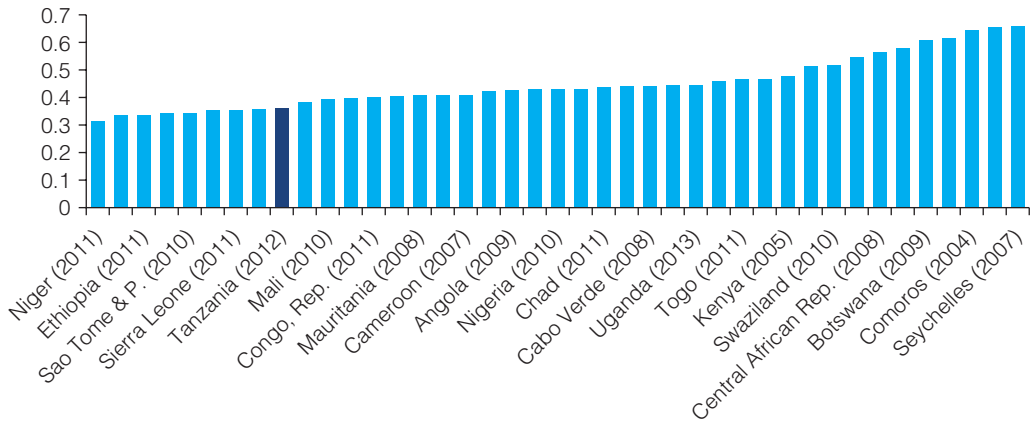


Source: World Bank 2015.

has fallen even more markedly, with the headcount dropping from 60 to 49 percent between 2007 and 2012.

Tanzania had made good progress in increasing shared prosperity. Between 2007 and 2012, economic growth has been pro-poor, as indicated by a higher percent increase in equivalent consumption for the bottom 40 percent of the wealth distribution compared to the country's average per adult equivalent consumption (14.9 percent vs. 4.9 percent). As a result, nearly a third of the bottom 40 has risen out of poverty (under the national poverty line standards) since 2007. Inequality as measured by the Gini index of real per capita consumption is notably lower compared to other Sub-Saharan African countries (figure 2.3).

Figure 2.3: Gini Coefficients across Countries in Sub-Saharan Africa



Source: World Bank 2015.

Despite a visible reduction in the poverty rate, vulnerability persists, with a large proportion of the population living just above the poverty line and a high absolute number of poor. The depth of poverty[3] is about 93 percent of the national poverty line, meaning that a large share of the Tanzania population is clustered around the poverty line (World Bank 2017).

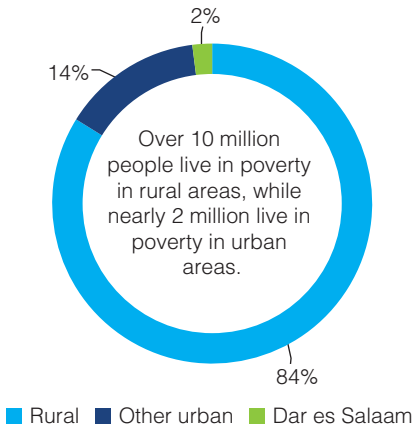
Those living only slightly above the poverty line are highly vulnerable to shocks and at risk of slipping back into poverty, due mainly to the heavy dependence of their livelihoods on smallholder farming and rain-fed agriculture (World Bank 2017). Furthermore, although the poverty rate has declined, the *absolute number* of the poor has decreased little since 2007 due to rapid population growth. As a result, approximately 12 million people remain under the national poverty line (World Bank 2015) and 4 million continue to live in extreme poverty.

Urban-Rural Poverty Trends

Although the national poverty rate has fallen, important differences stand out in reduction trends in different parts of the country. Notably, poverty in rural areas is more pervasive and extreme than in urban areas (figure 2.4 and table 2.1). While the rate declined rapidly in Dar es Salaam, where incidence fell by over 70 percent, rural areas are still facing a stubbornly high rate, with only a 15 percent reduction in the same period. Urban areas outside of Dar es Salaam also have not experienced significant declines. Poverty levels remained almost unchanged in secondary cities and towns, declining by only 5 percent. It is estimated that 84 percent of the poor (10 million people) live in rural areas compared to 16 percent (1.8 million) in urban areas.

Though the proportion of poor people is declining faster than average in urban areas, equitable growth needs to be sustained by expansion of a productive formal economy and the provision of basic services. Dar es Salaam's achievement of the greatest proportionate decline in poverty is related to the high concentration of economic growth in the city, where most of the expanding and flourishing sectors—such as telecommunications and finance—are concentrated. Nonetheless, investment and planning in urban areas are not keeping pace with rapid rise in population, threatening equitable growth. There is a critical need to create many more productive

Figure 2.4: Share of Poor across Rural and Urban Areas



Source: World Bank 2015.

Table 2.1: Districts with Highest and Lowest Poverty Rates, 2016

Region	District code	Poverty	Standard error	Concentration	Number of poor	Ranking incidence	Ranking concentration
Ten districts with the highest poverty incidence							
Mbeya	121205	0.985	0.01	0.01	122,040	1	31
Kigoma	161601	0.920	0.04	0.02	236,797	2	3
Ruvuma	101005	0.892	0.04	0.02	176,798	3	6
Ruvuma	101002	0.855	0.06	0.01	144,065	4	18
Njombe	222203	0.839	0.06	0.01	79,650	5	58
Kigoma	161607	0.810	0.05	0.01	133,422	6	25
Rukwa	151504	0.796	0.01	0.01	164,667	7	11
Mbeya	121209	0.752	0.06	0.01	146,636	8	17
Njombe	222204	0.749	0.08	0.01	63,224	9	66
Rukwa	151502	0.728	0.02	0.02	219,466	10	5
Ten districts with the lowest poverty incidence							
Kagera	181807	0.043	0.02	0.00	8,691	150	151
Manyara	212106	0.032	0.01	0.00	2,909	151	155
Tabora	141407	0.030	0.02	0.00	11,645	152	150
Dar es Salaam	70702	0.029	0.01	0.00	34,563	153	109
Dar es Salaam	70701	0.024	0.01	0.00	41,512	154	101
Geita	252503	0.016	0.01	0.00	2,985	155	154
Simiyu	242401	0.004	0.00	0.00	1,585	156	156
Iringa	111105	0.004	0.00	0.00	172	157	157
Pwani	60602	0.001	0.00	0.00	46	158	158
Simiyu	242405	0.000	0.00	0.00	31	159	159

Source: Rascón-Ramírez and Audy 2016.
Note: District poverty estimates are calculated by defining the cluster effect at the district level.

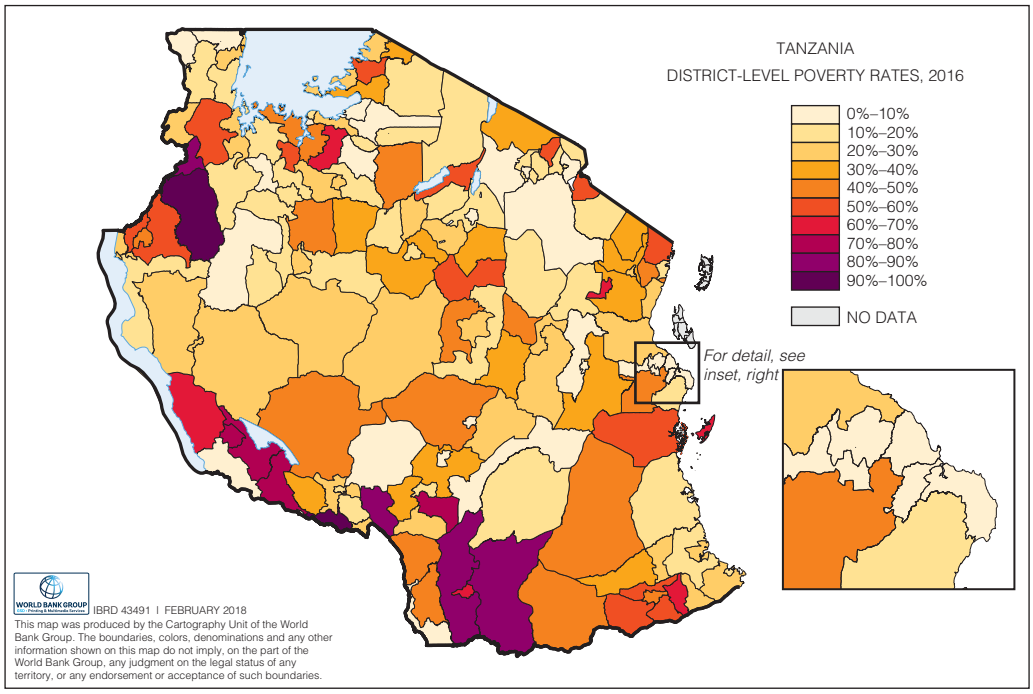
jobs in what is now a largely informal economy and to expand basic social services to cater to these new populations.

Rural areas experienced the greatest decline in the absolute number of poor. This was due to the population of Tanzania still being majority rural. In the 2007-12 period, 1.2 million rural people moved out of poverty compared to fewer than 300,000 in the capital city. Nonetheless, the high rates of poverty remaining in rural areas means that much work remains to be done, in the provision of basic services such as water and sanitation, as we shall see in later chapters.

Poverty Mapping

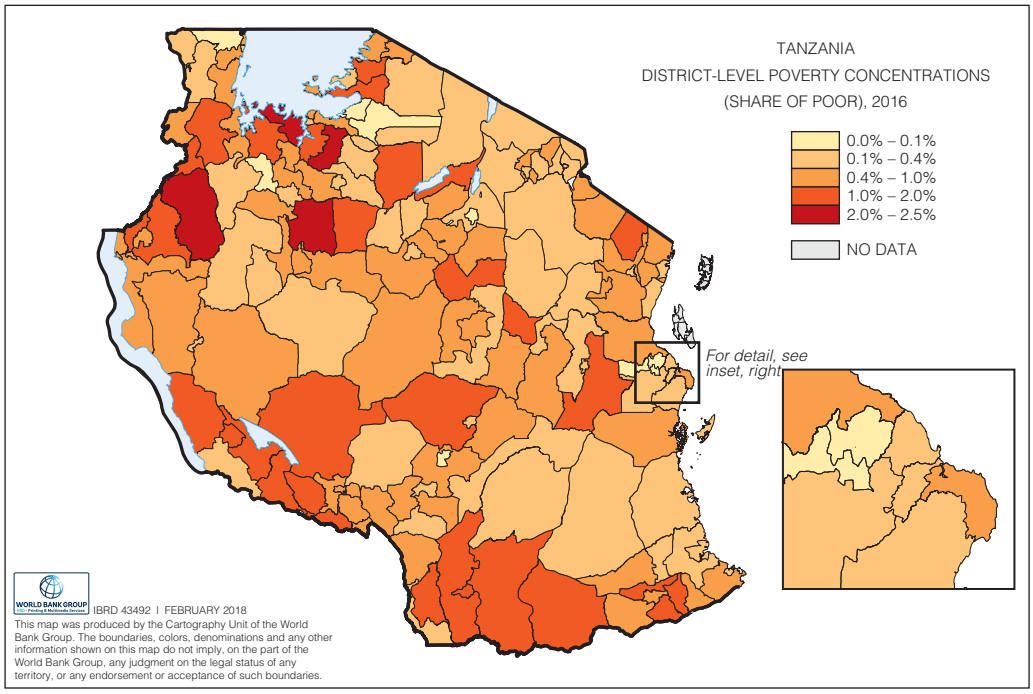
District-level poverty maps reveal clear spatial variation in poverty rates and concentrations accross rural and urban areas (map 2.1). Examination of poverty by percentage of population (poverty head count rate) finds that rates are highest in three regions—Rukwa (57 percent), Ruvuma (56 percent), and Kigoma (48 percent). District-level mapping also shows poverty being more concentrated in particular parts of these regions, such as districts in the northeast of Kigoma, southwest of Ruvuma, and inland of Rukwa. These have poverty rates as high as 99 percent. However, in terms of absolute number of poor, the greatest concentration seems

Map 2.1: District-Level Poverty Rates, 2016



Source: World Bank Group, 2017.

Map 2.2: District-Level Poverty Concentrations (Share of Poor), 2016



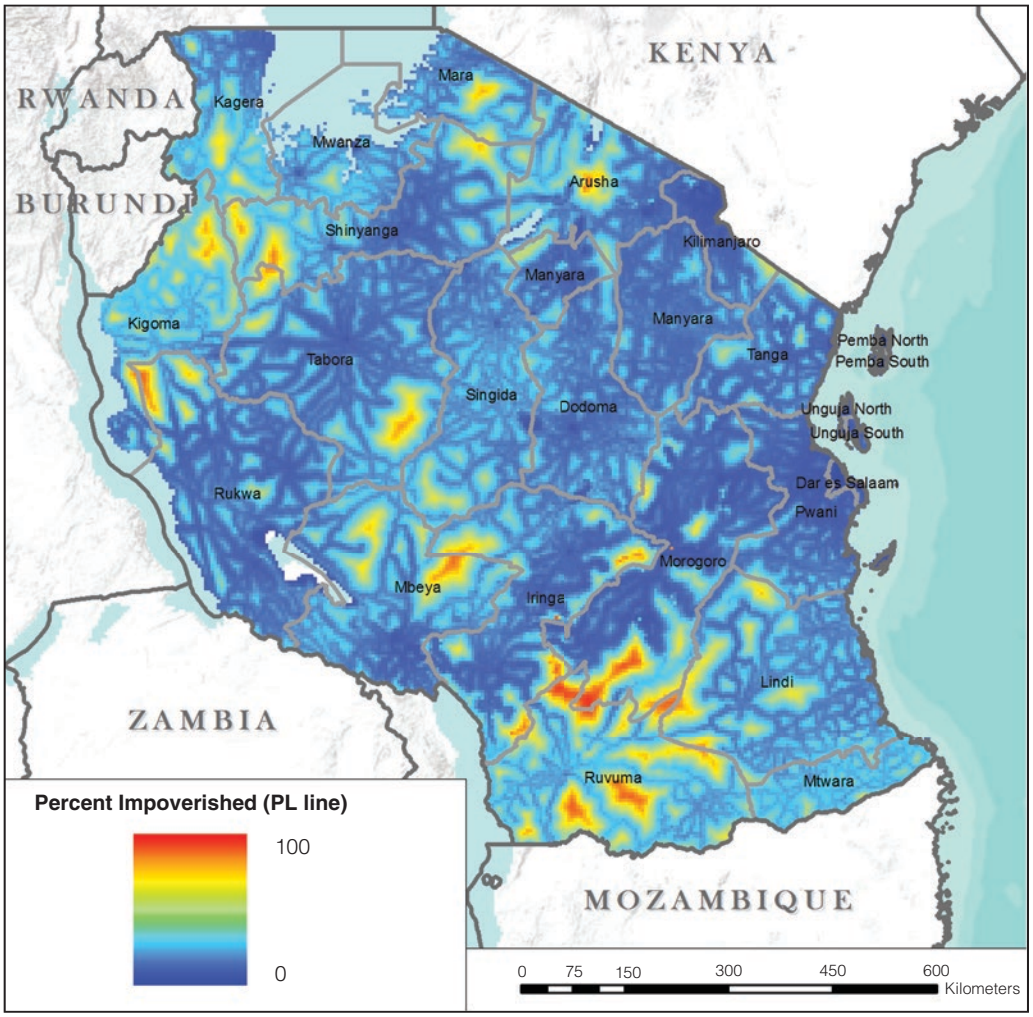
Source: World Bank Group 2017.

to be in the northwest province of Kigoma, while the area to the southwest of the country in Ruvuma is less heavily populated and therefore shows up with fewer poor, even though Ruvuma's poverty rate is higher (map 2.2).

Pixel-level poverty maps show pockets of high poverty across the country (map 2.3. Below district level, geospatial mapping techniques can help estimate poverty. The map shows how at pixel level (5 x 5 kilometers), the same poverty patterns are picked up as in maps at the regional and district levels, but with greater granularity. The importance of urban centers beyond Dar es Salaam can be detected at this pixel level. Consistently poorer areas are found to the far south, along the border with Mozambique in the Ruvuma and Mtwara regions, to the far northwest along the Burundi and Rwanda borders in the Makamba and Kagera regions, and bordering Lake Victoria in the Mwanza and Mara regions.[4]

Having broadly assessed the current state of poverty in Tanzania, taking into account improvements in recent years and differences occurring along geographic lines, we will now consider the current state of access to WASH services in the country. In doing so, we will further examine the extent to which poverty and geography limit access to quality WASH services. Reference will be drawn to the SDG definitions of improved water and sanitation, which are explained in detail in box 2.2.

Map 2.3: Predicted Poverty Rate at 5 x 5 Kilometer Pixel Level, 2012



Source: Gething and Rosas 2015.
Note: PL = poverty line.

Box 2.2: JMP Monitoring in the SDG Era—FAQ

Q1. What is JMP?

A1. The Joint Monitoring Programme (JMP) for Water Supply and Sanitation is the official UN mechanism for monitoring progress in WASH objectives in the Millennium Development Goals and now the Sustainable Development Goals. It is hosted by the World Health Organization and the United Nations Children's Fund.

Q2. What are the "Drinking Water and Sanitation Ladders?"

A2. The ladders, developed by JMP, are a common WASH statistical framework for global and country-level monitoring of progress toward MDG 7-c targets. The ladders were divided into two simple and mutually exclusive groups for both water and sanitation—"improved" or "unimproved." "Improved" drinking water was defined as

box continues next page

Box 2.2: Continued

coming from various water sources that by nature of their construction and proper use, "adequately protected the source from outside contamination, particularly faecal matter" (JMP 2015). "Improved" sanitation facilities were ones that are unshared and "hygienically separated human excreta from human contact." Unimproved facilities for both water and sanitation are any that do not classify as improved.

Q3. How will the JMP monitoring framework change in the SDG era?

A3. A common criticism of the Drinking-Water and Sanitation Ladders is that they only consider technological construction to indicate quality rather than their actual capacity to block bacterial contamination (Sutton 2008). Despite the great progress in meeting targets for access to improved water and sanitation, WASH-related disease and illness are still leading causes of morbidity and mortality. Focusing on other dimensions beyond access to certain types of technology could help meet public health objectives. Therefore, in alignment with SDG-6, the new ladder for drinking water encompasses five service levels, which take into account the amount of time needed to access such sources, water quality (the extent of arsenic, fluoride, and *E. coli* contamination), and whether water from these sources is available when needed. As for sanitation, a fecal sludge management component was added for the highest tier, *safely managed sanitation*. The updated framework also introduces separate ladders for handwashing and healthcare waste management, as well as specific ladders for water supply in schools and healthcare facilities.

Q4. Who will implement JMP monitoring?

A4. Moving forward, both the Demographic and Health Surveys (DHS) and the Multiple Indicator Cluster Survey (MICS) will collect data in alignment with the new JMP monitoring framework. The JMP will aggregate data from these secondary sources, as well as data from censuses and other national surveys, to estimate the national, rural, and urban WASH coverage of countries and to see whether countries are on track to meet SDG-6 targets.

Q5. Are the estimates presented in the TWPD study aligned with the new JMP monitoring framework for SDG-6?

A5. Due to data limitations, the Water and Sanitation Tier Framework (see figures B2.2.1 and B2.2.2) utilized in the TWPD differs from JMP's ladders for SDG-6. For drinking water, the TWPD's *Tier 0* effectively combines the *No Service* and *Unimproved* tiers from JMP. *Tiers 1* and *2* effectively correspond with JMP's *Limited* and *Basic* tiers, taking into account access to improved water sources within a roundtrip of 30 minutes or less. TWPD adds an additional tier (*Tier 3*) taking into account access to improved water sources on premise that are available when needed, while *Tier 4* looks solely at on-premise piped water. Data on *E. coli* and priority chemical contaminants were not available to estimate the JMP's definition of "safely managed water." TWPD effectively combines JMP's *Open defecation* and *Unimproved* tiers into a single tier—*Unimproved sanitation*. *Tiers 1* and *2*—Improved sanitation (including shared) and Improved sanitation (excluding shared)—correspond with JMP's *Limited*

box continues next page

Box 2.2: Continued

and *Basic* tiers. *Tier 3* (Private Sewage Connection) differs from JMP's *Safely managed* tier, which specifies that excreta may be safely disposed of in situ or transported and treated off-site. Data on this indicator were absent. TWPD also estimates population access to handwashing stations that have soap and water and other hygiene behaviors such as handwashing practices, child feces disposal, and menstrual hygiene management.

Figure B2.2.1: Water, Sanitation, and Hygiene Ladders in the SDG Era

Source: JMP 2015.
Note: Improved water sources include piped water, boreholes, tube wells, protected dug wells, protected springs, and packaged or delivered water. Improved sanitation facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, and composting toilets or pit latrines with slab. Water tier framework analysis is presented with two types of estimates: unadjusted for clean water (*E. coli* and arsenic) and adjusted for clean water.

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Box 2.2: Continued

Figure B2.2.2: Water and Sanitation Tier Framework Used in the TWPD

Water tiers	JMP improved water technology	Within 30 minutes roundtrip collection	On premise	Piped
On-premise piped, Tier 4	✓	✓	✓	✓
On-premise improved, Tier 3	✓	✓	✓	
Basic water, Tier 2	✓	✓		
Improved water, Tier 1	✓			
Unimproved water, Tier 0				

Sanitation tiers	JMP improved Sanitation technology	Unshared	Sewage connection
Private sewage connection, Tier 3	✓	✓	✓
Improved sanitation, Tier 2	✓	✓	
Improved sanitation (regardless of sharing), Tier 1	✓		
Unimproved/open defecation, Tier 0			

Source: JMP 2015.

Notes

1. The EAC member states are Kenya, South Sudan, United Republic of Tanzania, Burundi, Uganda, and Rwanda.
2. The HDI is a summary measurement of life expectancy, levels of education, and gross national income (GNI).
3. The depth of poverty (i.e., poverty gap) indicator measures the average consumption expenditure shortfall of the poor as a share of the basic needs poverty line.
4. Geospatial mapping at pixel level does not identify high levels of poverty along the Zambian border in Mbeya and Rukwa. This is so even though Rukwa is identified as a poor region in the statistical techniques used to inform the Systematic Country Diagnostic (World Bank 2017).

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Chapter 3
Water Access in Tanzania

At the end of 2015, 23.7 million people, nearly half of of all Tanzanians did not have access to improved water sources for drinking. That put the country among the 17 countries that did not meet their MDG water target. Tanzania missed the 2015 target by 21 percentage points. Moreover, improved water access increased a mere 2 percentage points between 1990 and 2015.[1] With the MDG goals now left behind, the new SDG era presents an opportunity for the government and development partners to revitalize their efforts to provide better water services that can enhance the quality of life of the Tanzanian population.

This chapter is organized into three sections. The first examines water access levels using a tier analysis, where higher tiers indicate access to higher-quality water services. The tier analysis estimates access levels by national, urban, rural, and wealth quintile groups. It also examines geographical inequities by using geospatial estimation techniques represented at the regional, district, and pixel (1 x 1 kilometer) levels. The second section delves deeper into service delivery gaps in urban settings, while the third examines service delivery gaps unique to rural parts of the country.

Water Access Levels Using Tier Analysis

In order to assess current service levels and inform strategies for meeting the more ambitious SDGs, our analysis defines four tiers of household water access motivated by the new SDG standards. The tiers are driven by the *convenience* of safe drinking water access to the household, a priority service dimension in the SDG's new target for safely managed water. The first tier, "Improved Water," is the simplest form of access and follows the "improved water source" target indicator from the previous Millennium Development Goals (MDG). The second tier, "Basic Water," adds a condition that households do not have to travel more than 30 minutes roundtrip to collect water from the improved water source. The third tier, "On-Premise Improved Water,"[2] requires that the improved water source is within a household's premises. The final, fourth tier, "On-Premise Piped," goes one step further to examine access to piped water supply that is within a household's premises. See figure 2.5 in chapter 2 for more details.

National, Urban, and Rural Access

Based on the latest household data from 2016, about 60 percent of Tanzanians are estimated to have access to an improved water source (T1). This is a six percentage point increase in national coverage since 1990. However, there are large inequities in access between urban and rural areas. About 87 percent of urban dwellers have access to improved water, compared to 48 percent of rural residents (figure 3.1). In rural areas, improved water access has increased from 45 percent in 1990 to only 48 percent in 2016 (figure 3.2). Though access levels are comparatively higher in urban areas, access there has steadily decreased in past decades, going from 92 percent in 1990 to 86 percent in 2016. The decrease could be a consequence of population growth and high level of rural to urban migratrion straining public services.

KEY POINTS

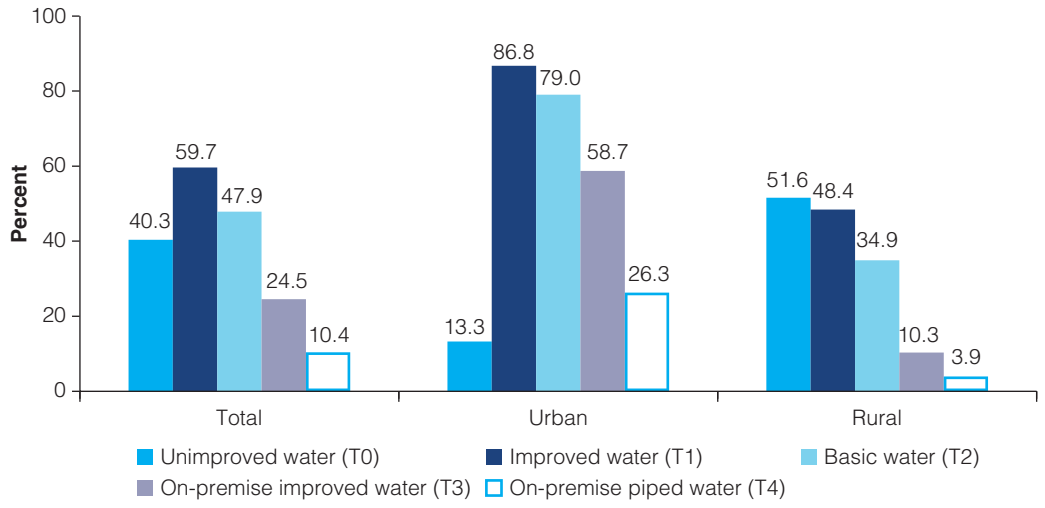
About 60 percent of the population of Tanzania has access to an improved water source, with on-premise sources serving the richest segment of the population almost exclusively. Coverage of the new SDG indicator for safely managed water is likely lower than 8 percent.

Less than 50 percent of people have access to an improved water source that is within a 30-minute collection time. For both urban and rural residents, time that could be spent on productive activities is being spent fetching drinking water from distant sources.

A prominent problem for the rural population is non-functioning water points. Mapping data reveals that about 40 percent of all existing water points are non-functional, with the highest concentration in poorer, rural regions.

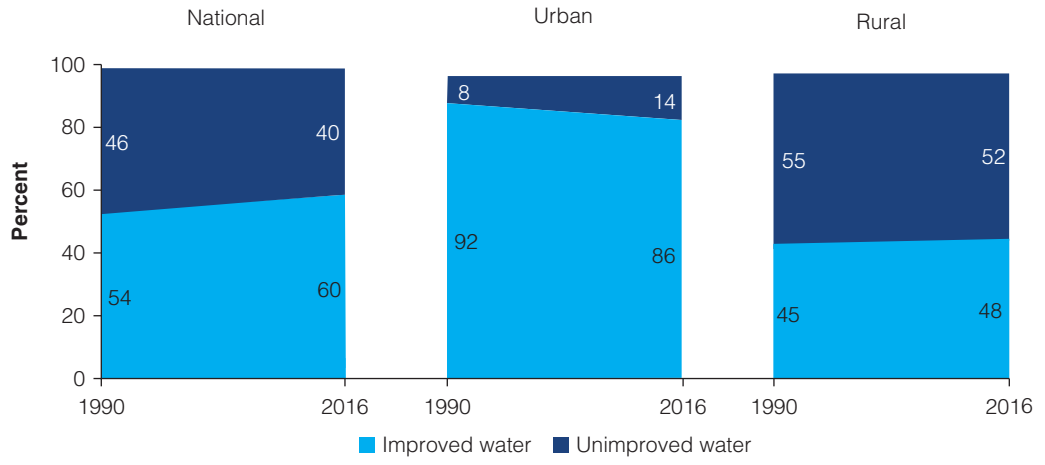
The rapid expansion of urban populations has been mirrored by an increased reliance on unimproved sources. They would benefit from expansion of improved coverage in accordance with SDG criteria and regulation of the quality of water from informal venders.

Figure 3.1: National, Urban, Rural Water Access, by Tiers of Service



Source: Author's calculations from DHS 2016.
Note: Box ES.1 provides a full explanation of JMP definitions on tiers of service for water and sanitation.

Figure 3.2: National, Urban, Rural Improved Water Access (Tier 1), 1990–2016



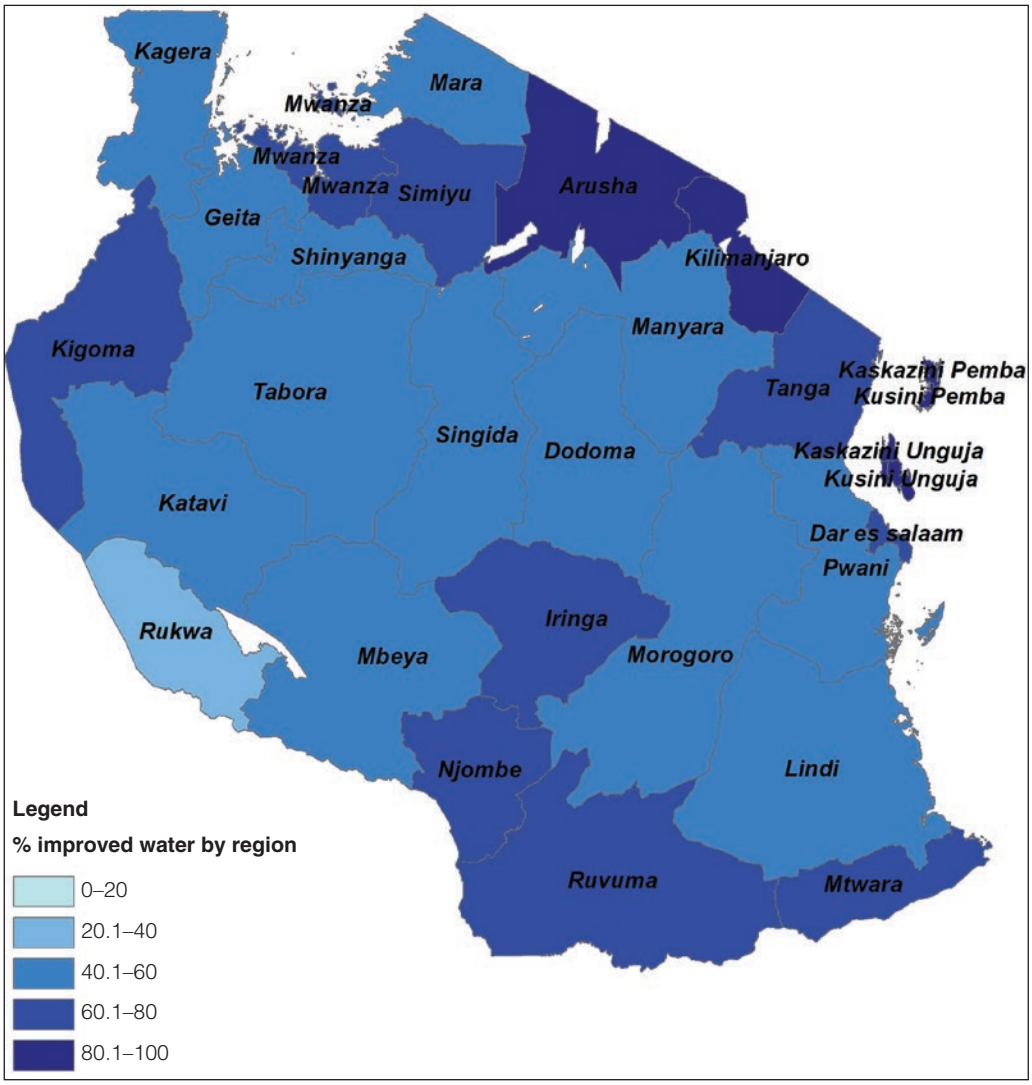
Source: JMP 2015.

Indeed, Tanzania's urban population is growing by 5.4 percent per year, one of the fastest rates in the Sub-Saharan region. By 2030, more than 54 percent of Tanzania´s population is expected to be living in urban areas. Specific urban and rural service delivery challenges are detailed in the final sections of this chapter.

Regional-level mapping (map 3.1) reveals geographic inequities in access. Generally, access to improved water is lowest in the western regions of the country. The three regions with the lowest coverage include Rukwa (39 percent) in the far west, Pwani (41 percent) on the coast, and Tabora (42 percent) in the northwest.

Access to an improved water source drops precipitously to 47 percent when considering access that has collection time of 30 minutes or less (Basic Water, T2). The drop in coverage is most

Map 3.1: Coverage of Improved Water by Regions

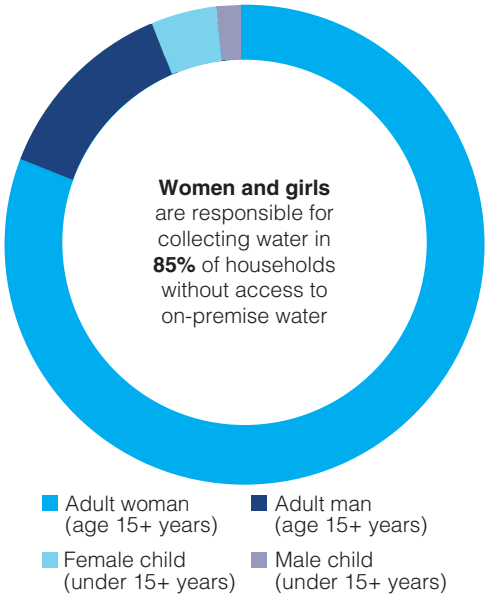


Source: Authors' calculation from DHS 2016.

significant in rural areas, where only 35 percent of residents can access basic water. However, access to basic water seems to be an issue even in urban areas, which only have 79 percent coverage. When considering just location of water sources, only about 25 percent of the national population has access to an improved water source on their household premises (Tier 3 Water), with this figure dropping to 10 percent in rural areas and increasing to 59 percent in urban areas.

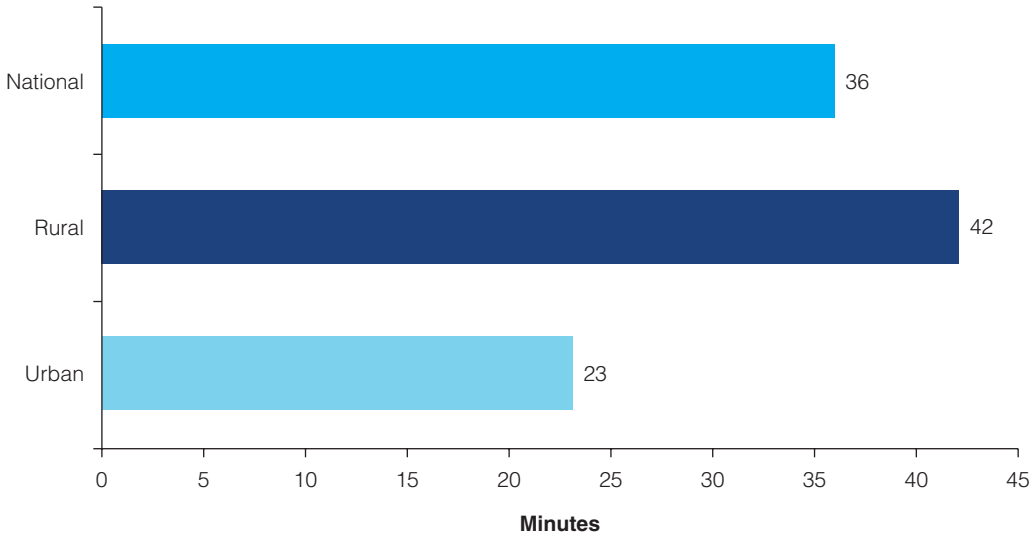
Further analysis of collection times show that a household on average spends 36 minutes per trip to fetch water. Assuming that water collection takes place at least once a day, we estimate that a household spends, on average, more than four hours per week collecting water. Moreover, similar to most of the developing world, the burden of this work falls disproportionately on women. Water collection responsibilities are found to be assigned to adult women in 85 percent of those households that must go off premises for collect water (figure 3.3). As expected, the average time to collect water is higher in rural areas than urban areas (figure 3.4).

Figure 3.3: Person Collecting Water in Households without On-Premise Water



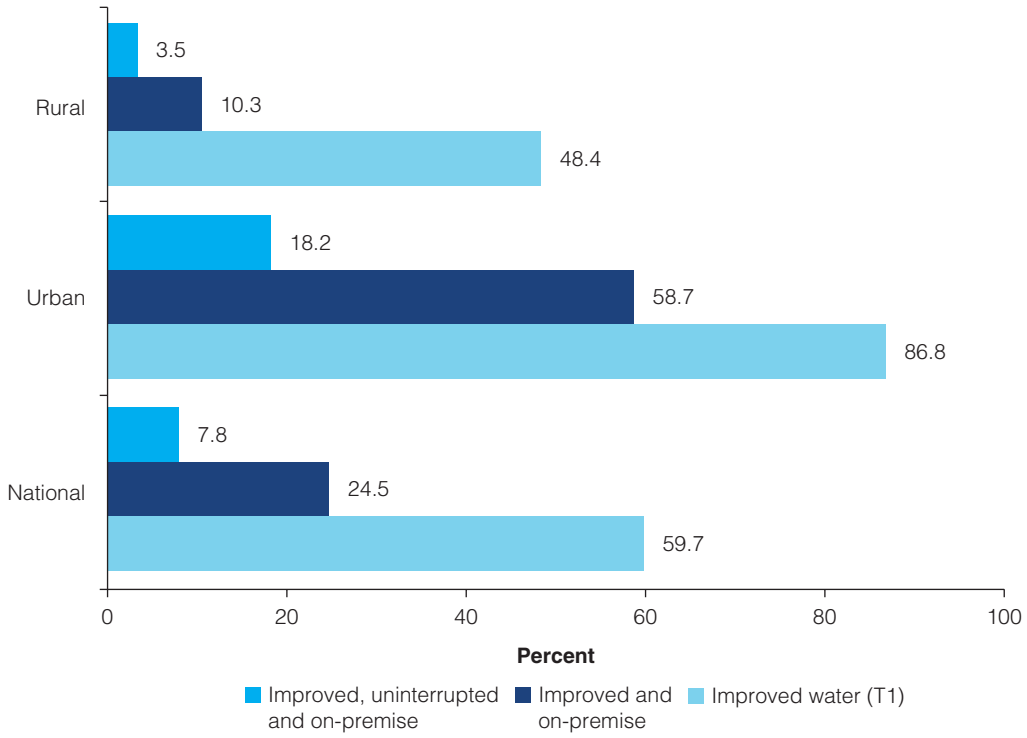
Source: Authors' calculation from DHS 2016.

Figure 3.4: Average Time to Collect Water, Roundtrip



Source: Author's calculation from DHS 2016.

Figure 3.5: Safely Managed Water Proxy, by National, Rural and Urban Interruptions



Source: Author's calculation from DHS 2016.
Note: The interruptions data point only examines interruptions among piped and borehole users.

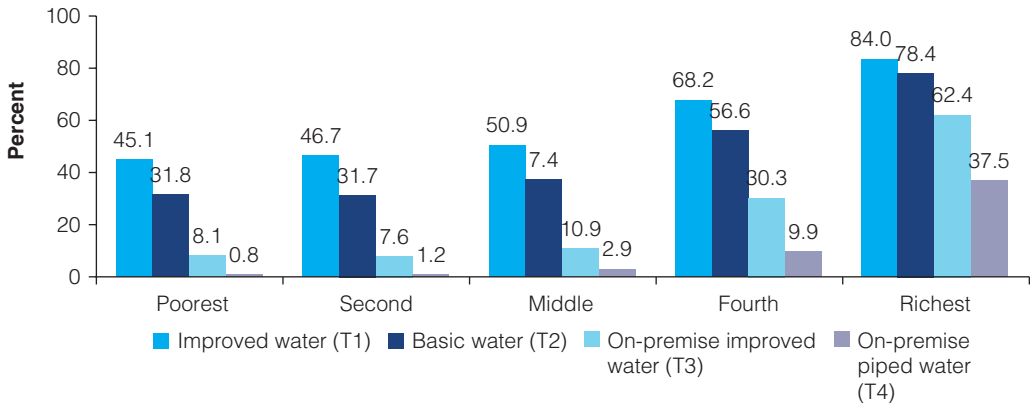
About 10 percent of the national population can access piped water in their homes (figure 3.1). Due to their centralized management and treatment, piping systems hold the potential to be a reliable, non-contaminating means of moving water to the home, but access to on premise piped water is a rarity in Tanzania. It is most prevalent in urban areas (26 percent) and least prevalent in rural areas (4 percent).

National access to the SDGs' new safely managed water target is likely lower than 8 percent.[3] In addition to proximity of water sources, interruptions in water supply seem to be a binding service delivery challenge for those who use piped water or tubewells/boreholes. About 45 percent of all Tanzanians using these sources report at least one interruption[4] in their water supply in the previous two weeks. Furthermore, as figure 3.5 shows, only a small proportion of Tanzanians across the country (8 percent) can access uninterrupted, piped or borehole drinking water supply on their household's premise (T3). About 18 percent of urban residents and only 4 percent of rural residents have access to uninterrupted, on premise water. The gap between improved water and improved and uninterrupted water is greatest in urban areas compared to rural areas (68.6 urban versus 44.9 rural percentage point difference). However, this likely reflects the fact that urban areas have higher coverage of improved, piped and borehole sources. When considering uninterrupted on-premise, piped water supply, the national figure drops to 3 percent. In urban areas, uninterrupted and on-premise piped water and borehole is available to 18 percent of the population, and in rural areas, this type of access is less than 2 percent.

Bottom 40 and Top 60 Access

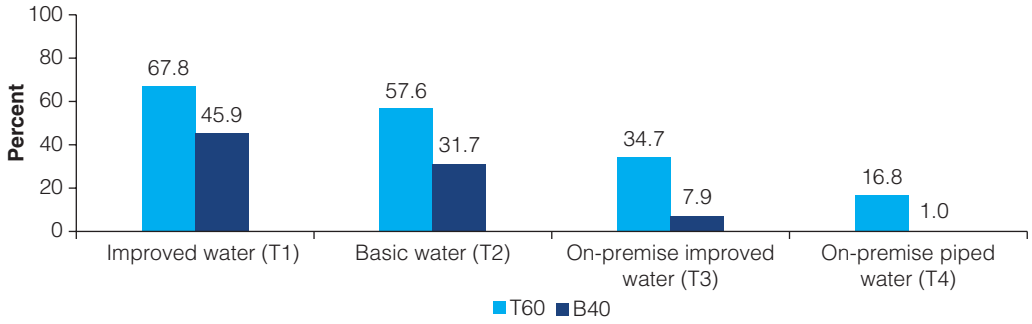
When broken down by wealth subgroup, the poorest have the worst access to water services (figure 3.6 and figure 3.7). Improved water access (T1) for the T60 currently lies at just under

Figure 3.6: National Water Access by Wealth Quintiles



Source: Authors' calculation from DHS 2016.

Figure 3.7: National Water Access by Bottom 40 and Top 60

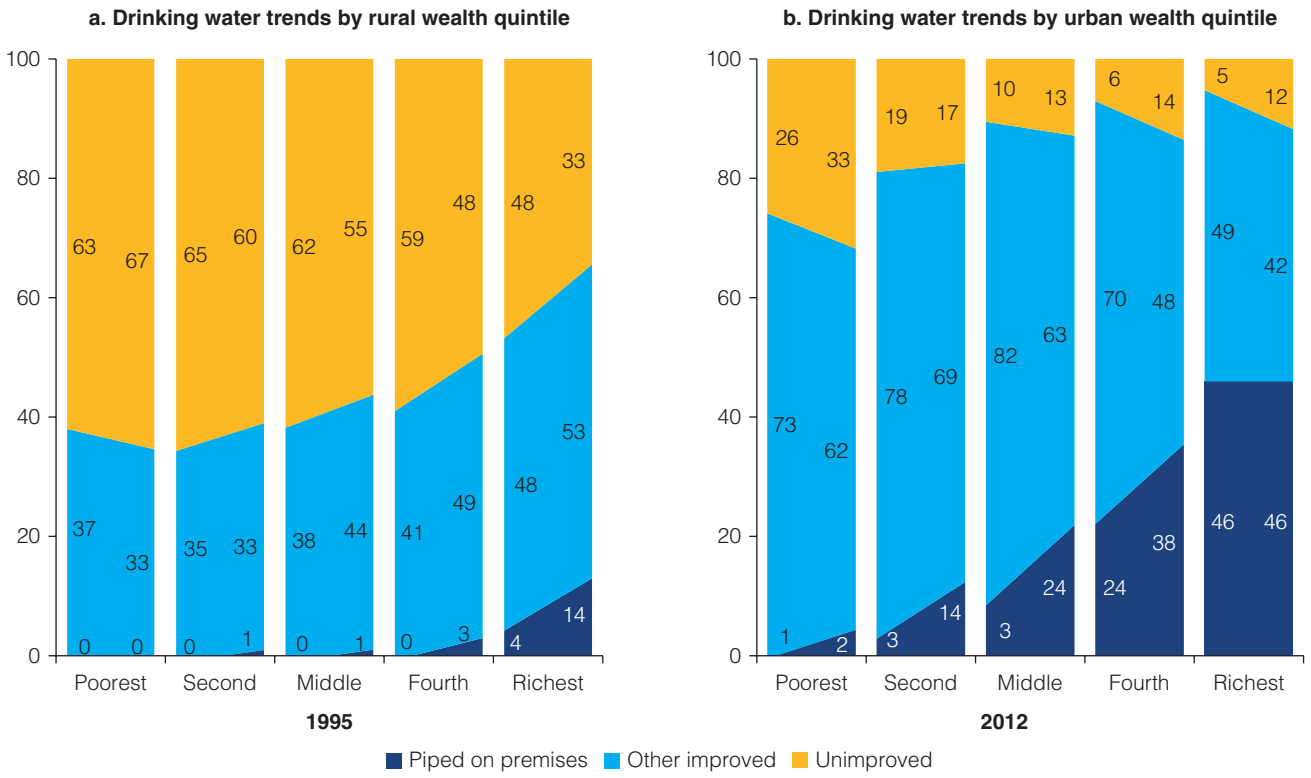


Source: DHS 2016.

70 percent, while for the B40 it is a little over 45 percent.[5] When comparing the richest to the poorest wealth quintile, the richest have 84 percent T1 access compared 45 percent access among the poorest. Moreover, the poorest have the least convenient access to water sources and most likely have to divert significant amounts of time to collecting water. For example, less than a third of the bottom 40 can access their improved water source within 30 minutes collection time (Basic Water, T2). Likewise, on-premise improved water (T3) and on-premise piped water supply (T4) are services almost exclusive to the rich.

Inequities in improved water access (T1) at least closed somewhat between 1995 to 2012 (figure 3.8), but the disparity remains stark in both rural and urban areas. For instance, trends from 1995 to 2012 reveal that expansion of on-premise, piped water in rural areas in particular has almost exclusively reached the richest quintile. Poorer wealth quintiles have had minimal gains in improved access, with the poorest rural residents having a *decreasing* trend in access to improved water sources. In urban areas, expansion of on-premise piped water at least seems to be a growing trend across most wealth quintiles, except, as it happens, for the richest quintile, whose coverage stagnated.

Figure 3.8: Trends in Access to Improved Water Sources from 1995 to 2012



Source: JMP 2015.

Box 3.1: Inequality in Access to WASH Services in Tanzania—the Human Opportunity Index

To further measure observed inequality in WASH services, a Human Opportunity Index (HOI) analysis was completed to understand how WASH services are distributed based on a person's socio-economic and location-based characteristics over which he or she has no control. The HOI takes the coverage of each service and discounts the measure by how unequally the services are distributed among the population (de Barros et al. 2009). The indicator summarizes in a composite indicator (1) the coverage rate of basic services (e.g., access to water and sanitation) and (2) how equitably those opportunities are distributed, that is, whether the distribution of that coverage is related to exogenous circumstances such as location, gender, and household characteristics.

The HOI is calculated to consider access to WASH services for households with children under the age of 16. Drawing from the Demographic and Health Survey (DHS) for 2010 and 2016, eight domains of opportunities have been considered for water and sanitation (see figures B3.1.1 and B3.1.2 and appendix E). As in earlier in this

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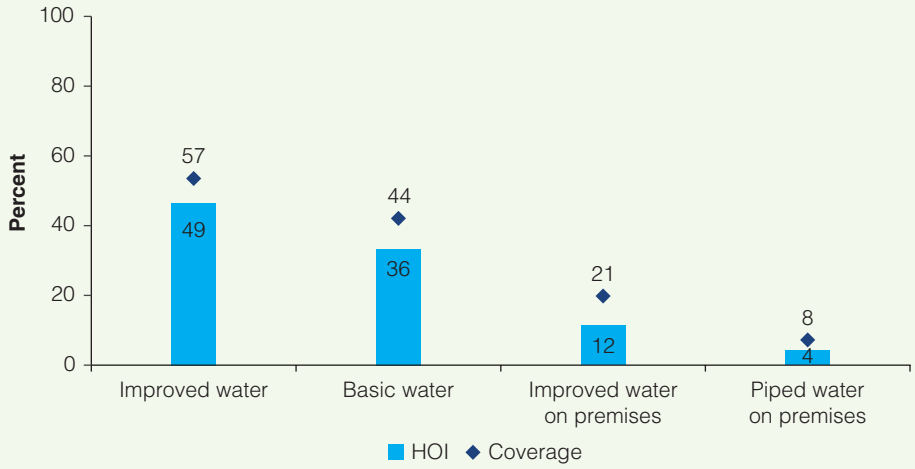
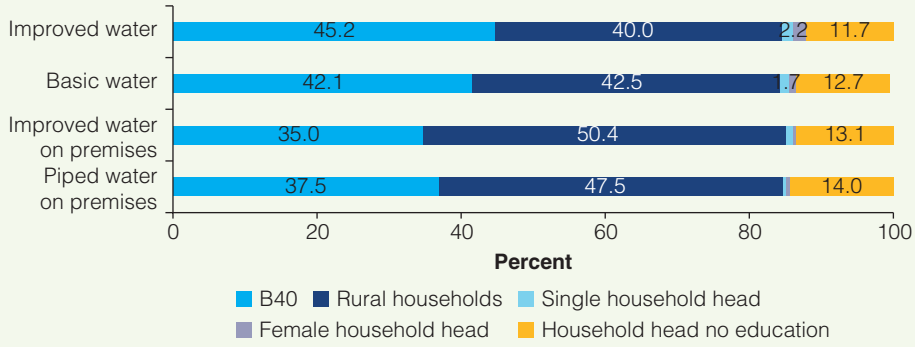
Box 3.1: Continued

Figure B3.1.1: Composite HOI and Coverage for Water Services, 2016



Source: Authors' calculations based on DHS 2016.
Note: Coverage rates may vary from JMP estimates due to restrictions when calculating the HOI.

Figure B3.1.2: D-Index Decomposition for WASH Services, 2016



Source: Authors' calculations based on DHS 2016.

chapter, we consider access to improved water, basic water, improved water on premises, and access to piped water on premises. Additionally, five circumstances have been selected to inform our analysis. These circumstances mirror those that have been utilized in previous studies that assess inequality of opportunities. The selected circumstances are out of a child's control and will most likely to be linked to the use of WASH services. The component used to estimate the inequality of opportunity is the dissimilarity index (D-Index). It is defined as the weighted average of the absolute differences of group-specific access rates from the overall average access rate. The D-Index ranges from 0 to 1 (0 to 100 in percentage terms); in a situation of perfect equality of opportunity, D will be zero. After calculating the D-Index,

box continues next page

Box 3.1: Continued

we then utilize the Shapley decomposition technique to identify the extent to which each circumstance impacts the inequality of opportunity across households.

For water, the main determinants for whether a household in Tanzania has access are rurality and wealth distribution. Among the five circumstances considered in this analysis, whether or not a child lives in a rural area is a strong determinant for improved water on premises and piped water. Rurality contributes between 40 and 50 percent of the explanation for a lack of coverage in different tiers of water access, while the income level contributes between 35 and 45 percent. Among the five circumstances considered in this analysis, whether or not a child lives in a rural area is a strong determinant for improved water on premises and piped water. Inequality in access is also to a lesser extent impacted by a parent's lack of education while marital status and gender have the smallest impact out of all the factors in the analysis.

Spotlight on Rural Water Service Delivery Challenges

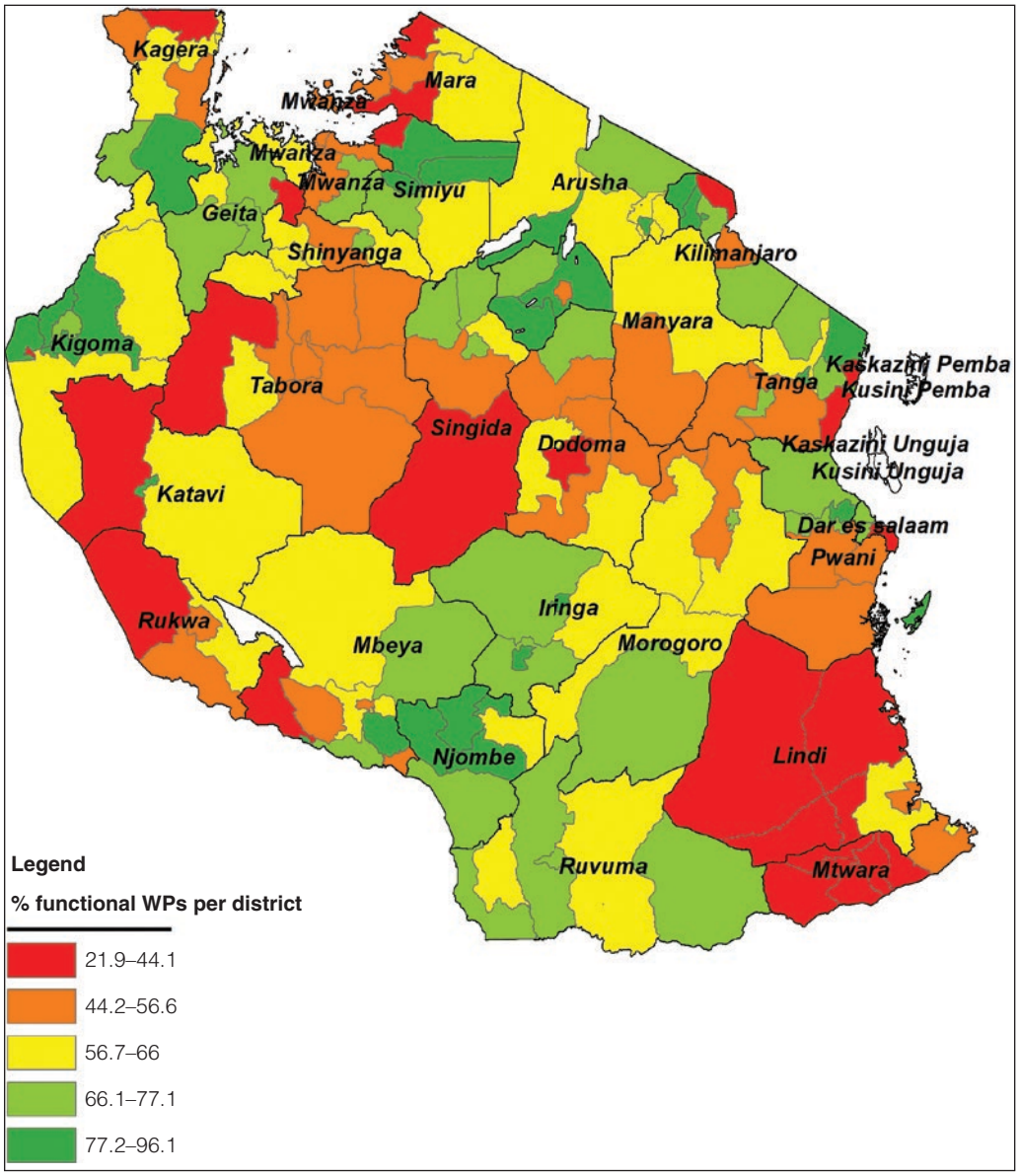
Lack of Proximal and Functional Water Points

Just over half of Tanzania's rural people have access to an improved water source, 35 percentage points lower than in urban regions. Furthermore, those with access to an improved source most likely have to travel off-premises to collect from it. Just over a third of the rural population have access to improved water that is within 30 minutes of round-trip collection time. A breakdown of types of water sources used by rural residents shows that a large proportion are getting their drinking water from unimproved sources such as unprotected wells (24 percent) or rivers, lakes, dams, streams, ponds, and irrigation channels (18 percent). Two improved sources make up the next highest categories: public tap/standpipe (17 percent) and protected wells (15 percent). About 4 percent use piped water from a neighbor, and just 3 percent have access to piped water on their own premise (piped into the dwelling or to a yard or plot).

A likely reason for low water coverage in rural areas is the poor long-term sustainability of water points. Water Point Mapping (WPM) data, collected periodically by Tanzania's Ministry of Water and Irrigation, have been used to identify the locations of functional and non-functional water points and to map access levels at different levels of aggregation: pixel, district, and regional. The results show that more than 40 percent of 83,000 water points identified in the database[6] are non-functional.

People who have no access to a nearby functional water point may have to resort to unimproved sources. Districts colored red in map 3.2, for example, in Rukwa, Lindi, and Singida regions, have only 22–44 percent of their water points functioning. The pixel level map 3.3 displays how long it takes for a household to travel to and from a functioning improved water point. Areas in green indicate where a household has access within 30 minutes, whereas red indicates it would take more than four hours. This analysis shows that to increase coverage in rural areas, attention should go to two objectives: first, rehabilitating existing improved water points where functionality is low, and second, constructing new improved water points in areas where none exist.

Map 3.2: Proportion of Functional Water Points, by District



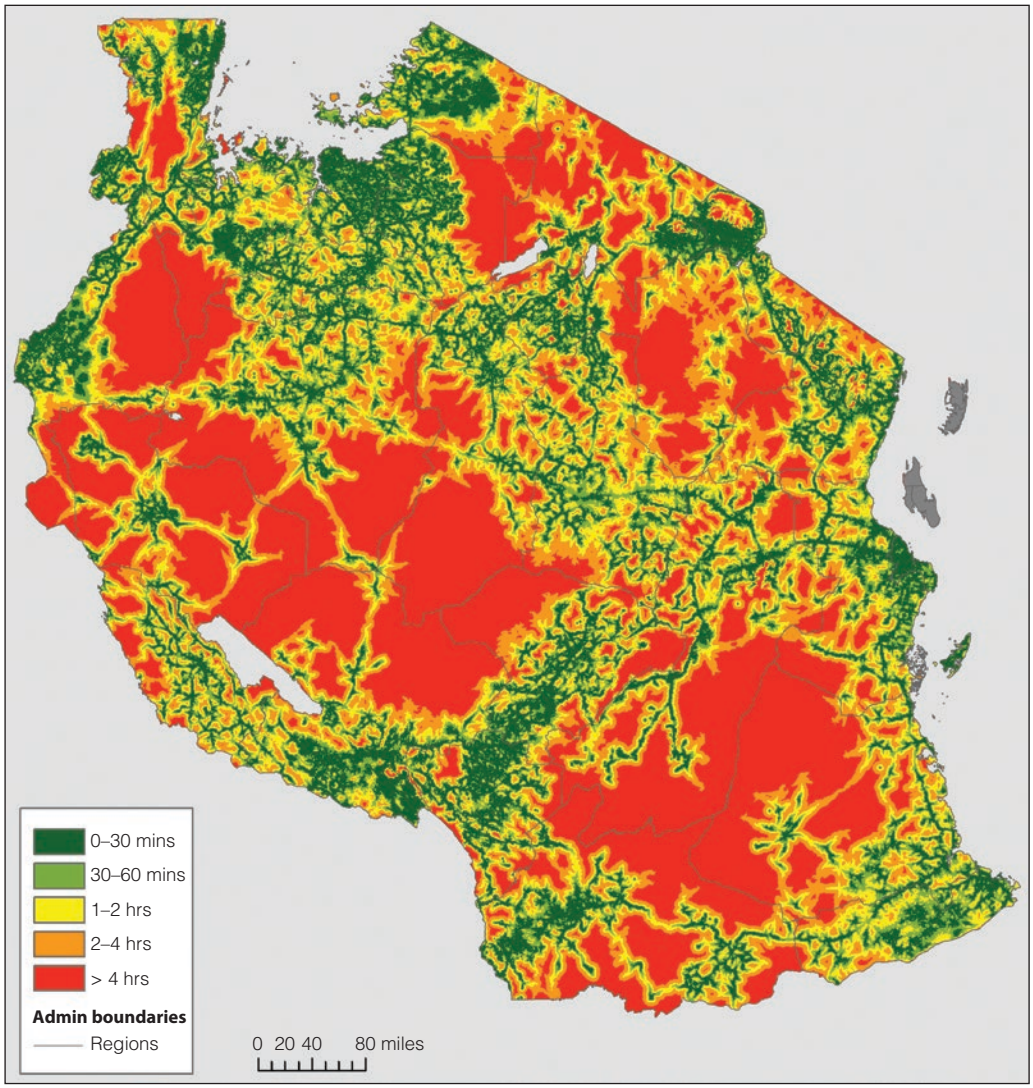
Source: Water Point Mapping Data, Ministry of Water and Irrigation (MOWI) Tanzania Nov 2016.

Why Are So Many Water Points Non-Functional?

Using the water point data, we examined the likelihood of functionality over the years (figure 3.9). Our analysis shows that a significant share of all water points (about 19 percent) fail within the very first year of construction. After 10 years of operation, another 30 percent of all points fail and 40 percent after 20 years. The Central zone has the highest failure likelihood of water points in the first five years (figure 3.10). Nonetheless, regional failure rates are not vastly dissimilar from one another.

Functionality also differed according to pump type (figure 3.11). Motorized pumps failed most in the first year, whereas hand pumps failed least in the first year. However, the failure rate of hand pumps increases up to their tenth year of operation. Old motorized pumps are more likely to fail than any other pump type at 15 years or more. Gravity pumps fail least overall.

Map 3.3: Round-Trip Journey Time to Functional Water Points

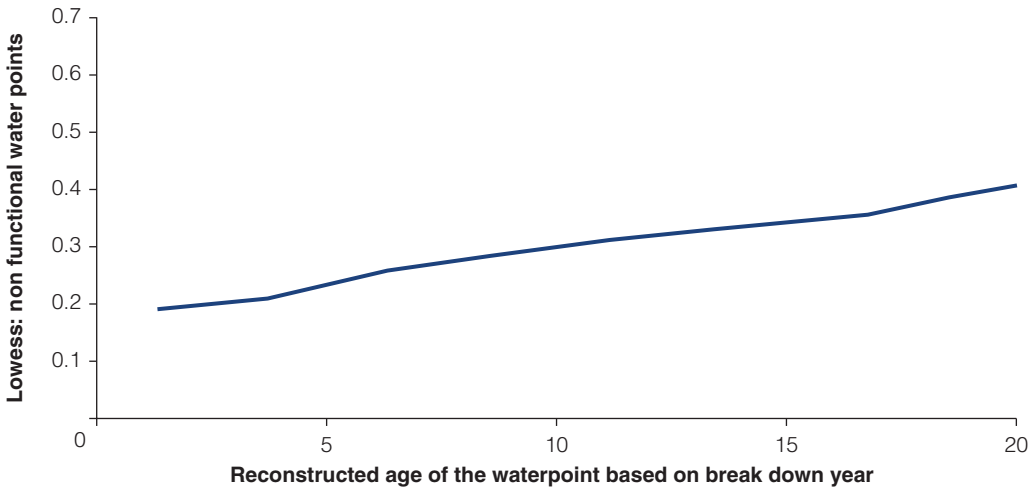


Source: Water Point Mapping Data, Ministry of Water and Irrigation (MOWI) Tanzania Nov 2016.

With 40 percent of some 83,000 water points in the database reported as non-functional, it is imperative to understand why they are failing. An initial analysis reveals that 19 percent of all water points were non-functional due to a broken engine, pipe, pump, or source damage; 11 percent due to either to an out-of-use water tank, broken tap, or a poorly sited tap; 6 percent due to being under construction, and 3.5 percent due to either a stolen pump or stolen engine. A Shapley decomposition[7] was carried out to assess which of a set of observable characteristics such as technology choice, promoter type, or management type could best explain the failure over time.

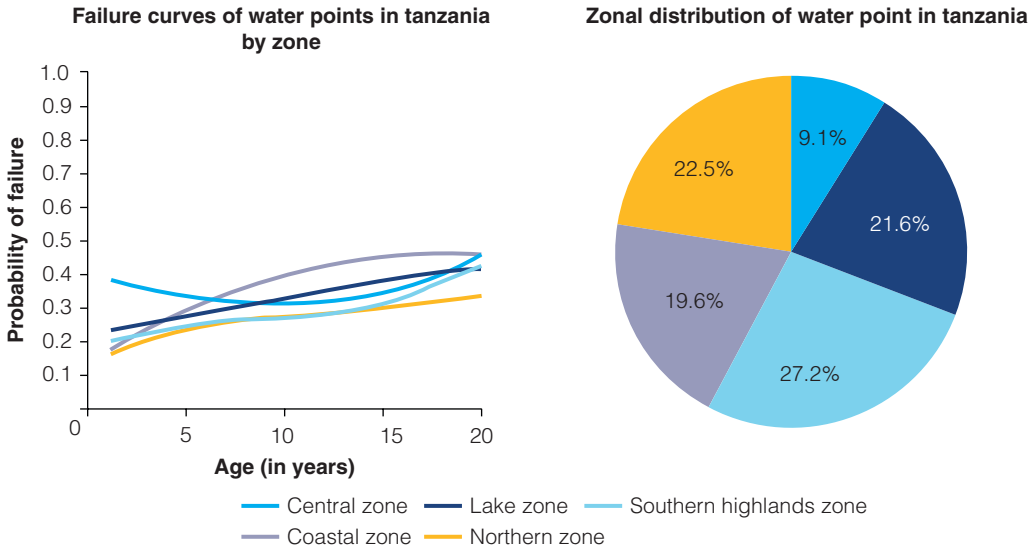
As seen in figure 3.12, the decomposition showing the relative contributions of observed determinants of water point failures (Shapley decomposition) found that in the immediate run (< 1 year of construction), hydrological factors such as groundwater depth and production explain the majority (56.4 percent) of the variance. Next, whether the water point is located in a given ecological zone (Central, Lake, Southern Highlands, Coastal and Northern) has an impact on its functionality status mainly due to the underlying ecological factors. Only then does the type of water pump selected (9.6 percent), which represents the technology choice factor in as a

Figure 3.9: Failure Curve of All Water Points in Tanzania



Source: WPM 2016.

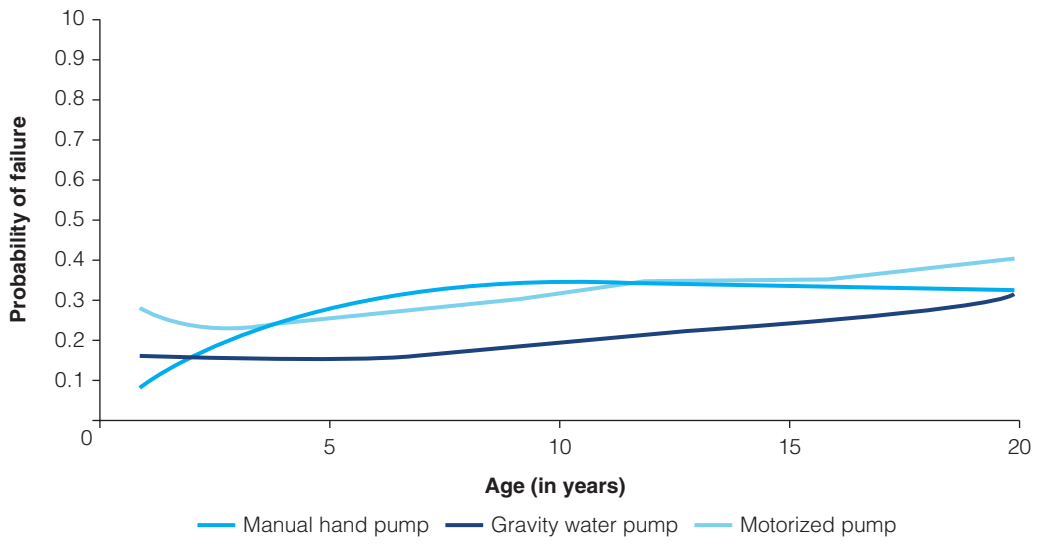
Figure 3.10: Distribution and Failure Curve of Water Points in Tanzania



Source: Water Point Mapping Data, Ministry of Water and Irrigation, Tanzania, Nov 2016.

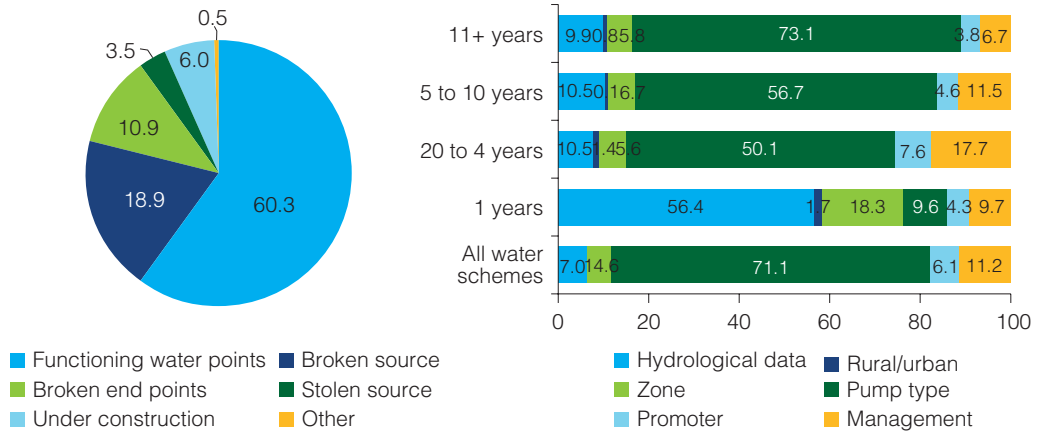
contributor to explaining the failure rate. Motorized pumps are most likely to fail in the first year of operation. At this stage, the management (whether it is public, private, or donor) explains 9.7 percent of observed failure. In the intermediate term (two to four years), the importance of the pump type comes in, constituting 60 percent of the explanation for breakdown. Management and the promoter also increase in importance to 17.7 percent and 7.6 percent respectively. The pump type increases in importance for the medium and long term to 67 percent and 73 percent respectively. Management of the pump holds most importance for pumps between two and four years after construction (17.7 percent) then decreases over time.

Figure 3.11: Failure Curve of Water Points, by Pump Type



Source: Tanzania WPM 2016.

Figure 3.12: Shapley Deconstruction of Water Point Failure



Source: Water Point Mapping Data, Ministry of Water and Irrigation, Tanzania, Nov 2016.

Management refers to whether the manager/operator of the water point is private, a village committee (including COWSOs), or a water board/government. Village committees seem less able to manage their water points sustainably compared to water boards/governments or private providers. Hydrological and regional factors become less important in the longer term.

Conclusions on Rural Water

In this sub-section, we have provided a spotlight on the key issues in providing a sustainable, accessible service to water supply in rural areas. One in every two rural Tanzanians still does not have a basic level of improved water service. In the SDG context, when we take into

account accessibility considerations, these population ratios drop further to just almost one in three for services within 30 minutes. Mapping exercises as presented reveal that the coverage and accessibility of fully functional water points may be even more reduced due to the fact that 40% of all water points in Tanzania are not functioning.

The analysis presented here highlights the importance of hydrological factors in explaining water point failure, in the first year after construction. It also identifies the importance of management factors in the medium term. In the longer term and throughout, the choice of an appropriate technology as an overriding factor in explaining water point failure. These discoveries prompt policy makers to be more carefully when certain technologies are promoted. A political economy analysis to be expanded on in chapter seven, brings us a richer understanding of contextual institutional arrangements which are inhibiting smooth management of water point construction and maintenance. Each of the different issues highlighted is difficult to resolve but if addressed, could provide the framework for a transformation of the rural water sector in favor of sustainability in the SDG context.

Spotlight on Urban Water Service Delivery Challenges

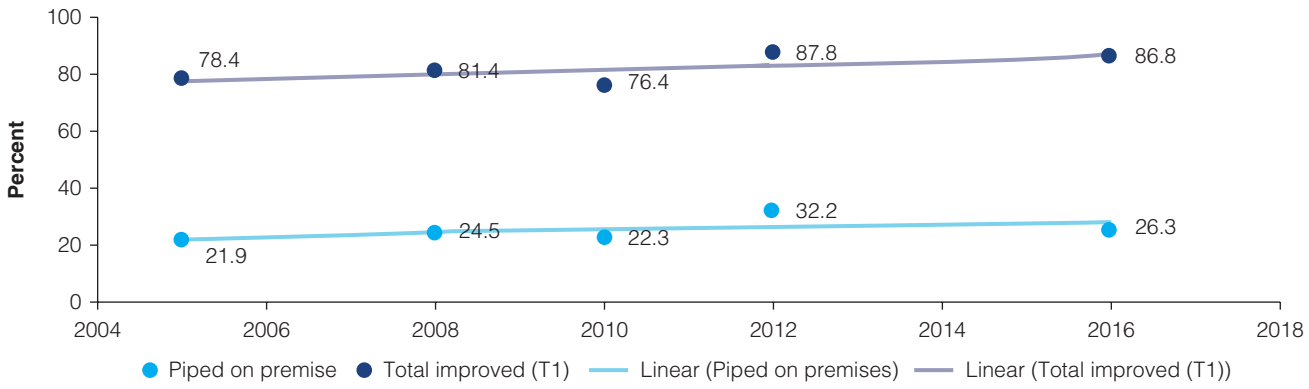
Strained Utilities in Tanzania's Urban Areas

In 1990, improved water coverage stood at 92 percent in urban areas. From that level it declined in subsequent years, falling to 78 percent in 2005. It has been edging upward since then, reaching 87 percent in 2016, still lower than the 1990 level, but heading in the right direction (figure 3.13). However, access to on-premise piped water increased only moderately in the 2005–16 period, from 22 to 26 percent. A major further challenge for urban piped water supply is reliability of service. According to 2016 DHS household data, about 66 percent of all piped water users in urban areas reported that they had been unable to obtain water for at least one day in the previous two weeks. These trends warrant further investigation on the performance of the primary service providers, utilities.

Urban Provision from the Urban Utilities Perspective

In this section, we draw from data provided by the International Benchmarking Network for Water and Sanitation Utilities (IBNET) to assess the efficiency, availability, quality, and financial

Figure 3.13: Trends in Urban Water Coverage by Tiers from 2005 to 2016



Source: DHS 2005–16.

Box 3.2: Indicators for Measuring Performance

In order to assess the efficiency, availability, quality, and financial sustainability of service providers, we utilize a number of key indicators.

1. **Efficiency**
   a. *Non-revenue water (NRW):* The difference between water supplied and water sold as a percentage of the former. This indicator helps assess the operational efficiency of the utility, with lower NRW implying better efficiency.
   b. *Staff productivity:* The number of connections per employee.
2. **Availability**
   a. *Continuity:* The average number of hours of service per day.
   b. *Quantity:* Water consumption in liters per person per day. Higher levels of consumption imply improved service delivery.
3. **Financial Sustainability**
   a. *Operational cost recovery:* The ratio between operating billed revenues and operating costs. A ratio greater than 1 implies that a utility is able to recover its costs and generate profits.
   b. *Average revenue:* Operational or billed revenue per cubic meter of water sold.
   c. *Collection ratio:* Cash income as a percentage of billed operational revenue.

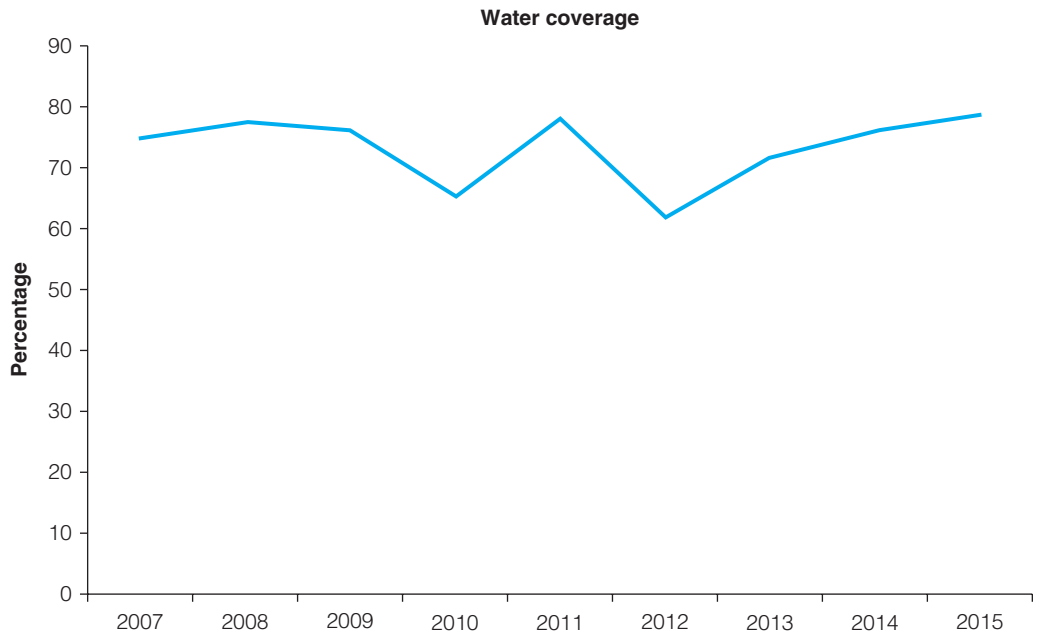
sustainability of urban service providers across Tanzania. In doing so, we develop a knowledge base for facilitating dialogues with providers, both public and private, to address deficiencies. See box 3.2 for a summary of the indicators used in this analysis.

Coverage by utilities in urban Tanzania was above 70 percent in most years in the period 2007–15 (figure 3.14). This was mostly through household connections, because the share of standpipes was quite low. Data were not available for most years, but the data from 2013–14 show standpipe coverage at 10-13 percent.

Overall, water utilities in Tanzania showed improvements between 2007 and 2015 (table 3.1) in the indicators of staff productivity, operational cost recovery, and average revenue. However, a number of indicators decreased in the period, implying poorer performance—non-revenue water, quantity of water consumed, continuity, and collection rate. But we see generally good performance because the indicators that rose increased at generally robust rates, compared to lesser declines by the falling indicators.

However, when compared globally and with Sub-Saharan Africa, Tanzania underperforms on most indicators that measure efficiency, availability, and financial sustainability (figure 3.15). While staff productivity was consistently below both the global and regional averages, Tanzania's weighted average for non-revenue water was mostly lower than the global average in 2007, but higher than that for Sub-Saharan Africa. However, from 2012 onwards, Tanzania's NRW was higher than the global average, but due mainly to the steady decline in the global figure. Both consumption per capita and duration of supply were lower than the Sub-Saharan African and global average for the entire period of 2007–15 under review. Cost coverage for Tanzania was initially lower than the global and regional average, but in 2014, it surpassed that of the Sub-Saharan Africa. However, the average revenue for Tanzania was consistently below the

Figure 3.14: Urban Population Water Coverage by Utilities in Tanzania



Source: IBNET (Accessed: July 2017).

Table 3.1: Tanzania Utilities Performance Summary Statistics (Unweighted)

Indicator	Number of utilities	2007	2015	% Δ 2007–2015	2015 Std. dev.	2015 Min	2015 Max
Non-revenue water (%)	25	50.40	35.89	–28.79%	11	15	57
Staff productivity (connections/ staff)	25	90.54	146.56	61.87%	53.91	36.64	228.35
Water consumption (l/capita/day)	23	61.24	52.43	–14.38%	20.94	20.98	110.73
Continuity (hours/day)	25	17	16	–5.30%	6.71	2	24
Operational cost recovery	25	0.74	1.00	35.85%	0.31	0.36	1.70
Average Revenue (US$/m3 sold)	25	0.28	0.49	77.15%	0.10	0.29	0.73
Collection Rate	25	105.99	85.93	–18.93%	11.22	55.20	102.40

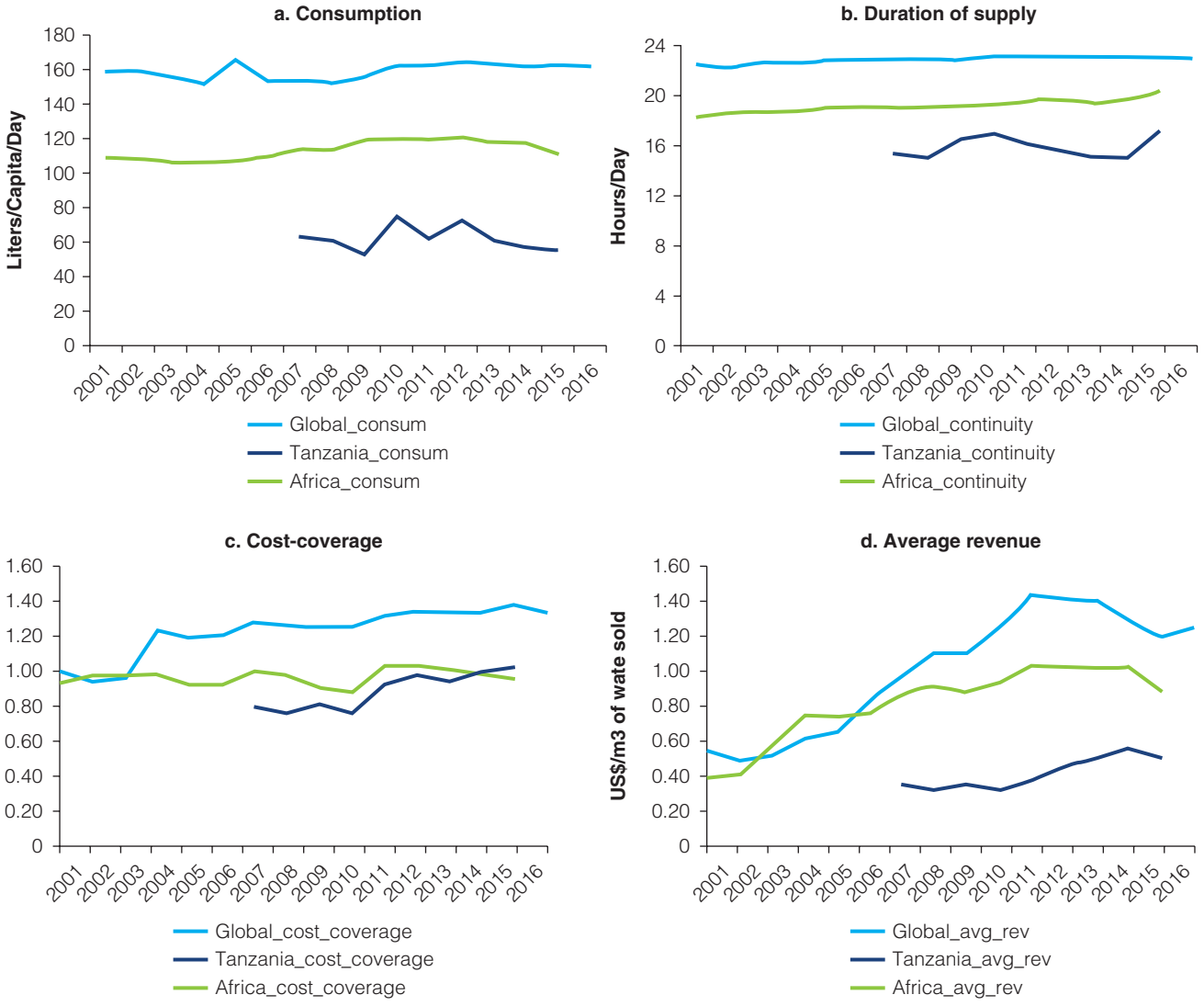
Source: Authors' elaboration based on IBNET data.

Sub-Saharan Africa and global average. Finally, collection rate for Tanzania was better than the Sub-Saharan African average, and towards the later years in the review period inched closer to the global average.

Reliability, Affordability, and Quality Constraints: The Story from the Consumer Perspective

Several data sources demonstrate the lack of reliability, affordability, and water quality affecting urban water service. There are several separate analyses that corroborate these findings. These include the baseline data from an impact evaluation conducted by the Millennium

Figure 3.15: Tanzania versus Sub-Saharan Africa Region versus Global Average Performance, Weighted by Number of Connections



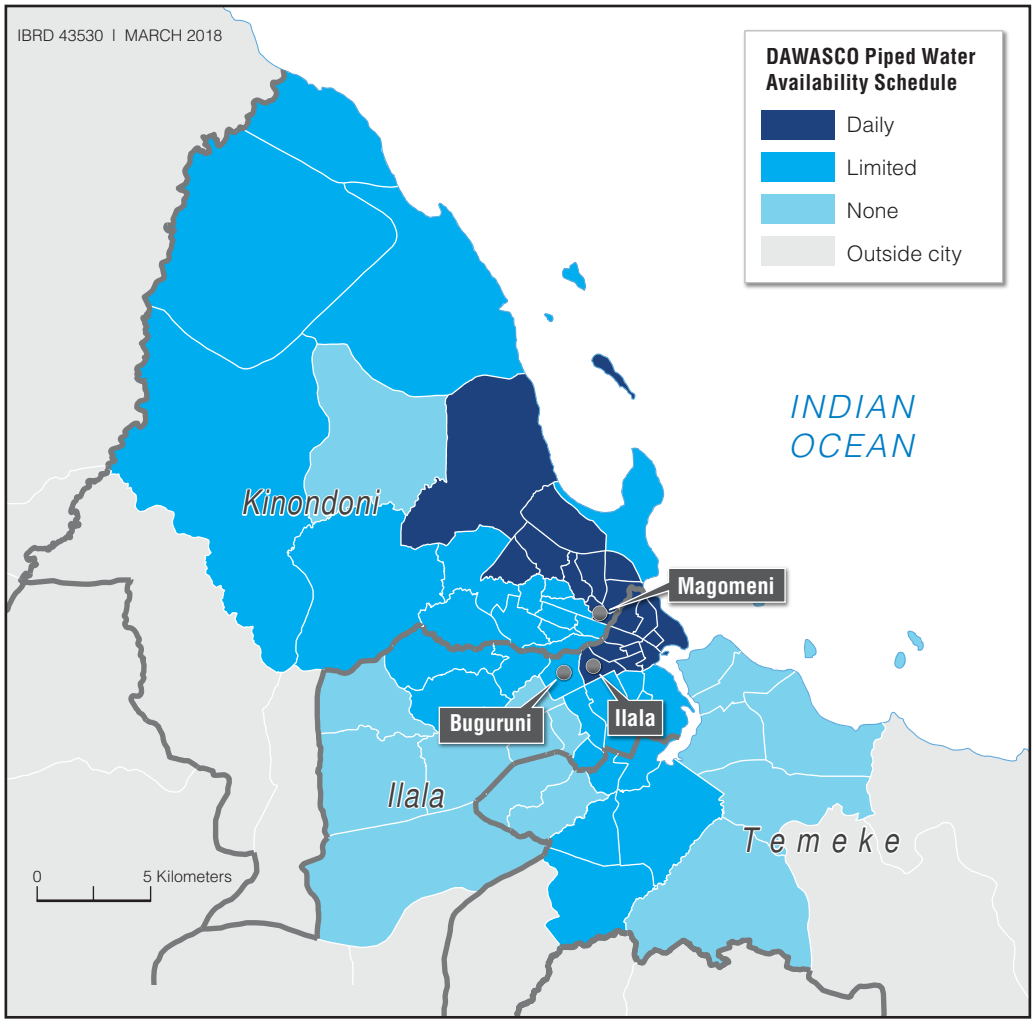
Source: Authors' calculations, based on IBNET data.
Note: (1) Weighted by number of connections. (2) Changes are computed based on the same composition of utilities in two consecutive years. (3) The bold lines are based on data from at least ten utilities per year for Tanzania and Sub-Saharan Africa and from more than 100 utilities per year for global trends.

Challenge Cooperation[8] focused on Dar es Salaam and Morogoro, data from DHS and a paper by Smiley (2016) based on data from 150 households across three wards in Dar es Salaam. Finally, an analysis by GIZ on the extent of informal service provision across Low Income Settlements (LISs) in all of the Tanzanian mainland gives the regional picture so that the analysis is not limited to Dar es Salaam.

Reliability

Various sources show that water service in major Tanzanian cities has limited reliability. DHS data from 2015 showed that of people who have piped service in urban areas, 66 percent reported that they had experienced interruptions for at least one full day in the previous two weeks.[9] Interestingly, reliability in urban areas for piped supply seems to be even lower than in rural areas. In rural areas 56 percent reported interrupted service in the same time frame (the national average is 63 percent).

Map 3.4: Schedule of Availability of DAWASCO Piped Water

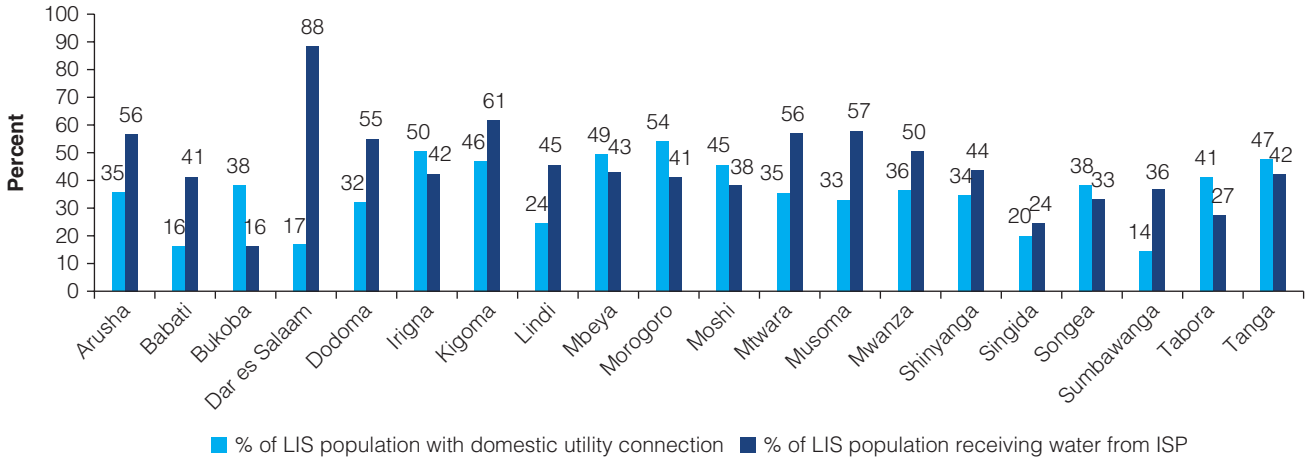


Source: Adapted from Smiley 2016.
Note: DAWASCO = Dar es Salaam Water and Sewerage Corporation.

Specifically, for Dar es Salaam, the MCC impact evaluation baseline survey found that among households that had a tap on premises, an estimated 41 percent reported a shortage in the previous week. For the other city in which the study was conducted, Morogoro, this figure was higher at 51 percent.

The lack of continuity of service is corroborated by DAWASCO itself. Data that Smiley collected from the utility shows that only the most central areas of the city receive daily water supply and that the further out the service goes, the more likely consumers are to have "limited" or no service. The MCC study also shows that users commonly rely on multiple sources to complement piped water supply. Thus we see the growth of informal service providers. As of 2016, 14 percent of the population of Dar es Salaam reported receiving water from a truck/water vendor or cart with small tank as opposed to 12-13 percent who reported receiving water piped to their premises. The percentage receiving by tanker truck is even higher for the poorest households, rising to 20 percent in the lowest quintiles (DHS 2016). GIZ reported the growth

Figure 3.16: Low-Income Population Receiving Water from ISP versus Household Utility Connection (Percent)



Source: Pauchert et al. 2012.

of Informal Service Providers in regions around the Tanzanian mainland. As figure 3.16 shows, the percentage of the population receiving water from these vendors in Low Income Settlements (LIS) is highest in Dar es Salaam.

The poor reliability of service and high reliance on informal substitutes is also a legacy of "hydraulic exclusion" in water provision, in particular in cities like Dar es Salaam (Slater and Jingu 2016). This is where a piped network was historically limited to a small, richer area of the city since colonial times and was heavily subsidized just in those areas. Even historically, poorer populations and incoming migrants on the outskirts of the city have had to resort to point sources or mobile vendors. The existing infrastructure has expanded little to cater to the population growth.

Affordability

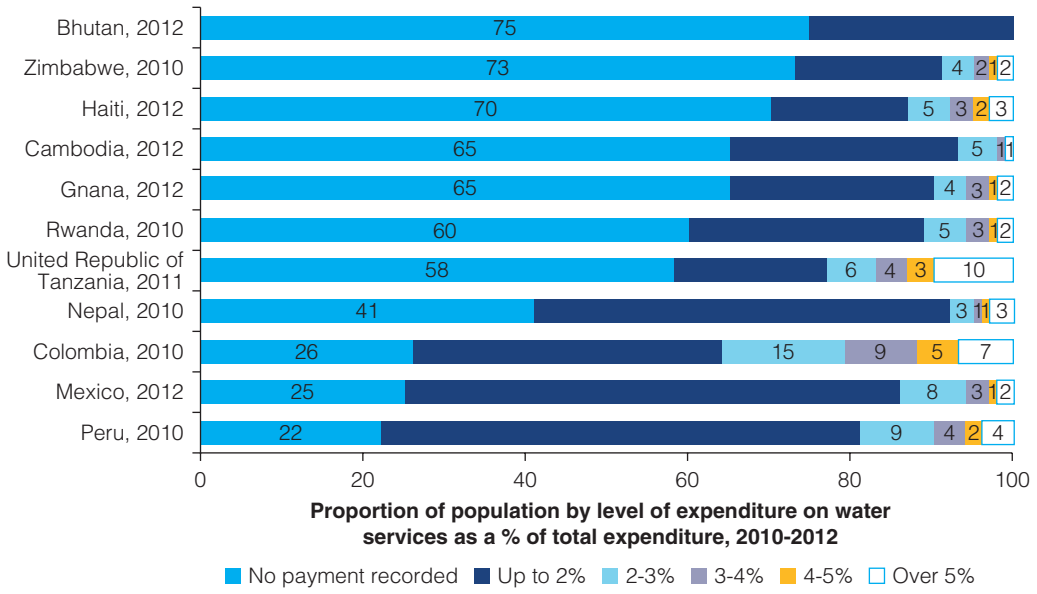
SDG 6.1 emphasizes the importance of affordable drinking water. A recent analysis by JMP of the Household Budget Survey 2011/12 for eleven countries found that Tanzanian users of delivered water had the highest rate of devoting more than 5 percent of their annual household expenditure on water (figure 3.17). The recommended international standard is under 2 percent.

While our initial assumption may be to attribute this to tanker trucks, a more thorough assessment reveals that tanker truck water is often out of reach of the poorest due to the location of their homes. Our own analysis found that all DHS data since 2005 show that a higher percentage of the T60 than the B40 have been using tanker trucks as a water source in urban areas. We can also see from figure 3.18 that the dominant water source for the B40 (28 percent) is their neighbors' connections. The next largest category is 18.2 percent who rely on public taps or standpipes, followed by 16 percent who use protected wells.

Water Quality

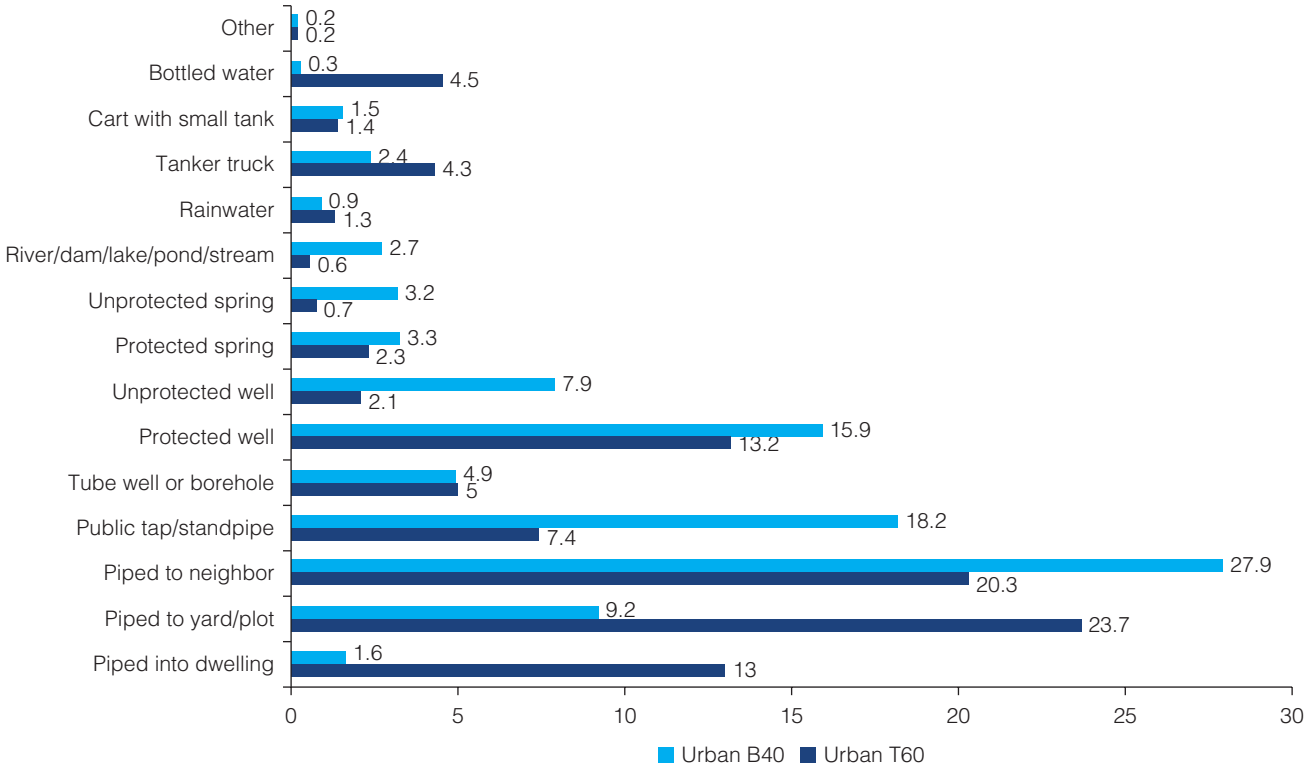
Finally, water quality in Tanzania's major cities is of concern both for people receiving formal and informal supplies. The source of water that informal providers resell is often unknown. Neighborhood resellers in particular are likely to draw water from the public utility but others may mix borehole water with public utility water. Pauschert et al. (2012) report that 25 percent of people served by ISPs receive borehole water. In particular, in Dar es Salaam, seawater intrusion can lead to brackishness in groundwater (Smiley 2016). Theoretically, all wells require a permit so that the regulator can monitor groundwater extraction. However, unauthorized wells are common and thus water quality cannot be vouched for. In addition, with wells being dug in unauthorized locations and not necessarily protected, there is particular concern that cities'

Figure 3.17: Percentage of Household Expenditure on Water Services, by Country



Source: JMP 2017.

Figure 3.18: Water Sources by T60 and B40 in Urban Areas (Percent)



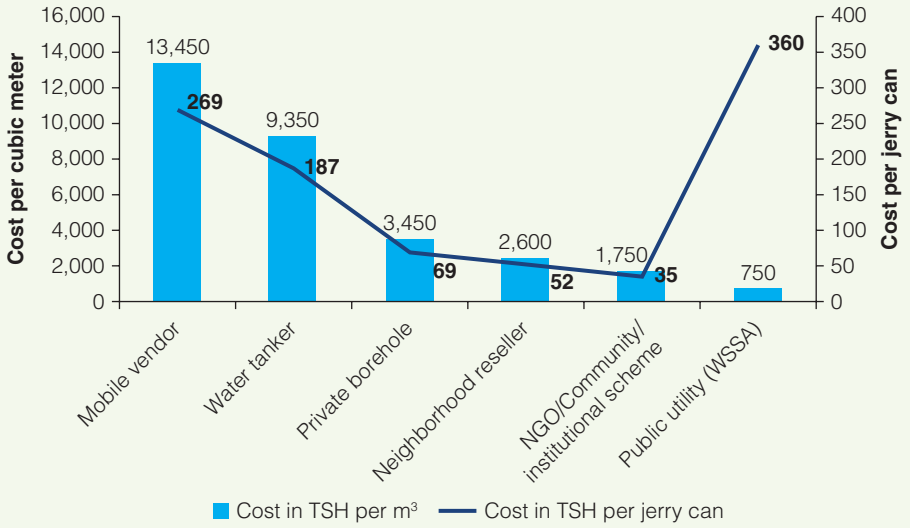
Source: Authors' calculation from DHS 2016.

Box 3.3: Informal Service Providers in Urban Centers

Our data is consistent with an assessment from GIZ that only a small percentage of Tanzania's poor population currently receive their water supply from water tankers. This is in part due to the difficulty of access into some LIS. Larger trucks simply cannot pass along their poor quality or narrow roads. Instead, the poor may rely on small carts, which can more easily maneuver through LIS to make deliveries, but are also more likely to charge a higher price. For this reason, these small-scale providers are typically a last resort for the poor (Pauschert et al. 2012).

A reliance on neighborhood resellers is also identified in GIZ's analysis and is reported to be particularly common in Mwanza, Morogoro, and Mbeya. There public utilities are even reported to promote neighborhood reselling as a means of improving coverage of LIS despite, even though this practice is outside of EWURA regulation (Pauschert et al. 2012). Of the different ISPs, neighborhood resellers are among the more affordable options. While they are not as low as the cost of buying directly from a utility, they are still much more affordable than mobile vendors. The different costs in shillings of each of the providers is shown in figure B3.3.1.

Figure B3.3.1: Cost of Water in Tanzanian Shillings per Jerry Can, in Cubic Meters

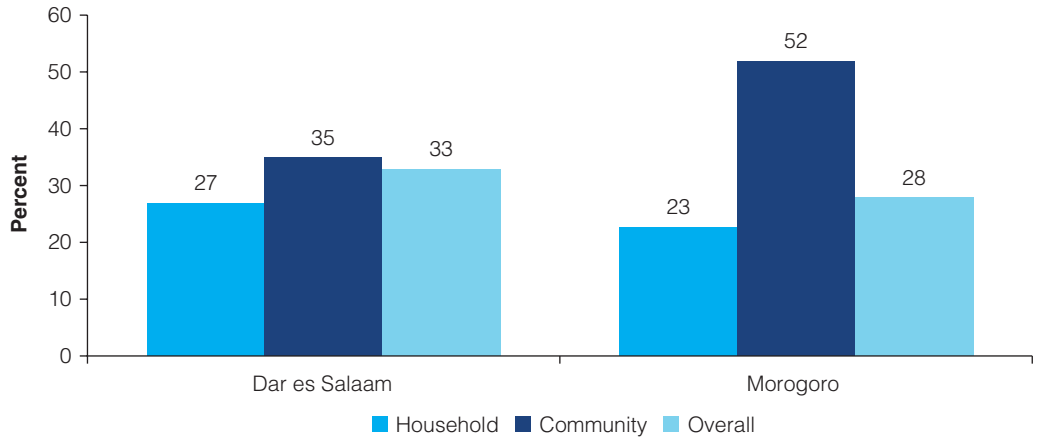


Source: GIZ 2012.
Note: TSH = Tanzanian Shillings.

high levels of unimproved sanitation and lack of proper fecal sludge disposal will result in fecal matter contaminating the water supply. MCC conducted more than 1,000 water quality tests in Dar es Salaam and Morogoro and found that contamination was common (figure 3.19).

Of special benefit in the MCC analysis is that it took samples from household and community sources as well as sources at the treatment plant itself. For household and community sources, it is not possible to distinguish from the data whether these were utility connections or not. Nonetheless, it is concerning that 27 percent of households in Dar and 23 percent in Morogoro had unsatisfactory risk ratings for *E. coli* bacteria. Furthermore, in both cases, community

Figure 3.19: Community and Household *E. coli* Contamination—Percentage of Water Samples with Unsatisfactory Risk Rating



Source: MCC 2014.

water supply was even less clean, with 52 percent of those sources in Morogoro showing signs of contamination.

One of the three treatment plants (Dar es Salaam: Lower Ruvu) had difficulty complying with the Centers for Disease Control and Prevention's (CDC) recommended minimum dosage of free chlorine to maintain chlorine throughout the distribution network (Rostapshova et al. 2015). Considering the higher levels of unsatisfactory readings for *E. coli* at the household level, we can deduce that while treatment is not always sufficient, the state of the pipes and low reliability of service may well be a cause for the drop in quality of water by the time it reaches the household.

Data on water quality are relatively rare and practically absent at a national level. The high incidence of water quality issues that we glean from what little information we have, suggests the need for a more systematic collection of water quality data as part of household surveys.

Conclusions on Urban Water

As Tanzania's urban areas, in particular Dar es Salaam, see increasing levels of growth in recent years, the expansion of networks need to be designed with reliability, affordability and water quality in mind. While Tanzania's urban providers have made certain progress in narrowing the gap between rich and poor populations in terms of their access to MDG-improved water coverage, focus now needs to be re-aligned in accordance with SDG criteria. In urban Tanzania, an expansion of the network on its own will not be sufficient for Tanzania to reach its SDG targets. Research highlighted in this subsection has shown that presently, some customers are paying up to five times more for their water than the price that the utility could be providing it to them for directly. We notice that in Dar es Salaam the dependence of the B40 on tanker trucks has even surpassed the dependence of the T60 in recent years. In this sense, the current arrangement benefits neither the customers nor the utility itself, and seems at risk of backsliding on its progress for the poor. In urban areas in Tanzania, now that progress in water coverage has been made, providers are encouraged to take a step back and reconsider investment in water treatment, network maintenance, and water production. This includes prioritizing their ability to enforce stronger regulation of water treatment, acknowledging and working with informal providers; building mechanisms to ensure greater continuity of supply; and improved capacity to operate and maintain the existing network. With a solid foundation, further network expansion can then continue with lower risk of repeating the same reliability, affordability, and safety concerns. Furthermore, it can reduce dependence on informal providers in the process.

Notes

1. Our 2016 data from the DHS appears to show slight improvements on JMP figures, though a significant trend change cannot yet be identified..
2. This is the closest proxy for the new Safely Managed Water (SMW) target, and includes three out of the four criteria for the SMW target: technologically improved water source, located on household premises, and available when needed. Water quality is also included in the new SDG monitoring strategy, but Tanzania has no national data on water contamination so it could not be used in this analysis.
3. This is a proxy estimate for safely managed water (SMW) as it *does not* consider water quality. This figure reflects T3 access, considering only three out of four criteria of SMW: (1) improved water technology, (2) available when needed, and (3) located on household premises.
4. In this analysis, water supply is considered interrupted when a household reports that it was unable to access drinking water from its source for at least one day in the previous two weeks.
5. Wealth quintiles are based on an asset ownership index, used as a proxy for poverty.
6. About 90 percent of the water points in the database are located in rural areas and 10 percent in urban areas. Following analyses using WPM data describe the rural context.
7. Shapley decomposition is an econometric estimation technique that enables estimation of the contribution of observable characteristics to the variance in the outcome variable. For more information, see Shorrocks 1999.
8. In 2014, the Millennium Challenge Corporation (MCC) contracted a survey firm to conduct the baseline study of an impact evaluation prior to a US$64.2 million investment in the Lower Ruvu Plant Expansion in Dar es Salaam and Morogoro. The evaluation collected data across 626 census enumeration areas, 5,008 households that were split 50:50 between Dar es Salaam and Morogoro. In addition to the household surveys, 515 water quality tests in Dar es Salaam and 598 tests in Morogoro were carried out over more than three hundred clusters in each city. Qualitative data were also collected through focus groups, interviews, and visits to health and education centers.
9. The question asked in DHS is: "In the past two weeks, was the water from this source not available for at least one full day?"

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Chapter 4
Access to Sanitation and Hygiene

Tanzania did not meet its MDG target to increase access to improved sanitation facilities. By the end of 2016, only about 20 percent of the national population was estimated to use an unshared, improved sanitation facility, though that was at least a 13 percentage point improvement since 1990. The vast majority of Tanzanians use rudimentary sanitation facilities that often fail to reliably keep human excreta from human contact. Though open defecation is not common in Tanzania, the northeast regions of the country have a heavy concentration of this dangerous practice. The new SDG target for "safely managed sanitation" now not only challenges the country to reach universal access to unshared, improved sanitation facilities, but to also ensure that facilities are coupled with proper fecal sludge management practices. That means that excreta is safely transported and treated before going into the environment.

This chapter is organized into two sections. The first examines sanitation access levels using a tier analysis, where higher tiers indicate access to higher-quality facilities. The analysis estimates tier access levels by national, urban, rural, and wealth groups. It also examines geographical inequities by using geospatial estimation techniques represented at the regional, district, and pixel (1 x 1 square kilometer) levels. The second section considers hygiene practices.

Sanitation Access Levels Using Tier Analysis

In a similar vein to our measure of progress in water access, this analysis follows a tier framework for assessing sanitation access. Tier 0, Unimproved Sanitation, includes people who use technologically unimproved sanitation facilities (open defecation, hanging latrines, buckets, flush to somewhere other than a septic tank or sewer system) , or a pit latrine without a slab) or any shared sanitation facilities. Tier 1, Improved Sanitation is a step better and represents the JMP definition of technologically improved sanitation, but regardless of whether or not the facility is shared. Tier 2, Unshared Improved Sanitation, follows the MDG target of having access to a technologically improved sanitation facility that is unshared. Tier 3, Sewage Connection, includes those households that have access to an unshared improved sanitation facility with a sewerage connection, which can theoretically transport sewage for safe disposal (figure 4.1).

National, Urban, and Rural Access

Analysis of 2016 DHS data shows that about 20 percent of Tanzania's population now has access to an improved sanitation facility that is unshared between neighbors (T2), about a 13-percentage point gain since 1990 (figure 4.2). However,

KEY POINTS

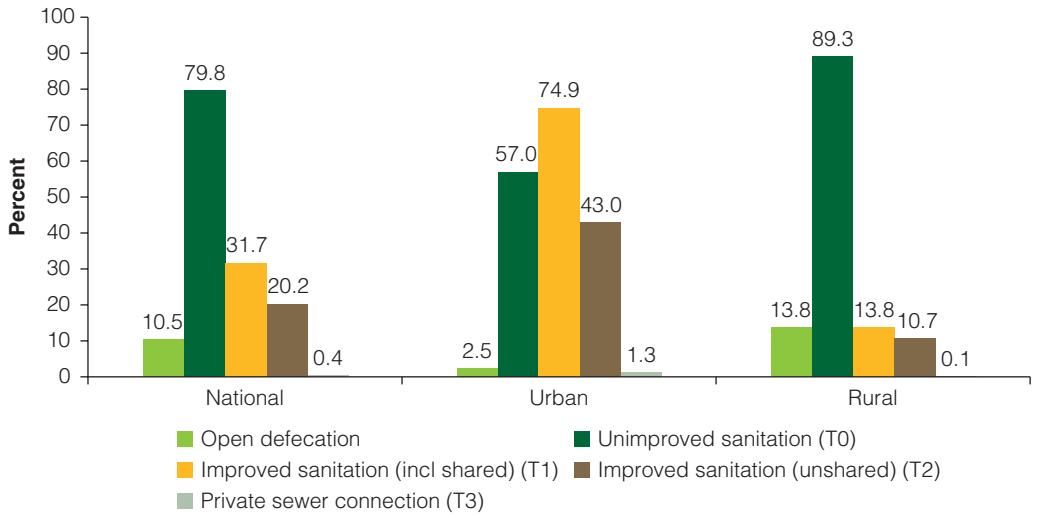
Most Tanzanians use rudimentary, unimproved sanitation facilities. In 2016, only 20 percent of the population had access to an improved sanitation facility, though that was a significant jump from the 7 percent rate of 1990. Gains have largely benefited the richer segments of the population.

Open defecation is concentrated in some rural areas of the country and is more common among poorer populations. The national open defecation rate is 13 percent, but 75 percent of it is among the bottom 40 of the wealth distribution. In some districts, the rate is as high as 68 percent.

Safe fecal sludge management is rare. For instance, in Dar es Salaam only an estimated 40 percent of human excreta is safely managed, while the rest is discharged into the environment, potentially doing drastic harm to health outcomes.

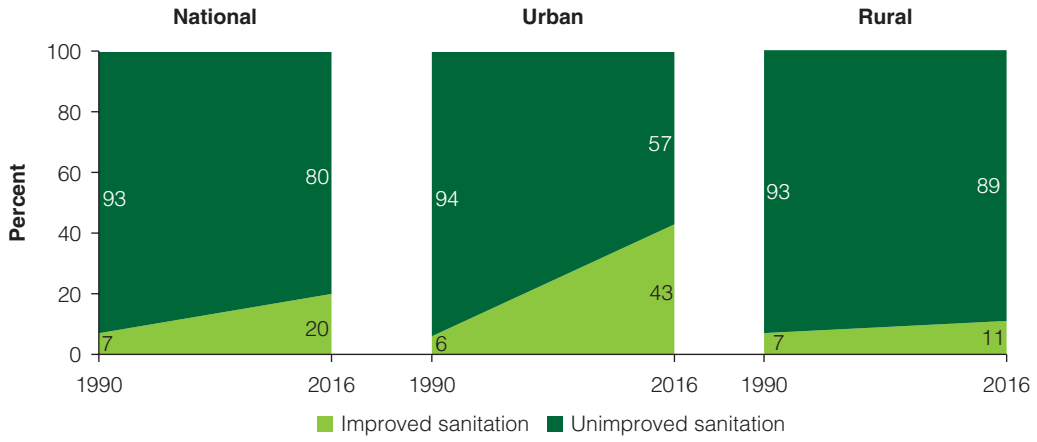
Handwashing needs improvement. Less than half of all households have access to a handwashing station that includes soap and water. While many people know why washing the hands is necessary, few people do it.

Figure 4.1: National, Urban, and Rural Sanitation Access by Tiers



Source: Authors' calculation from DHS 2016.

Figure 4.2: National, Urban, and Rural Trends in Increasing Improved Unshared Sanitation from 1990 to 2016 (Percent)

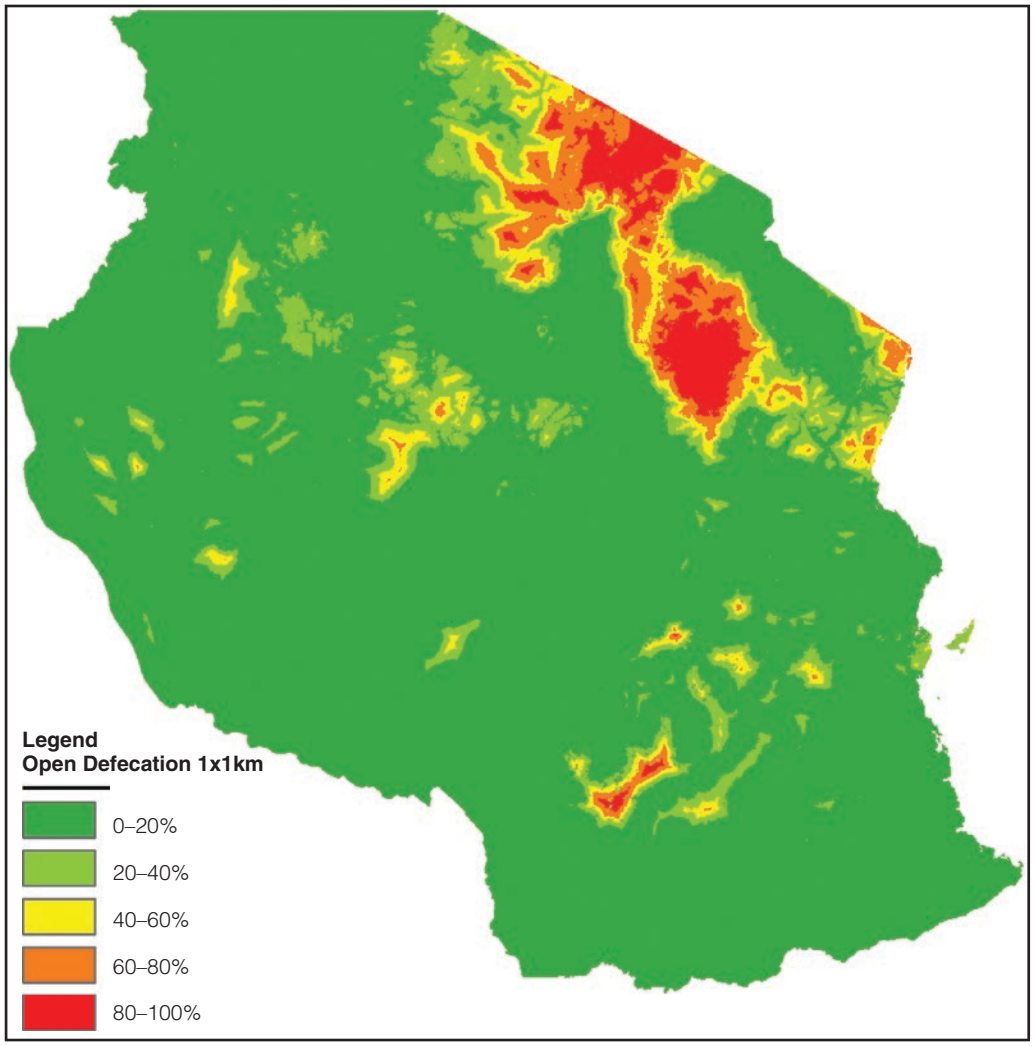


Source: JMP 2015.

this progress comes largely from improvements in urban areas. From 1990 to 2016, urban sanitation coverage jumped from 6 to 43 percent, a tremendous achievement. However, rural Tanzania did not see comparable advances. Only 11 percent of people living in the rural areas have access to an unshared, improved sanitation facility.

Though nearly 90 percent of rural residents remain without this access, the vast majority is at least practicing fixed-point defecation. Open defecation rates in rural areas are only about 14 percent. Nevertheless, pixel-level mapping at the district level reveals that some parts of the northeast have much higher rates: some districts such as Longido and Ngorongoro have open defecation rates as high as 68 percent (map 4.1). One of the reasons attributed to these high open defecation rates in these areas is the large presence of nomadic and

Map 4.1: Percentage of People Practicing Open Defecation, 1 x 1 Kilometer Pixel Level



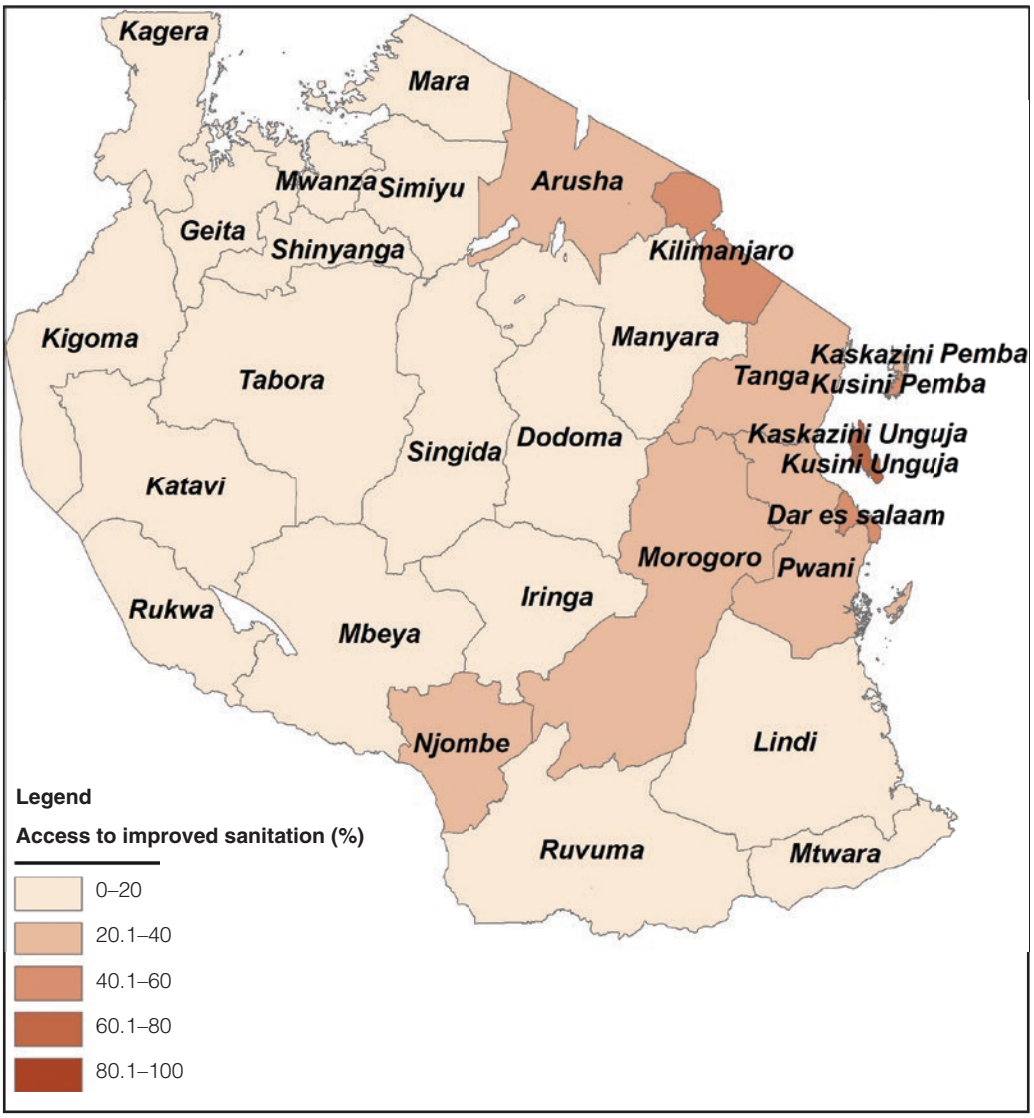
Source: Authors' calculation based on RWS 2014.

pastoralist populations which follow social and cultural practices that fit their itinerant lifestyles.

In the SDG era, the larger task at hand is to transition households from using rudimentary sanitation facilities to improved sanitation facilities. About a third of the population uses some type of improved sanitation facility (shared and unshared). However, in rural areas, the vast majority of people (70 percent) use rudimentary, unimproved pit latrines that have slabs that are not washable or are uncovered and ineffective in preventing human waste from spreading through the environment (map 4.2). Some of these pits can at least easily be transformed into improved sanitation facilities by installing hygienic slabs that can reduce the risk of spreading excreta.

To achieve the improved sanitation target as per the JMP guidelines, it is also imperative to reduce the practice of sharing sanitation facilities between households, particularly in urban areas. Improved sanitation access requires not only access to a technologically better facility, but also that such access is not shared with other households. Sharing and ambiguous ownership of these facilities can often mean that their safety, upkeep, and cleanliness suffer. Sharing of facilities is predominantly an urban issue. Though about 75 percent of urban dwellers use

Map 4.2: Percentage of People with Access to Improved Unshared Sanitation, by Region

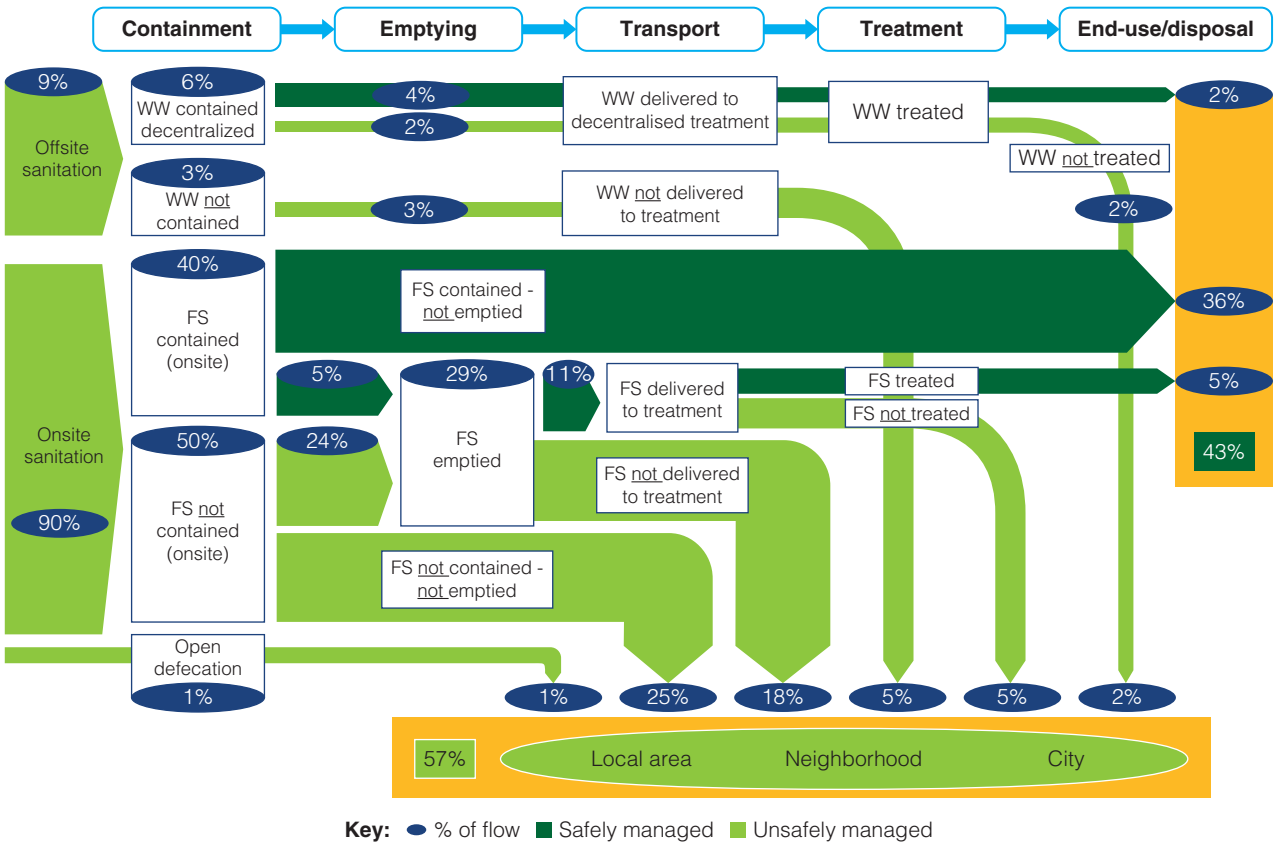


Source: Authors' calculation from DHS 2016.

improved sanitation technologies, improved sanitation access drops to 43 percent when considering only unshared improved sanitation. In rural areas, the drop is not as significant, decreasing from 13 to 10 percent based on sharing status.

In addition to transitioning to unshared, improved sanitation facilities, proper fecal sludge management (FSM) services must be ensured both in the rural and urban areas. The benefits of better sanitation facilities cannot be fully realized without safe FSM. At present, only about 3 percent of the entire population is connected to a piped sewer system, which is essentially an urban phenomenon. Instead, the most commonly used facility is some variation of an improved pit latrine. No available nationally representative household data are available on on-site FSM such as pit or septic tank emptying practices or waste disposal and treatment. But regular pit or septic tank emptying is vital for sustainability of sanitation facilities. Likewise, proper waste treatment and disposal are necessary to protect the environment from fecal pollution.

Figure 4.3: Fecal Flow Diagram of Dar es Salaam



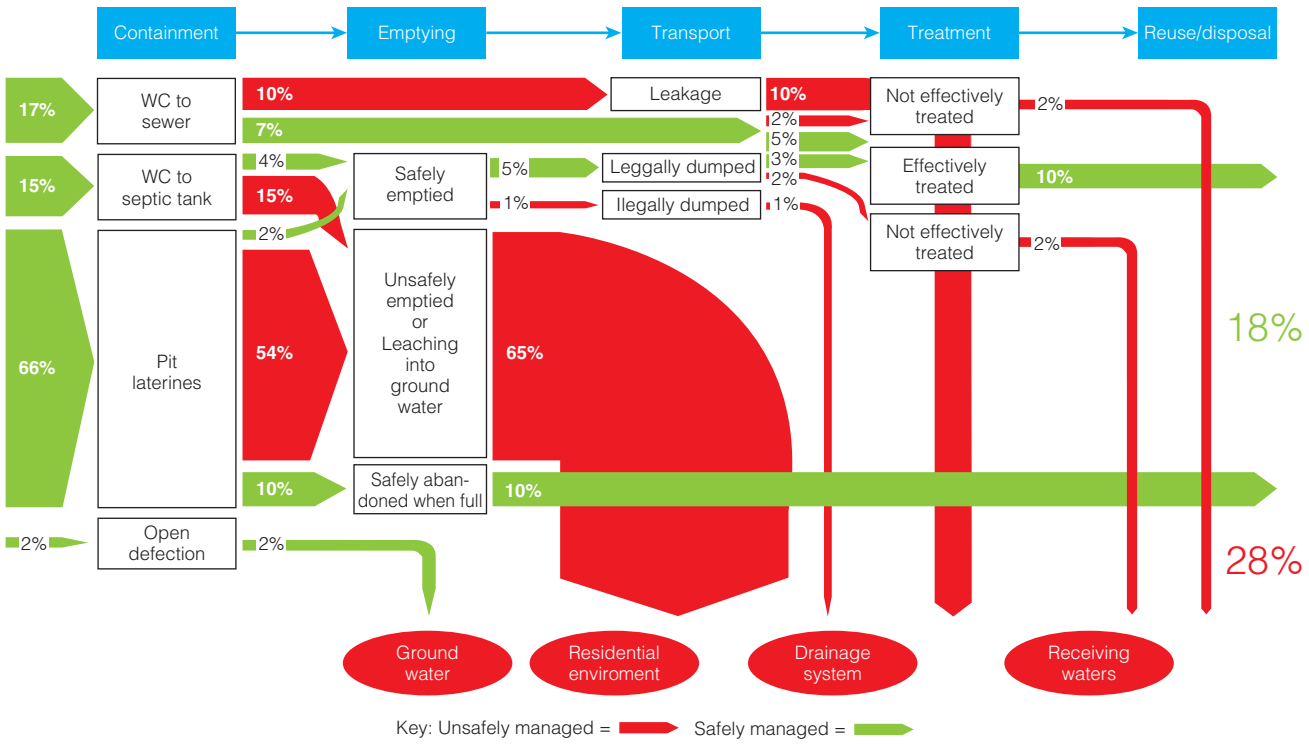
Source: Sandec 2015.

Small-scale studies of urban fecal sludge management find that most sewage is not centrally treated before being discharged into the environment. In Dar es Salaam, for example, it is estimated that only 43 percent of human excreta is safely managed, even though the city has both a sewer system and a wastewater treatment plant. The sewage system connects to an estimated 20 percent of the city's population, but is often in disrepair and unable to effectively collect and treat sewerage (figure 4.3). This situation is most likely representative or maybe better than other cities in Tanzania. A fecal flow study in Moshi estimated that 82 percent of human excreta was not safely managed (figure 4.4).

Bottom 40 and Top 60 Access

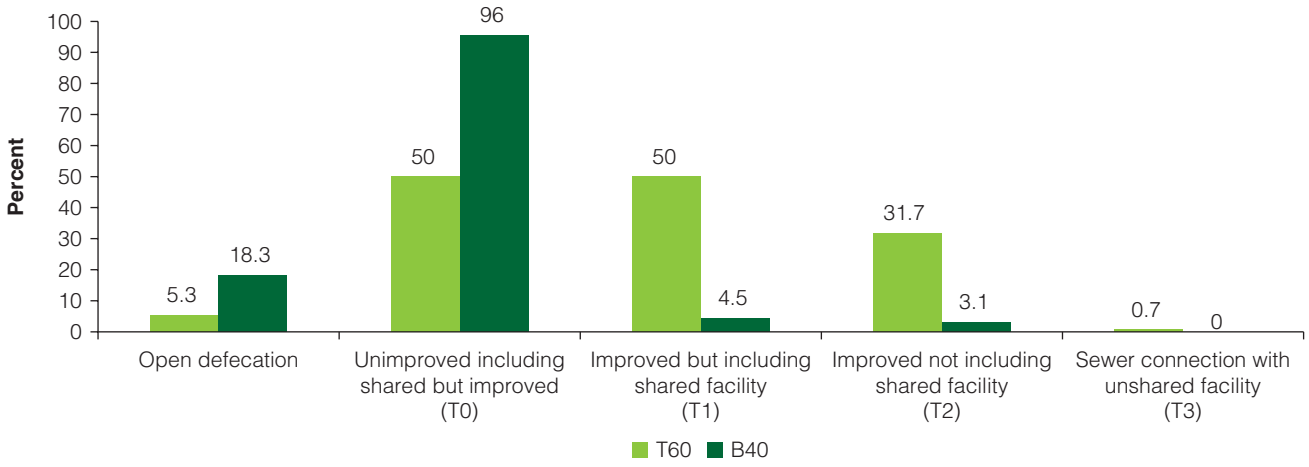
When access is broken down by wealth subgroup, the poorest people are found to have the least access to improved sanitation. Overall access to improved sanitation is already low, but almost all improved sanitation access is among the wealthier segments of the population. Improved sanitation access (T2) for the T60 currently lies at 32 percent, while for the B40 it is a mere 3 percent,[1] clearly exhibiting huge disparities (figure 4.5). Furthermore, more than 20 percent of the poorest wealth quintile practice open defecation. Only the richest wealth quintile has access to unshared, improved sanitation facilities connected to a sewerage system (figure 4.6). However, because such a small proportion of the population is connected to a sewerage network, this disparity might be negligible.

Figure 4.4: Fecal Flow Diagram of Moshi



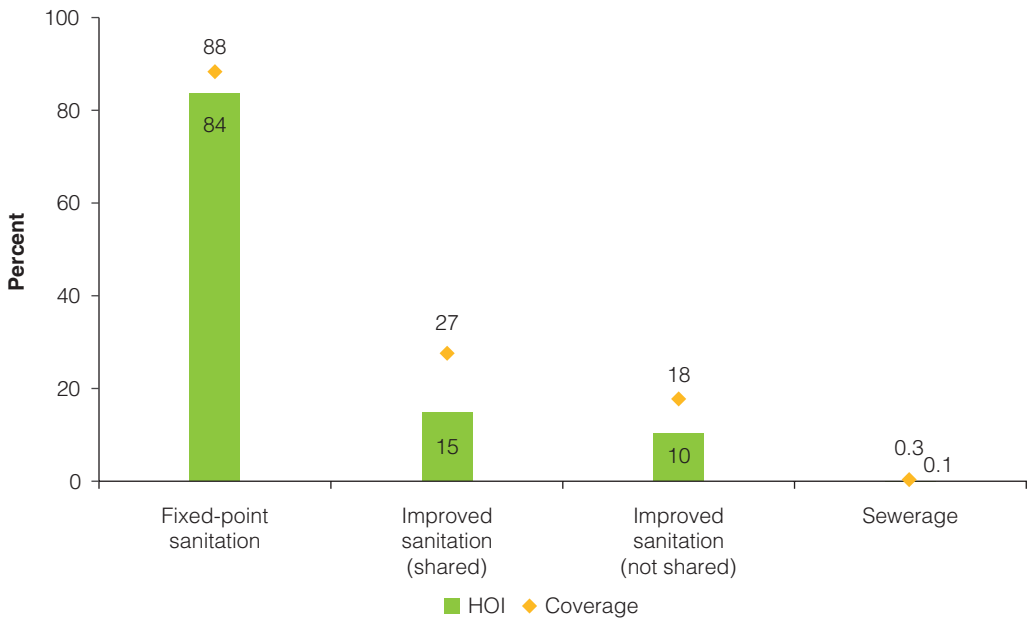
Source: GIZ 2015.

Figure 4.5: Access to Sanitation—T60 and B40



Source: Authors' calculation from DHS 2016.

Figure 4.6: Composite HOI and Coverage for Sanitation Services



Source: Gething et al. (2017).

According to the Human Opportunity Index (HOI) as was fully explained in the previous chapter (Box 3.1) we can also look at the extent to which different levels of sanitation service are unequally distributed among the population and according to what population characteristics. We see that the greatest disparity between the HOI score and sanitation comes from improved and shared sanitation (Figure 4.6). Income distribution is the most powerful predictor of whether or not a child has access to sanitation services. This is most pronounced in access to fixed-point sanitation (60%) for the B40 (Figure 4.7). For access to a sewerage system, the strongest determinant of inequality is whether or not a child lives in a rural area (49%). To a lesser extent, similar to water services, inequality in access to sanitation is impacted by parents' lack of education. Marital status and gender of the household head seem to have a slight effect only in access to sewerage (11 and 7 percent, respectively). For the rest of sanitation services, marital status and gender of the household head seem to have relatively little significance in impacting the distribution of sanitation services (less than 3 percent). In Box 4.1 inequalities in access are also explored geographically by dividing the population into T60 and B40 distributions by region. (See page 53)

Trend analysis from 1995 to 2012 (figure 4.8) confirms that the gains have largely benefited richer, urban populations. Though the MDG target for sanitation was not met, Tanzania at least achieved higher coverage of improved sanitation, which since 1990 has risen by about 13 percentage points. Urban access to improved sanitation significantly increased from 6 to 43 percent, whereas rural access rose only from 7 to 11 percent. However, in both urban and rural settings, it was the richest segments of the population who benefited the most from gains in coverage. In urban areas, their coverage increased from 29 to 53 percent compared to just a 6 to 15 percent rise among the poorest quintile. In rural areas, a similar pattern emerged, with access among the richest quintile increasing from 13 to 29 percent compared to a marginal reduction in coverage from 3 to 2 percent among the poorest quintile. More alarming, in the poorest quintile open defecation appears to have increased from 1995 to 2012 particularly for rural areas.

Figure 4.7: D-Index Decomposition for Sanitation Services, 2016

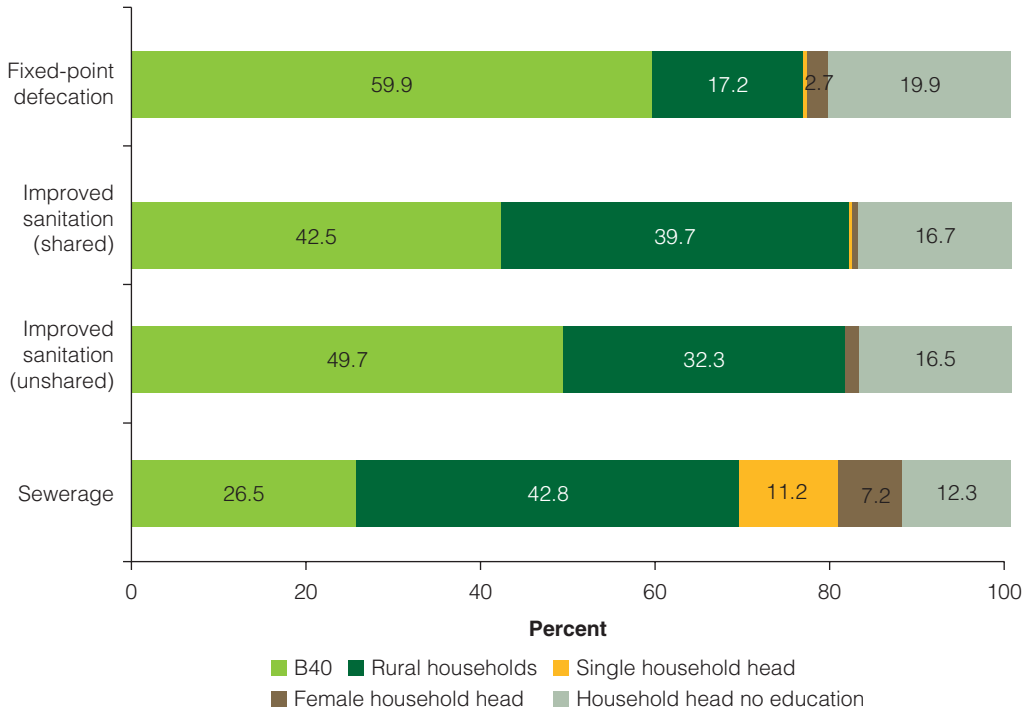
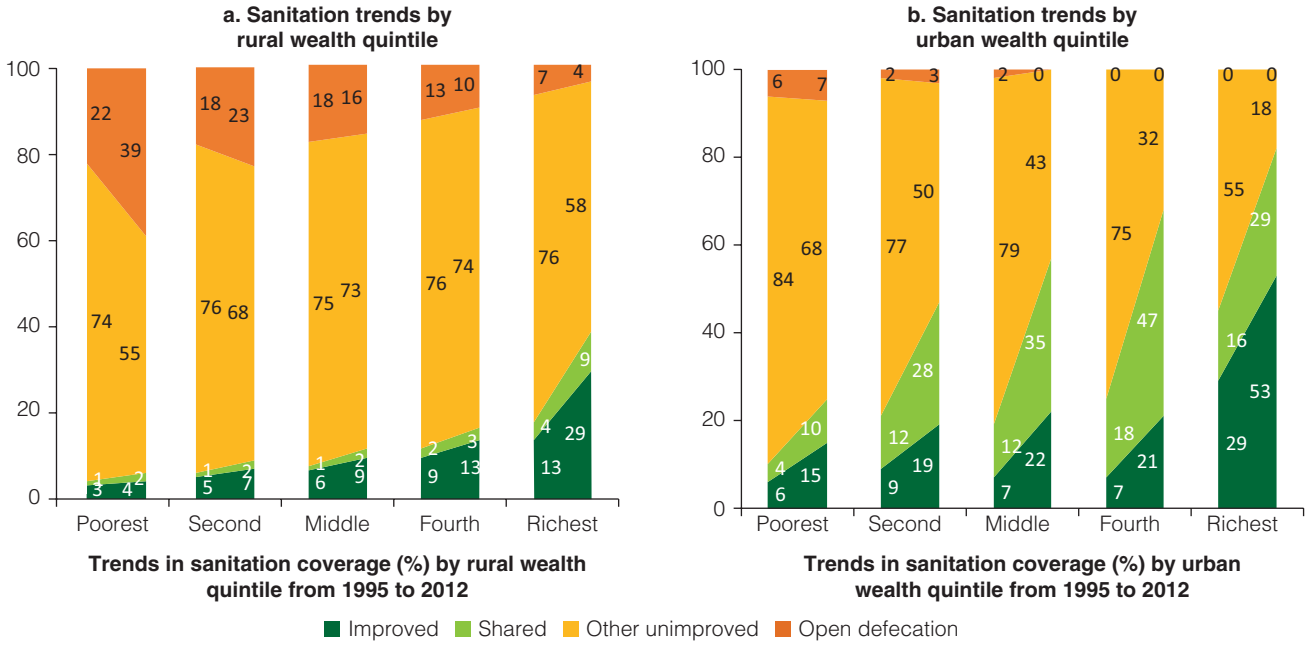


Figure 4.8: Trends in Sanitation by Rural and Urban Wealth Quintiles, 1995–2012



Source: JMP 2015.

Hygiene

To reap the economic returns of a lower disease burden in Tanzania, hygiene promotion must receive priority along with any water and sanitation intervention. Hygiene promotion is reported to be the most cost-effective intervention for reducing disease, with a US$3.35 per disability-adjusted life year (DALY) loss averted, compared to US$11.15 per DALY loss averted due to a sanitation intervention and more expensive options such as oral hydration therapy and immunization. Yet hygiene promotion has largely been neglected in national policy and programming, and data on hygiene practices are seldom collected in household surveys.

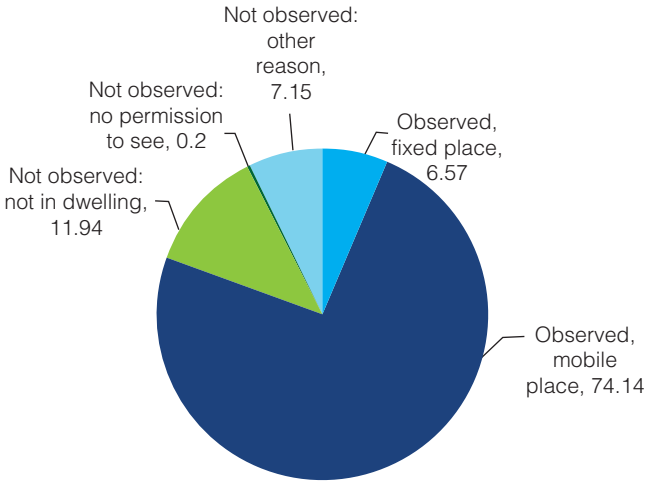
Hygiene promotion will be a priority area for the SDGs. This section provides an assessment of hygiene behaviors including household handwashing behavior and child feces disposal. In most cases, data on behaviors is limited due to self-reporting or observational biases, but such data can still be useful for designing and targeting hygiene promotion interventions. Formal education levels of household heads or caregivers are one of the main drivers of good hygiene, but targeting specific hygiene messages can also improve behaviors.

Handwashing

Handwashing at critical times has been shown in Tanzania to be a rapid and reliable indicator of general hygiene behavior in households (Almedom 1996). Critical times were determined to be after defecation, after handling children's feces, before handling food, before feeding young children, and before eating. Washing at these times lowers the risk of oral-fecal transmission of bacterial infection by reducing the presence of enteric pathogens on the hands/fingers and objects or utensils of frequent use (Briceño, Coville, and Martinez 2015).

The first step toward good handwashing practices is to ensure the existence of a good handwashing facility. According to the top rungs of the SDG scale, this means that the facility must have soap and water. The latest data from DHS 2016 shows that most households in Tanzania do now have handwashing facilities in place, though the vast majority of these (74 percent) are in a "mobile place," while only 6.6 percent are in a fixed place (figure 4.9). This likely reflects the scarcity of piped water connections in Tanzanian households. But in just under 20 percent of households, no handwashing facilities were observed. When we divide this up into the SDG tier categories, we find that although 78 percent have water and a handwashing facility, the figure drops to 48 percent when we consider those that also have soap.

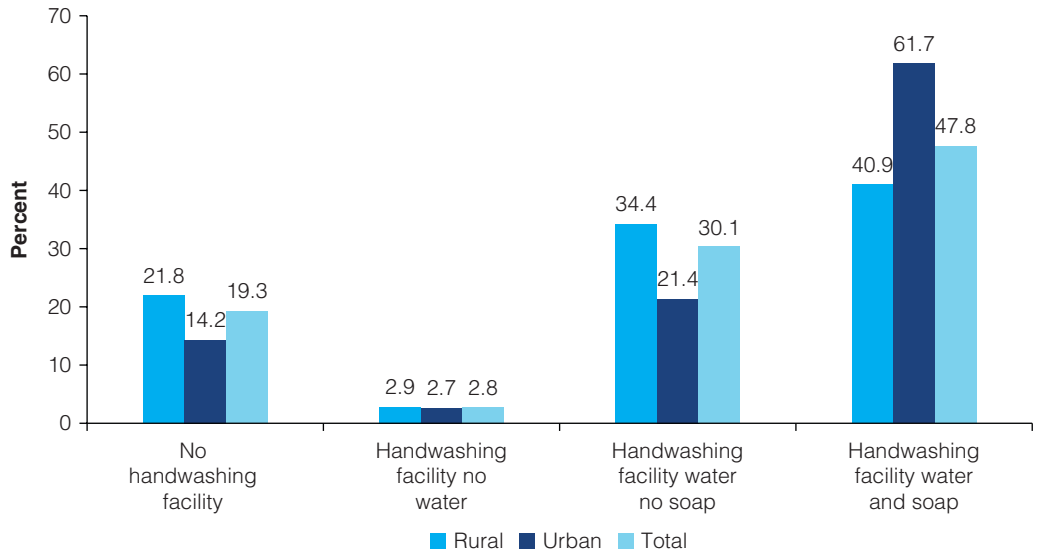
Figure 4.9: Percentage of Households with Handwashing Stations



Source: Authors' calculation from DHS 2016.

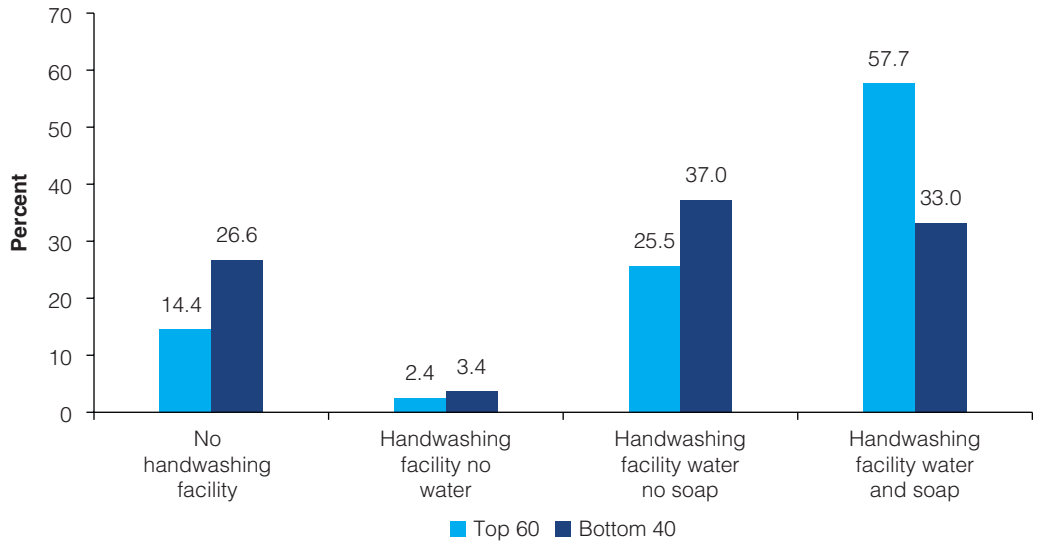
As with water and sanitation, handwashing is starkly divided by urban, rural, and wealth profiles (figures 4.10 and 4.11). About 61.2 percent of people who live in urban areas have handwashing with soap and water while in rural areas, those with facilities without soap are more common than in urban areas. Finally, the difference between the B40 and T60 is 24.7 percentage points in this category, reflecting the disparity among the poor and non-poor households

Figure 4.10: Percentage of Households with Handwashing Stations with Soap and Water, by National, Rural, and Urban



Source: Authors' calculation from DHS 2016.

Figure 4.11: Percentage of Households with Handwashing Stations with Soap and Water, by T60 and B40



Source: Authors' calculation from DHS 2016.

Tanzania´s National Sanitation Campaign

In 2011, the Government of Tanzania launched the National Sanitation Campaign (NSC) as part of the Water Sector Development Programme (WSDP) aimed at stimulating demand for and improve supply of sanitation nationally with the overall goal of delivering improvements in health and education in the country. The campaign is coordinated and implemented by the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) and the Ministry of Education and Vocational Training (MoEVT).

The campaign has two phases: The phase I (2011–2015) focused on improving sanitation and hygiene conditions in households and schools in rural Tanzania while the **Phase II:** (2016–2020) is centering on improving these conditions in urban areas, in public spaces such as hospitals and health care facilities, as well continuing to support rural and school WASH (SWASH) improvements.

The NSC's Phase I sought to deliver: (1)1.3 million households with improved sanitation facilities; (2) 812 schools with access to improved sanitation and hygiene facilities (3) 600 villages with signed Open Defecation Free (ODF) declarations and (4) 600 villages served by local service providers in their respective areas. In order to achieve these targets, a combination of Community Led Total Sanitation (CLTS), social marketing and art training, a behavioural change campaign (BCC) and the rehabilitation or construction of appropriate WASH conditions in schools were to be combined.

Results: The National Sanitation Campaign though started with great expectations has been showing some mixed results. For the rural areas overall in Tanzania, 92% of the rural population were still using either shared (4%), other unimproved facilities (71%) or practicing open defecation (17%). Reasons identified for why the NSC had such limited success include that there were systematic delays in the disbursal of funds from national to regional and local governments; limited capacity and incentives of regional and local governments to manage budget allocations; irregularities and procurement delays at central level which resulted in BCC not being properly implemented alongside NSC. However, an evaluation conducted by the Ministry of Water and Irrigation found that in the villages where NSC was carried out, about 61percent of households had improved sanitation facilities when compared to 43 percent in non-NSC villages.

Source: Chitty, Roma and Durrans 2013 *Process Evaluation of Tanzania's National Sanitation Campaign* SHARE research Consortium Policy Brief Nov 2016; and Mwakitalima, A., et al (forthcoming) Scaling up Rural Sanitation in Tanzania: Evidence from the National Sanitation Campaign.

The second step to ensuring handwashing is to encourage the adoption of good hygienic practices. Global studies have shown that while knowledge of the reasons for washing hands is high, adoption of the practice is low. In 2006, the Water and Sanitation Program (WSP) began to scale up the handwashing program across ten rural districts with end-of-project targets that included 1.25 million women and children practicing improved handwashing behaviors; 14.5 million women and children ages 5 to 14 exposed to behavior change messaging through radio; 300,000 women and children reached through interpersonal communication (IPC) activities;

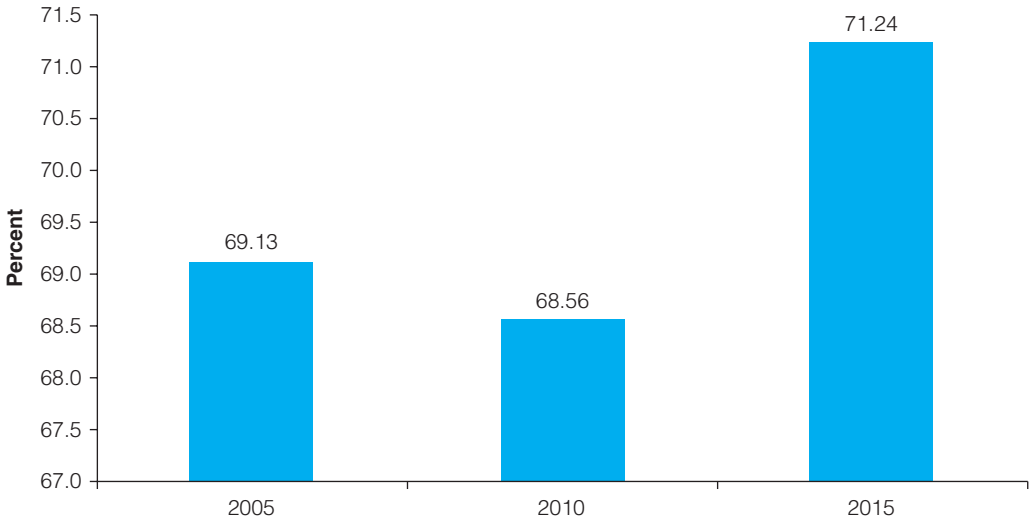
and 170,000 people attending Direct Consumer Contact (DCC) events (World Bank Water and Sanitation Program 2011). From mid-2009 to early 2011, interventions were rolled out in ten districts to support local governments in improving handwashing practices. The second of the two interventions was evaluated using a large-scale randomized contol trial (RCT).

Evaluations of these programs have unfortunately highlighted that it is extremely difficult to get households to adopt handwashing practices. The intervention evaluated by an RCT was targeted in part to encourage hand washing at five junctures for potential infection.[2] There were small but significant improvements in knowledge about the importance of hand washing at these junctures. Nonetheless, results from direct observation of handwashing were not encouraging, with no statistically significant behavioral difference between treatment and control groups. Thus, while encouraging handwashing practices remains very important, interventions may need to be re-thought to ensure their effective impact.

Child Feces Disposal

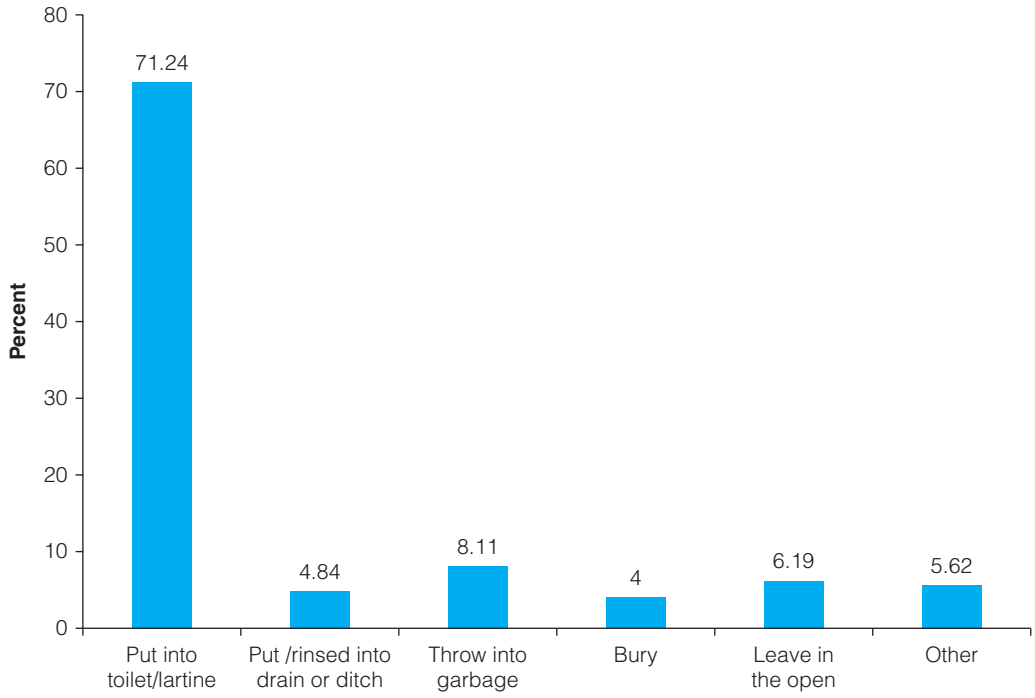
Rates of safe disposal of child feces in Tanzania were among the lowest of 38 African countries in 2010 and have only improved by one or two percentage points since then. DHS 2015/6 shows the rate at just over 70 percent in 2015 (figures 4.12 and 4.13). Child fecal disposal may be even more important than adult fecal disposal due to a higher prevalence of diarrhea and pathogens such as *Hepatitis A*, *rotavirus*, and *E. coli* (UNICEF and WSP 2014). In the household environment, children are at highest risk of exposure, leading to such health risks as higher rates of diarrheal disease, intestinal worms, enteropathy, malnutrition, and death. The WHO reports that 88 percent of diarrheal deaths worldwide are caused by unsafe water, sanitation, or hygiene. For all of these reasons, child fecal disposal is being considered as part of this diagnostic as a priority while tackling the sanitation challenges facing Tanzania.

Figure 4.12: Percentage of Mothers Engaging in Safe Disposal of Youngest Child's Stool, 2005–2015



Source: Authors' calculation from DHS.

Figure 4.13: Disposal of Youngest Child's Stool by Mothers When Not Using a Toilet, by Percentage per Method



Source: Authors' calculation from DHS 2016.

Box 4.1: Spatial Visualization of Inequities in WASH Access among the Poor and the Non-poor

The Human Opportunity Index and descriptive statistics on WASH access have demonstrated that rural regions and poorer populations were most deprived of WASH services. To further examine these inequalities, geospatial mapping was done to spatially understand where the B40 were being most deprived of WASH services and to overlay rural areas that exhibit high poverty rates and low WASH access.

The differences in improved coverage for T60 and B40 wealth groups are even more stark when contrasted by regional coverage. To compare the relative WASH performance of regions with one another, regions were classified into low-, mid-, and high-performing groups based on their levels of coverage of improved water and improved sanitation access. To be in the mid-performing group, a region had to have coverage levels higher than the national median for improved water or improved sanitation access To be considered a high-performing region, a region had to have good performance in both improved water and improved sanitation, while to be considered mid-performing, a region had only to have good performance in one area. A low-performing region had poor relative performance in both areas.

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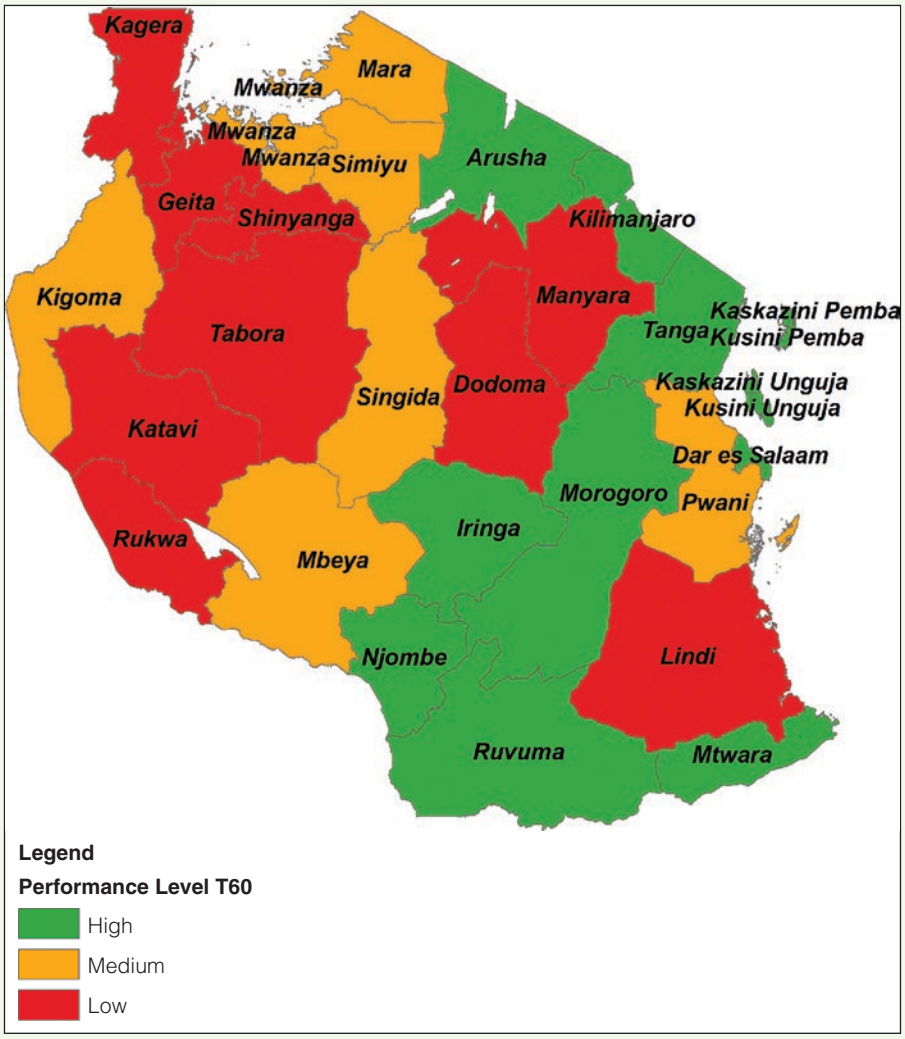
Box 4.1: Continued

Map B4.1.1: Top 60 Regional WASH Performance



Source: Authors' calculation from DHS.

See maps B4.1.1 and B4.1.2 for a display of how regions performed in providing improved water and sanitation for the T60 vs. B40, with the green regions being high-performing and the red regions being low-performing. They show on the left how the T60 have higher than the national average in improved water and sanitation coverage in several provinces, including some of those found to be the poorest (Kigoma and Ruvuma) in poverty analysis. For T60 access, nine regions can be classified as high performing. However, no regions can be classified as high preforming in serving the B40. In fact, all but two regions are considered low-performing, meaning that B40 access is less than the national average for improved water and sanitation across

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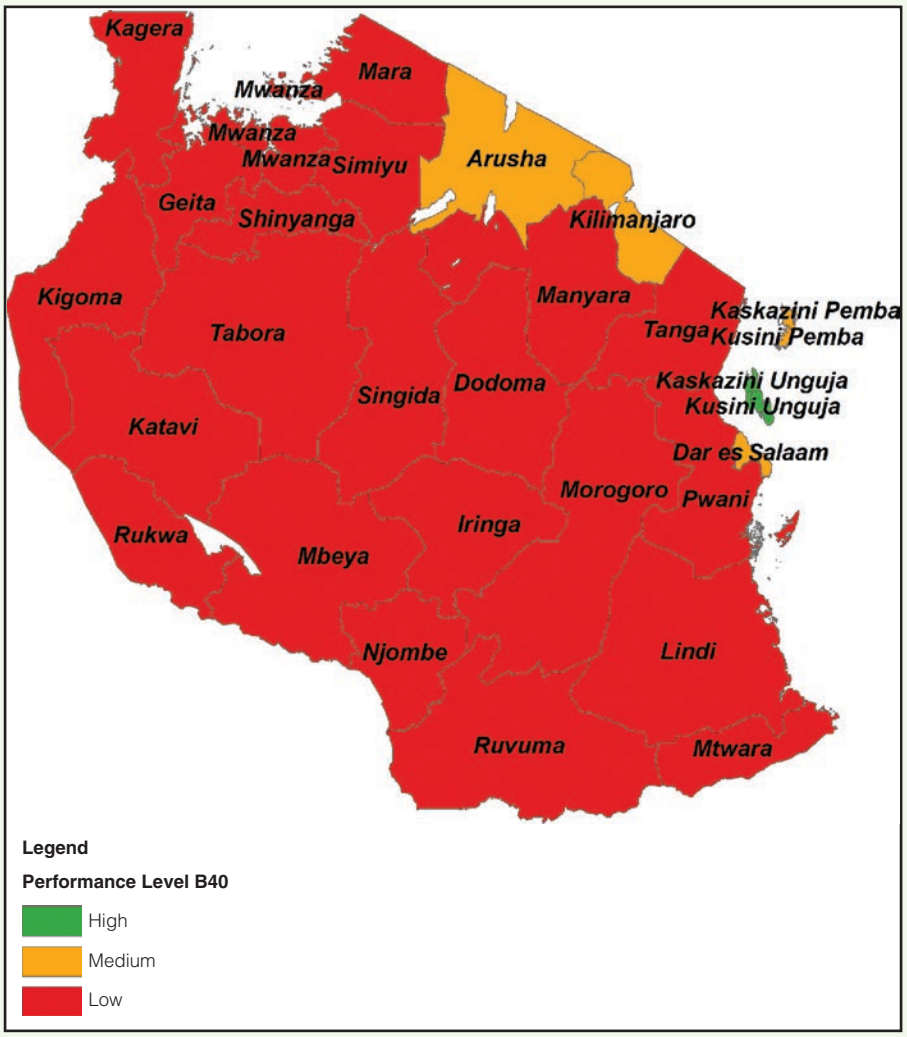
Box 4.1: Continued

Map B4.1.2: Bottom 40 Regional WASH Performance



Source: Authors' calculation from DHS 2016.

almost all regions. This shows that poorer households need to be targeted in region-wide WASH policy and planning.

Rural areas with low water and sanitation access also have high levels of poverty. Cross mapping of poverty rates and water and sanitation access levels shows large overlaps of areas with high poverty rates and areas with low access to water and sanitation services (maps B4.1.3 and B4.1.4). All areas showing up in red on the maps have lower than average coverage in basic improved WASH and higher than average poverty. This type of visualization could be useful for future pro-poor geographic

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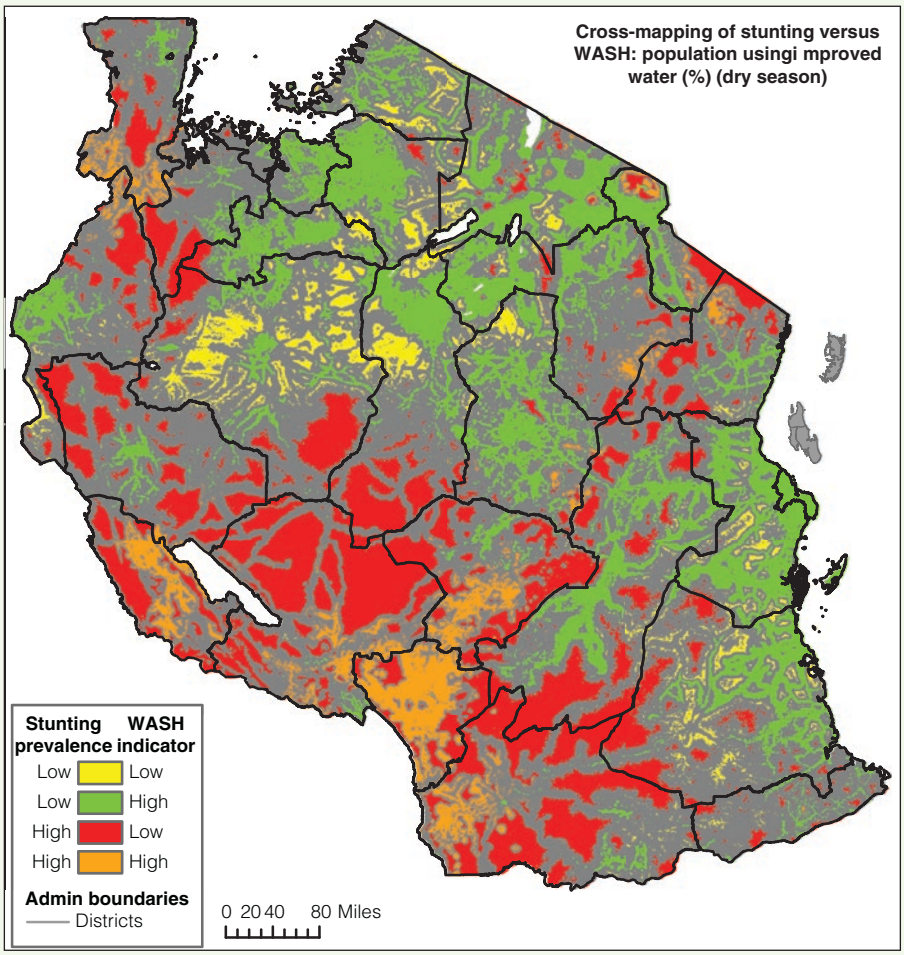
Box 4.1: Continued

Map B4.1.3: Overlaps of Poverty and Lack of Improved Water Access (Dry Season)



targeting. One of the key findings of the TWPD is the stark disparities in water and sanitation access between rural and urban areas. Other analysis also revealed that living in a rural region is one of the main determinants for whether a household lacks access to water and sanitation. However, as noted in the poverty assessment in the first chapter, close to 90 percent of people who live below the national poverty line are located in rural areas. With this in mind, it is reasonable to assume that urban-rural disparities could be explained by coincidence of poverty and rurality.

Likewise, economic opportunities are strongly shaped by access to goods and infrastructure services. Thus, making access to basic services universal is at the core of equality of opportunity. When the coverage of a specific service is universal,

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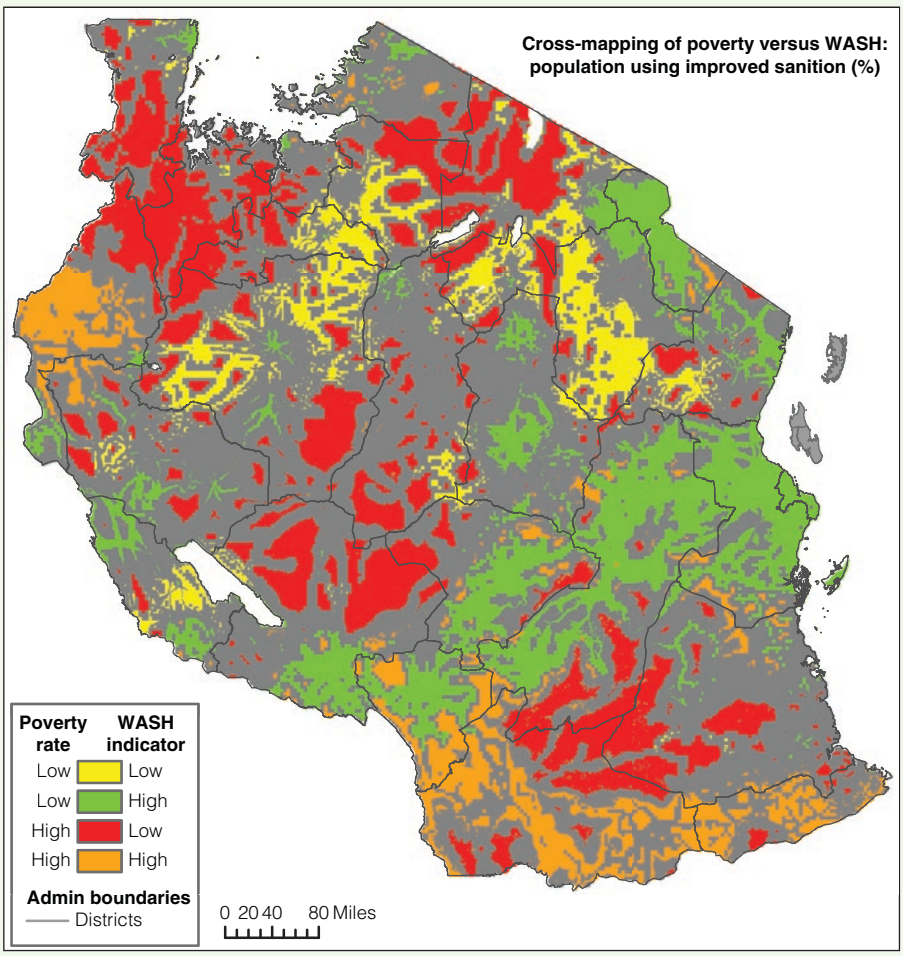
Box 4.1: Continued

everybody has access to it. However, as a country develops, the real-world reality is that opportunity to access key goods and services is only partial; they are scarce and can be allocated in many different ways. In many developing countries, lack of access to affordable infrastructure services means living in rural isolation from markets and services and having intermittent or no supply of power or water for productive activities and daily existence. All these often result in a significant curtailment of economic opportunities in rural areas and opportunities to move out of poverty

Map B4.1.4: Overlaps of Poverty and Lack of Improved Sanitation Access



Source: Authors´ elaboration 2017.

Notes

1. Wealth quintiles are based on an asset ownership index, used as a proxy for poverty.
2. 1. After going to the latrine, 2. Before preparing food, 3. After washing a baby's bottom, 4. Before eating, 5. Before feeding/breastfeeding.

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Chapter 5
WASH in Schools and Healthcare Facilities

As part of the post-2015 global monitoring agenda, the JMP proposes to expand the focus on WASH beyond the household and into public institutions, where people spend a significant amount of time. The JMP prioritizes monitoring schools and healthcare facilities that are at a risk of high contamination due to poor WASH. Global data on WASH in schools remain limited and there is so far no standardized set of indicators to facilitate monitoring. Based on estimates from various Educational Management Information System (EMIS) from various countries, in 2015, 71 percent of schools worldwide had access to adequate water and 69 percent to adequate sanitation (UNICEF 2015). For healthcare facilities, global estimates indicate significant variation in coverage in hospitals and clinics across regions, with Southeast Asia having higher access to water than sanitation (80 percent and 58 percent, respectively) while Sub-Saharan Africa has the opposite trend (WHO, UNICEF 2015). The following section discusses WASH access in schools and healthcare facilities in Tanzania.

Healthcare Facilities

A lack of adequate WASH in healthcare facilities (HCFs) can exacerbate the chances of bacterial infection for patients, doctors and visitors. Patients who show up for services, expecting safe treatment and care, could end up being newly infected or transmitting infections to other people at the facility. In this way, poor WASH conditions can increase unnecessary illnesses and deaths particularly among newborns, women in maternity, and others who are immune-deficient. In a working environment where WASH facilities are limited, frontline workers find it impossible to apply their knowledge and skills concerning hygiene requirements for better health outcomes (National Institute for Medical Research 2016).

The initial picture is that approximately two out of every three health care facilities (67 percent) (see figure 5.1)[1] in Tanzania are connected to an improved water supply within 500 meters of premises but the access varies by health facility type. Private hospitals have the best coverage, 93 percent in improved water (and 96 percent in improved sanitation). However, clinics or dispensaries and national or regional hospitals have lower rates, at 61 and 64 percent respectively for improved water. Because dispensaries are more commonly used by women and children, this leaves them most at risk in this regard.

Coverage also varies by region for HCFs. The 2014 DHS-SPA survey collected information in health care facilities around the country. In maps 5.1 and 5.2 below, we see the distribution in the percentage and number of HCFs per region that were found to be with and without Tier 2 improved sanitation and improved water facilities within 500m. The lowest coverage was found in HCF in Lindi and Mbeya, with Mwanza, Rukwa and Shinyanga also all having under 50% coverage. For sanitation,

KEY POINTS

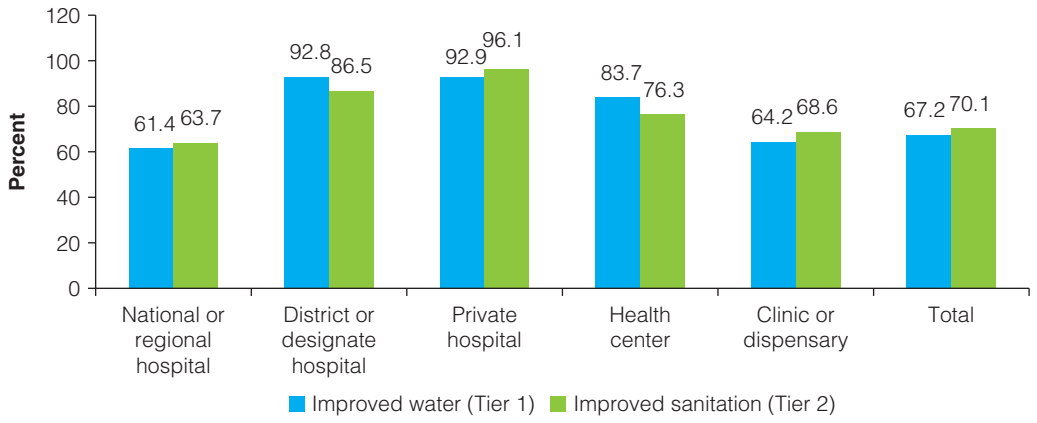
Healthcare facilities often lack basic WASH facilities that provide safe, hygienic environments and promote effective treatment of patients and control infection. Nearly a third of healthcare facilities have no access to improved sanitation or an improved water source with collection time of 30 minutes or less.

Coverage of adequate WASH varies by region and by type of facility. Clinics and dispensaries have lower coverage than district and private hospitals.

Schools have lower handwashing facility coverage than some households. Seventy-six percent of rural schools are without a basic handwashing facility—and ones that claimed to be equipped often could not find it for surveyors.

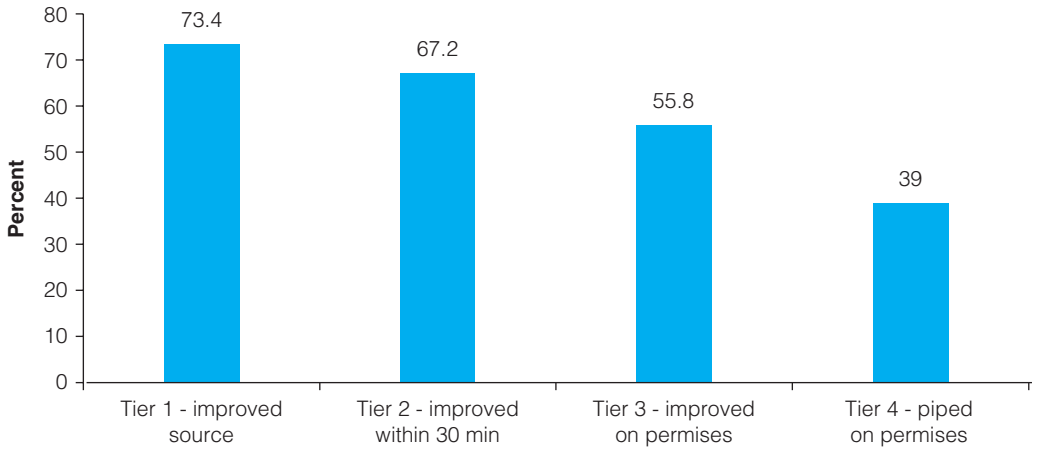
Though school toilets are often dirty and crowded, open defecation is not a common or accepted practice at schools. Less than 1 percent of staff and 2 percent of students report that they defecate in the open.

Figure 5.1: Coverage of Improved Water and Sanitation in Health Care Facilities



Source: Author's calculations from DHS-SPA 2014.

Figure 5.2: Coverage of Improved Water in Health Care Facilities, by Tiers of Access

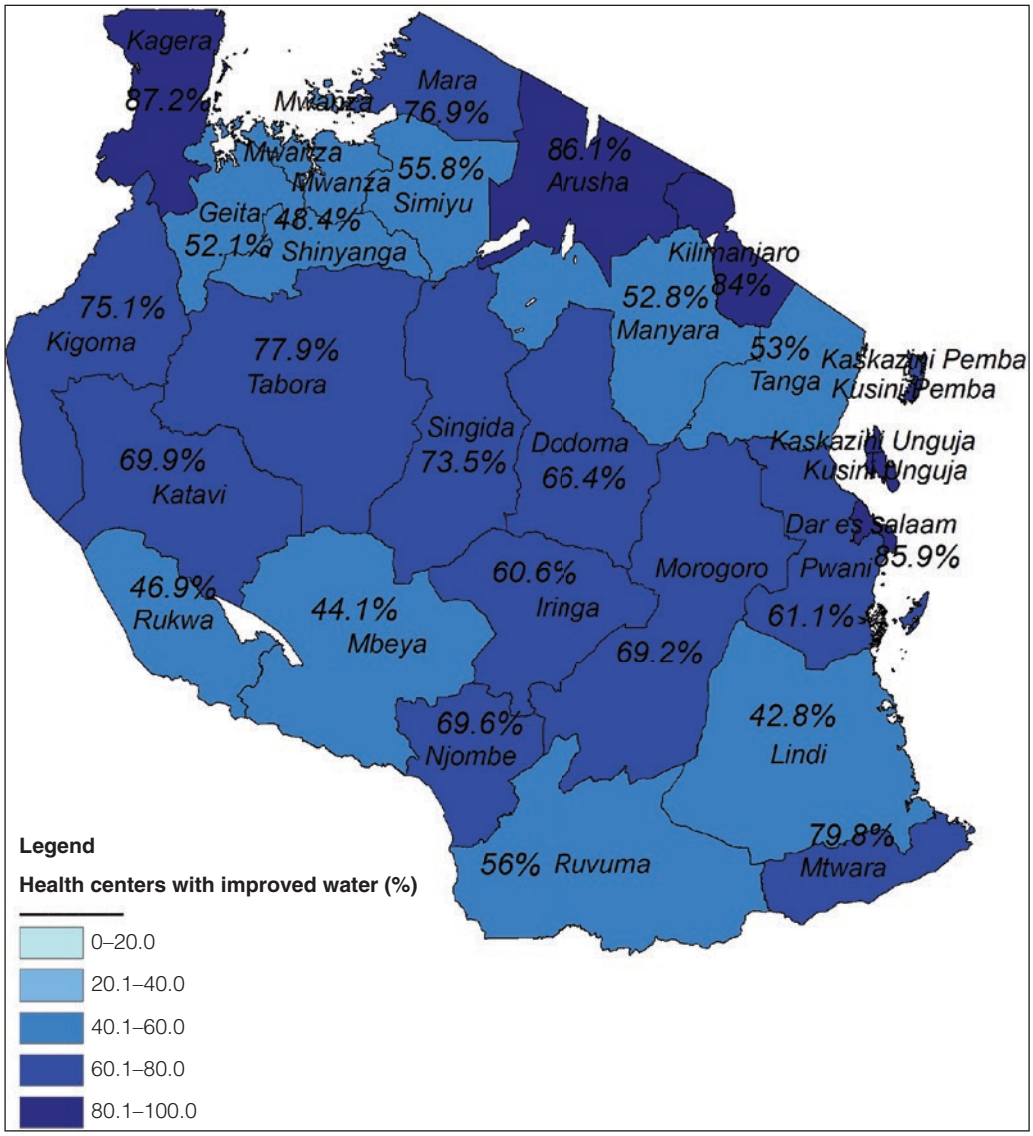


the average coverage nationally is 71% but there are several regions that have HCF with far less than that, at 22% in Njombe, 34% in Manyara and 35% in Rukwa.

Improved water coverage drops further when considering if the facility was on-site, from almost 70 percent for Tier 2 improved down to 39% percent for Tier 4 improved (see Figure 5.2). The 73 percent of HCFs that have water from an improved source (Tier 1), drops to 56 percent that receives this water on site. Almost one in five (17.9 percent) must arrange for someone to travel up to 500 meters from the facility to collect the improved water. Furthermore, 53 percent of health facilities report routine water shortages, which can interfere with providing quality care.[2]

Inadequate water supply is also demonstrated by a case study of seven districts by Tanzania's National Institute for Medical Research.[3] It found that only 41 percent of the

Map 5.1: Percentage of HCFs by Region with Improved Water

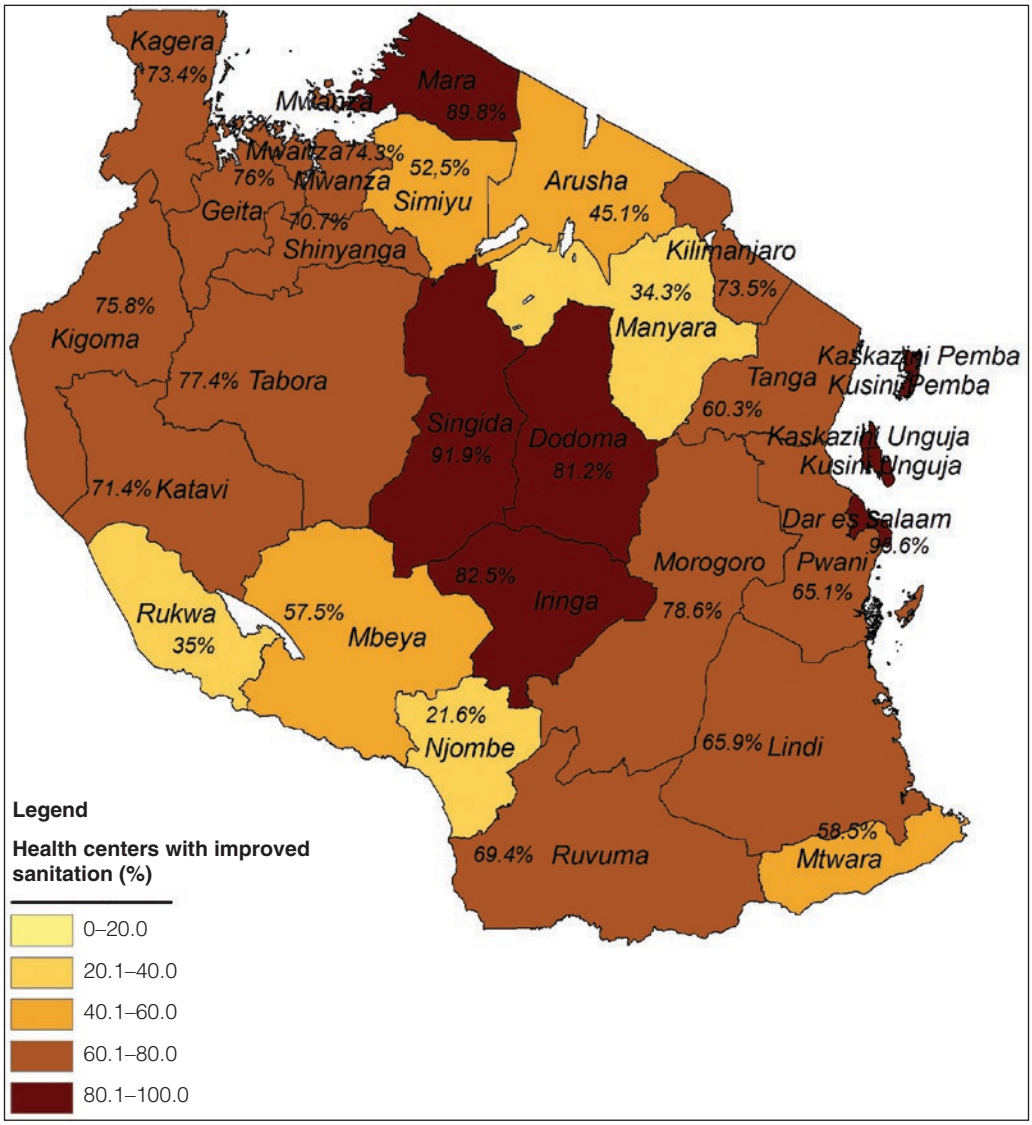


Source: DHS-SPA 2014.

facilities had pipeline connections into facility buildings (mainly community tap water and tube wells with mechanized pumps). The remaining facilities received water at outside standpipes or were supplied by water vendors. Even among those that had community piped water connections, only 40 percent had connection into their buildings (National Institute for Medical Research 2016). If medical facility staff has to spend collecting water, this could reduce their ability to provide care.

Lack of water supply is made worse by unreliable service. In a study of 96 facilities over seven districts (National Institute for Medical Research 2016), 46 percent of facilities reported that they cannot access their water sources every day of the week. This is supported by DHS data which showed 53% of HCFs in the country reported a time of year when there was "routinely a severe shortage or lack of water." As many as 78% of HCFs in Tabora responded "yes" to this question (see figure 5.3).

Map 5.2: Percentage of HCFs with Improved Sanitation, by Region

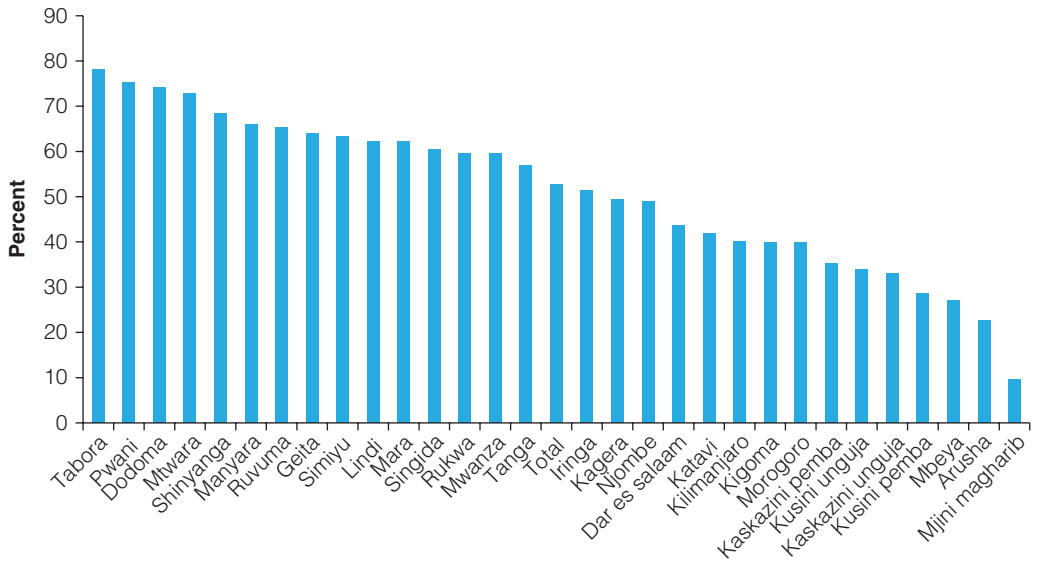


Source: DHS-SPA 2014.

Seasonal factors could be behind low reliability as groundwater supplies may be limited during the dry season. Lack of consistent supply makes it difficult to perform essential tasks including sterilizing equipment, washing soiled linens, flushing toilets, and properly bathing patients. This also affects higher level services in larger HCFs such as the ability to perform surgery. When facilities face water shortages or long waits for water delivery, they perform only emergency operations and delay others (Rostapshova et al. 2015).

National-level data on water quality in healthcare centers does not exist, but one recent small-scale study found gaps in water treatment and issues of contamination. The study across seven districts found that only 23 percent of healthcare facilities received water that was treated at the source, with worse conditions for dispensaries than for district hospitals. About half of district hospitals received water that was treated at the source. This dropped to 20 percent for non-district hospitals and 13 percent for dispensaries. About 37 percent of healthcare facilities were found to have leakages in pipelines and distribution systems that posed risks of

Figure 5.3: Routine or Severe Water Shortages in Health Care Facilities, by Region



Source: DHS-SPA 2014.

water contamination. This was highest rate was in Mbeya DC and lowest in Mbarali. Moreover, water samples across all seven district health facilities were contaminated with *E. coli* and other microbes. Total *coliform* (TC) in water samples were discovered to range from 0.15-110 MPN/ml in Temeke DC, 0.23-4.6 MPN/ml in Mbarali, 0.036-2.4 MPN/ml in Mufindi and Njombe, and 0.15 -2.4 MPN/ml in Iringa and Makete. The MPN values showed Temeke DC water samples to be most contaminated, followed by Mbeya and Mbarali (National Institute for Medical Research 2016).

The lack of easy access to water inhibits handwashing, though medical staff know of its importance regarding hygiene. When asked if they washed their hands when performing their duties, all auxiliary workers interviewed (100 percent) reported that they did so at some point during the execution of their duties, demonstrating awareness of hygiene concerns. Nonetheless, only 55 percent reported that facilities had adequate handwashing facilities (National Institute for Medical Research 2016). In fact, according to DHS-SPA data, only about two-thirds of facilities overall had soap or alcohol-based detergent and running water. Broken down into facility type, this constituted 65 percent of those offering outpatient curative care services for sick children, 60 percent for family planning facilities, and less than two-thirds of ANC facilities. Those with the lowest coverage were HIV testing facilities, at 57 percent (DHS 2016). This lack of access to clean water for handwashing results in a much increased risk of the spread of germs. In the study across seven district health care facilities, only 5.6 percent of wash basins of staff and clients were found *not* to have microbes (National Institute for Medical Research 2016).

While both studies cited here detected an average of 70 percent improved sanitation coverage across all facility types, there were substantial differences between them. National referral hospitals had the lowest rates at 37 percent, while regional and district hospitals were far higher at 95 percent and 86 percent. Dispensaries helped to bring down the average to 68 percent. Of the sanitation facilities available, 37 percent used water and flushed to either a septic tank or piped sewer system, while 22 percent were pit latrines with slabs. In the case of sanitation facilities requiring water, its lack of ready availability made it harder to maintain hygiene. Only 36 percent of facilities were found to be sufficiently clean for normal uses upon visual assessment (National Institute for Medical Research 2016).

In conclusion, WASH facilities in Tanzanian health care centers are alarmingly inadequate and require concerted effort by authorities to reduce the risk of infection there. The government of the United Republic of Tanzania should work to forge a framework involving MoHCDGEC, MoWI and PoRALG for the reform of WASH in health care facilities. The plan should generate strategic sub-sector investment that increases coverage of improved WASH facilities in HCFs all over the country. The plan should include consideration of SDG targets in ensuring that water is accessible, reliable, and clean, particularly in environments where disease already spreads so easily and where people are coming to receive treatment.

Schools

Lack of reliable water supply or sanitation facilities in schools can undermine a child's learning experience. Students in these schools may be asked to arrive at the premises with water or spend time collecting it during the school day, taking away from time spent in the classroom. Teachers may also join in such tasks, leaving the premises to collect water or use nearby toilets, sometimes interrupting or delaying lessons. Altogether, education is harmed in numerous ways by water scarcity at schools, notably by poor sanitary conditions, which can raise absenteeism among female students and increase illness.

Some of these problems arise from lack of WSS infrastructure, but they can also be related to water scarcity. Unreliable or scarce piped water facilities can put more pressure on resources, leading schools to substitute more expensive solutions. Schools report using piped water, boreholes, rainwater, and water tankers (Rostapshova et al. 2015). Students are affected in numerous ways by water scarcity at schools, the most prominent being the poor sanitary conditions, which can contribute to absenteeism among female students and increased incidence of illness.

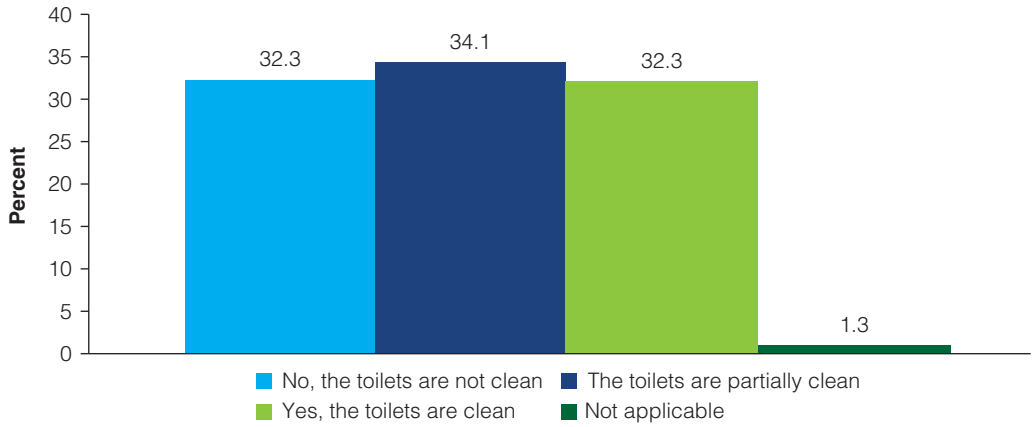
A recent survey of almost 3,000 schools in rural Tanzania (RWS 2014) showed that schools lag behind in their WASH facilities, and in some cases have lower coverage than households. The survey was conducted over 24 regions and 132 districts. Of the schools, only three were private and the rest were government institutions. It found that 67 percent of schools had an improved latrine, while 26 percent did not.[4] Five percent of the sample had broken or incomplete latrines. Even if the school had a latrine, it did not mean that it necessarily had water. And in those schools that had a latrine, the facilities were not necessarily sanitary. Sixty percent reported that there was no water at the school and only 32 percent of the latrines were reported as clean (See Figure 5.4). About 20 percent reported that if there was water service, it was inadequate. Only 16 percent called the water supply for the toilets adequate. In an environment where pathogens can so easily pass from one child to another, poor facilities like these pose an added risk to children's health.

Meanwhile, more than 76 percent of rural schools lack any handwashing station, compared to 22 percent of households. Among the 24 percent of schools that reported having a handwashing facility, not all could actually produce it—when surveyors asked to see the handwashing facilities, officials at 7.5 percent of these schools said they did not know where they were. About 55 percent of those that had a facility only had water for washing, while 36 percent had soap or detergent and water.

Despite poor available facilities, schools have very low percentages of open defecation both among boys and girls. Though boys defecate in the open more than girls (1.2 percent rather that 1 percent), the use of toilets is very high, especially considering the sorry state of the facilities. Ninety-seven percent of boys and 98 percent of girls reported using the school toilet and a tiny minority of other children used nearby toilets or temporary facilities.

Interestingly, among teachers, many choose to use a "nearby toilet" rather than school facilities. Only 67 percent of both females and males use toilets designated for the staff or located at

Figure 5.4: Disaggregation of Responses to "Are the Toilet Facilities Clean?" in Rural Schools



Source: RWS 2014.

the school premises, with 31 percent reporting that they go to use a nearby toilet instead. Open defecation is also uncommon among the teachers, less than 0.4 percent in each gender.

Poor WASH can negatively impact on school attendance, achievement and completion, in particular for girls. Global research by organizations such as UNICEF has highlighted the importance of having access to safe and hygienic water and sanitation facilities for increasing child school attendance, achievement and completion. Making improved water more accessible for example, can reduce time spent collecting it during the school day, and illness that can result from when unimproved drinking water is the primary option (UNICEF 2015[5]). A striking statistic highlights that more than 40% of diarrhea cases in school children result from transmission in schools rather than in homes UNICEF (2010). This can certainly be due to poor hygiene in the case of Tanzanian schools as we seen from the statistics presented here. After reaching puberty, girls' attendance in school is found to be more severely affected if they have inadequate WASH facilities as they are less likely to attend during their cycle. UNICEF found that 52% of schools had no doors on girls' latrines, thus reducing their privacy. Without privacy, female students who use school bathrooms are 10-20% more likely to be absent from school (IRC 2005[6]). The lack of hygiene can also increase health risks such as diarrhea, worms and urinary infections, all of which reduce children´s ability to learn and the likelihood of having to miss school. An impact evaluation of a deworming program in Kenya demonstrated that the worm burden in children contributed to 25% of overall school absenteeism (Poverty Action Lab 2007). The recommended maximum students per toilet are 50 boys per drop-hole and 40 girls per drop-hole for girls in Tanzania. However, 50% of schools met this standard for boys whilst 43% met this guideline for girls according to a study to assess intermediate outcomes from the Tanzania National Sanitation Campaign (NSC) (Antwi-Agyei, Mwakitalima et al., 2017[7]). Such congestion can make it harder to keep such facilities clean and again, increase the risk of contamination.

Notes

1. The DHS-SPA report defines "improved" as what we are calling Tier 2 improved, that is, improved source within 30 minutes of travel round-trip. Their equivalent is 500 meters. For our Tier 1 equivalent (just the improved source), the total is 73.4 percent.

2. The DHS-SPA 2014 survey does not specify the nature of the shortages—time span or frequency, for example. The relevant question asks only "is there routinely a time of year when the facility has severe shortages or lack of water?"
3. These districts were selected based on the assessment setting the groundwork for an ongoing system of supportive supervision interventions and assessment of health care waste management (HCWM) in healthcare facilities as part of the Ministry of Health and Social Welfare's work on infection prevention and control in HFs in Tanzania. (For more information please see National Institute for Medical Research 2016).
4. The remaining 7% were broken or incomplete constructions
5. https://www.unicef.org/tanzania/wes.html
6. IRC International Water and Sanitation Centre (2005) *School Sanitation and Hygeine Notes & News, May 2005*.
7. http://washdev.iwaponline.com/content/early/2017/02/14/washdev.2017.159.

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Chapter 6
WASH for Health and Human Development

The need to improve WASH goes well beyond its traditional sector boundaries. Ensuring WASH access is critical for achieving the Sustainable Development Goals at large. SDG-6 and its six targets are inextricably linked with other targets including ending extreme poverty (1.1), ending forms of malnutrition (3.2) and reducing infant mortality (4.2). Understanding the inter-linkages between the goals can help countries harness synergies, minimize tradeoffs, and integrate implementation to achieve the overall SDG agenda (UN Water 2016). This chapter describes the linkages between WASH, health, and human development. As a prelude to a more in-depth analysis later in this chapter, the following section lays out Tanzania's current situation in human development outcomes, including child and maternal mortality, malaria, HIV/AIDS, and under-nutrition, particularly stunting.

The Economic Impacts of Poor WASH

Poor sanitation costs Tanzania US$206 million (T SH 301 billion) annually, equivalent to 1 percent of GDP and US$5 per Tanzanian citizen per year (WSP 2012). Most of this loss is a direct result of poorer health among the population at large. That figure was calculated by WSP as part of the global study "The Economic Impacts of Sanitation Initiative." Of the total, 83 percent or US$171 million is lost due to premature death from diseases such as diarrhea, malaria, and acute lower respiratory infections (ALRI), which are heavily linked to poor WASH. Approximately 26,500 Tanzanians including 18,500 children under five die each year from diarrheal disease, and in nearly 90 percent of those cases, the death was directly due to their exposure to poor water, sanitation, or hygiene conditions. About US$1.6 million is attributable to productivity losses when people are sick or seeking healthcare as a result of diarrheal disease. This includes productivity losses as a result of being out of work, school, or spending time caring for the sick. Finally, Tanzania is losing US$19 million in costs of consultation, medication, transport, and in some cases hospitalization, which can place a heavy burden on household and government budgets.

WASH and Its Impact on SDGs in Health

Due to its impacts on health, WASH is inextricably linked with human development and thus several other SDGs will not see the necessary improvement without an improvement in WASH. WASH has important consequences for infant mortality and under-nutrition affecting development of children later in life. Furthermore, frequent outbreaks of cholera in the country remain a persistent problem. WHO reports that In 2017 alone, some 4,985 cases including 99 deaths were reported in Tanzania Mainland and Zanzibar (WHO 2018). Assessments show that the main factors driving the spread of the infection both in mainland Tanzania and Zanzibar are limited access to safe water and sanitation. As a result of the inextricable links that

KEY POINTS

Poor WASH has economic impacts commensurate to US$206 million annually, which is largely manifested through its impacts on the health of the population and impacts on productivity

Poor WASH affects several health outcomes and thus has consequences for SDG 3. Poor WASH can increase the risk of water-borne diseases such as malaria and cholera, accelerate the deterioration of HIV sufferers, contribute to higher child mortality rates as well as retarded growth in children under five.

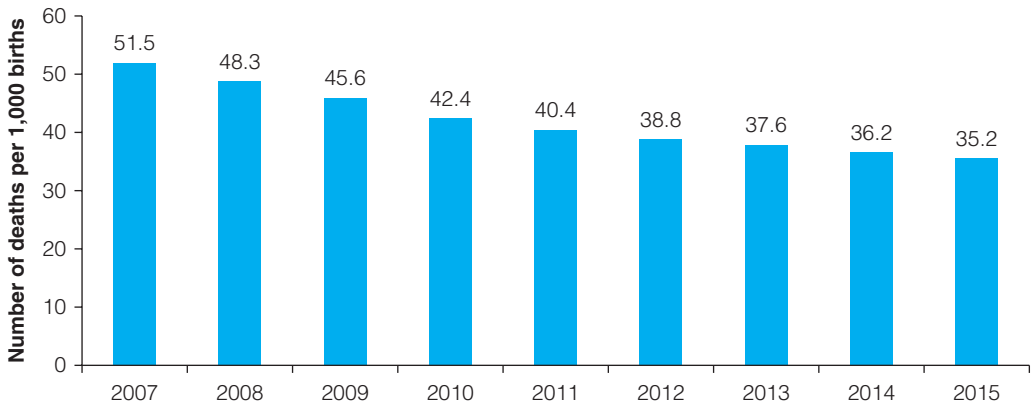
More than one in every three children in Tanzania are chronically undernourished. With stunting rates at 35% nationally for children under 5 years old, and the country not having met its MDGs for reducing undernutrition, stunting is a pressing problem in the country.

Evidence shows that poor WASH environments can interrupt healthy childhood development by increasing a child's risk of contracting enteric infections. Such infections can in turn lead to stunted growth where a child is limited in reaching his or her full physical and cognitive potential.

Box 6.1: WASH-Relevant Targets for SDG-3 in Tanzania

- By 2030, end preventable deaths of newborns and children under five years of age, with all countries aiming to reduce neonatal mortality to at least 12 per 1,000 live births and under-five mortality to at least 25 per 1,000 live births.
- By 2030, end the epidemics of AIDS, tuberculosis, malaria, and neglected tropical diseases, and combat hepatitis, water-borne diseases, and other communicable diseases.
- By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and wellbeing.

Figure 6.1: Infant Mortality Rate, per 1,000 Live Births



Source: WDI 2015.

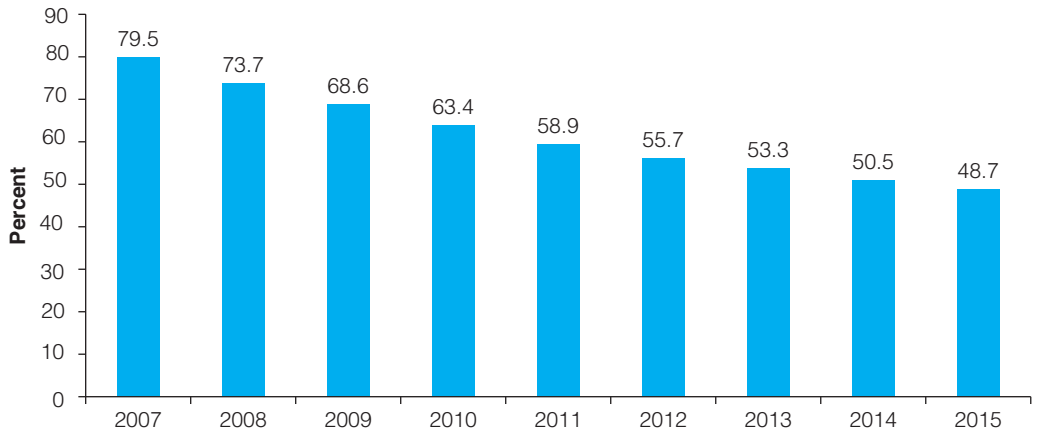
WASH has with health outcomes, key components of SDG 3 are also impacted by improvements in WASH (box 6.1).

With these health SDGs in mind, we now take a brief look at relevant data from the World Development Indicators (WDI) database.[1]

SDG 3 aims to end preventable deaths of newborns and children under five. The MDG goals set for Tanzania were 38 infants for every 1,000 live births and 64 for children under age five. Tanzania was able to meet both these targets by 2015, as figures 6.1 and 6.2 show. While these drops during the MDG era are encouraging, there is still work to be done and provision of adequate WASH can help advance the efforts. In particular, good WASH in healthcare centers can help make birthing conditions more hygienic and safe. Moreover, for children under five, diarrheal disease was found to be the second leading cause of death among children under five (CDC. 2017) and therefore improvements in WASH access could make a dent into infant mortality in Tanzania.

Poor WASH also exacerbates the deterioration of health of people suffering from HIV/AIDS. HIV incidence (see appendix map A.1) seems to be concentrated in the southwestern Njombe

Figure 6.2: Under Age Five Mortality Rate, per 1,000 Live Births, 2007–15



Source: WDI 2015.

and Iringa regions, where it can be as high as 21 percent, although the national average is just under 5 percent (WDI 2015). HIV/AIDS prevalence affects women more severely than men (figure A.1). The link with WASH is that people living with HIV/AIDS are particularly vulnerable to the effects of inadequate WASH, mainly due to the immune system suppression that the condition causes. Persistent diarrhea can greatly reduce the effectiveness of antiretroviral therapy (ART) and other interventions. Diarrheal disease can also lead to an increased viral load, thus accelerating the disease's progression. An HIV/AIDS patient who also contracts enteropathy can become unable to properly absorb anti-retroviral medicines, making them less effective, and in some cases this can lead to drug resistance. Finally, women are more likely to suffer from HIV than men in Tanzania, and gender-based violence (GBV) can also be a cause of HIV infection (Ramjee and Daniels 2013). Women with poor water access in these regions of Tanzania may be vulnerable to GBV on long journeys to collect water (UN 2017). Thus the poor WASH can disproportionately affect women over men in the context of HIV/AIDS too.

WASH and Malnutrition: Consequences of Poor WASH Today on Future Prosperity

The detrimental effects of poor WASH are not just limited to the present generation but have far reaching consequences for the health and wellbeing of future generations as well. These effects are manifested primarily through the impact of poor WASH on nutritional outcomes of children, particularly stunting (box 6.2). Stunting is an indicator of chronic undernutrition, in which a child is not getting enough nutrients to grow and develop both physically and cognitively to their full potential. Stunting and its consequences are largely irreversible, not only reducing a child's physical stature for life, but also their cognitive capabilities, health, immunity and even earnings later in life. Stunting too often affects the poorest populations and has intergenerational effects. Investing in interventions that can reduce undernutrition is paramount to the World Bank's twin goals of ending poverty and improving shared prosperity.

Stunting has two immediate causes: inadequate dietary intake and disease. Children need a highly nutritious diet to get the energy they need to grow, but suffering from any disease can divert that needed energy to fighting off sicknesses rather than healthy growth and development. In some instances, disease can even change the metabolism, making it impossible for the child even to absorb essential nutrients for growth. The underlying causes of poor dietary

intake and disease include food insecurity, low access to health services, lack of care practices such as breastfeeding, and bad WASH environments, the focus of our discussion.

The scientific linkages between inadequate WASH and poor health and nutrition outcomes have been long established in the literature mainly through its acute effect in causing sudden bouts of diarrheal disease, expelling essential nutrients from the body at just one given point in time (Humphrey 2009, Brown 2003, Caldwell and McDonald 1982, and Luby et al. 2015). However, recent research indicates that inadequate WASH causes a physiological situation called environmental enteric dysfunction (EED), a chronic malformation of the gut induced by repeated exposure to fecal bacteria (Humphrey 2009). If a young child develops EED, he or she is unable to *absorb* the essential nutrients needed to properly develop and grow, which can lead to stunted growth. Those with EED may not display any other signs of enteric infections such as diarrheal disease, which makes the condition difficult to diagnose.

Other WASH-related diseases such as hookworm infections and malaria can directly cause anemia, another form of under-nutrition and risk factor for stunting (Coffey and Geruso 2015).

Box 6.2: The Early Years Initiative

Investing in people during their earliest years of life is a critical socioeconomic priority that underpins the very future of nations.

— Jim Kim 2016 Spring Meetings, World Bank, Washington DC

Eliminating stunting by targeting children during their early years was announced as a central strategy for meeting the World's Bank's twin goals of ending extreme poverty and increasing shared prosperity. Such importance is placed on the early years of life because children develop rapidly before the age of five and positive and negative experiences of that period have deep implications for their wellbeing, school readiness, and later life success. The "first 1,000 days," from gestation through the first two years of life, is a key window for nutrition interventions in order to avoid irreversible effects in later life. The prevalence of stunting increases steadily up to age two. About 90 percent of a child's brain development occurs before the age of five, making investment to ensure early-year development crucial for releasing a child from the cycle of poverty in later life (Grantham-McGregor et al. 2007).

Poverty and nutritional deficiencies are among the leading causes why 165 million children in the developing world have stunted growth, which compromises their ability to reach their full potential in physical and cognitive development. From an education perspective, early gaps in cognitive skills can jeopardize a child's capacity and motivation to learn upon entering primary school and can increase the probability of poor academic performance, repeated grades, and early school dropout.

In response to this evidence, the World Bank is increasing its support for Early Childhood Development (ECD) around the world through financing, policy advice, technical support, and partnerships at the country, regional, and global levels. It invests through multiple entry points to augment healthcare, hygiene, nutrition, and parental training with a goal of promoting children's physical, cognitive, linguistic, and socio-emotional development.

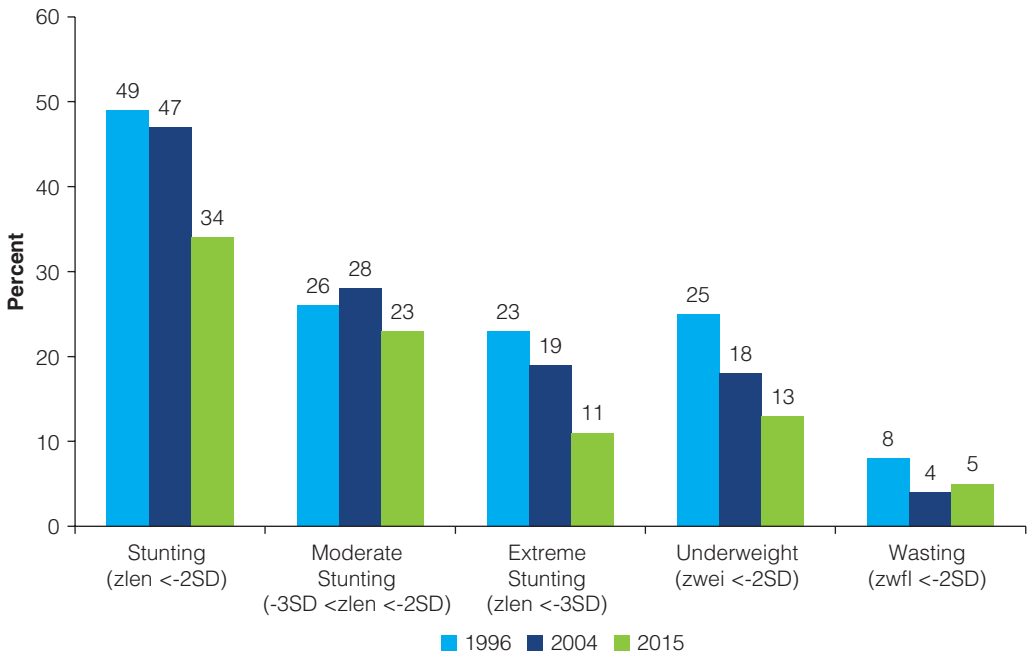
Chronic malnutrition or stunting has far-reaching health and development outcomes. Evidence suggests that stunting can have long-term effects on cognitive development (Spears and Lamba 2013), school achievement, lower later-life productivity (WSP 2014) and maternal reproductive outcomes and also increased mortality (Geruso and Spears 2015). There are also several indirect pathways of WASH that could contribute to poor health and nutrition outcomes. For example, the time needed to collect water could divert household members from productive activities such as caring for children or going to school or work. A lack of toilets in schools for girls has also been shown to increase the likelihood of adolescent girls missing or dropping out of school (Ngure et al. 2014).

Evidence from other regions of the world has begun to demonstrate the link between WASH and nutrition outcomes. Spears (2013) shows that about 65% of the international variation in child height could largely be attributable to levels and concentration of open defecation. Meanwhile, country studies in Cambodia (Zanello et al. 2016) and Bangladesh (Headey et al. 2015) have found that reductions in open defecation rates have made a significant contribution to reductions in child under-nutrition and to diarrhea of between 30 and 50 percent (Duflo et al. N.D.). All these evidence calls for a targeted approach to improve WASH conditions in Tanzania which is fundamental to developing a healthy and prosperous future generation in the country.

Stunting in Tanzania

Tanzania is home to the third highest population of stunted children in Sub-Saharan Africa, next to Ethiopia and Democratic Republic of Congo. In 2014, about 35 percent of children under five were found to be stunted across Tanzania, indicating that about 2.7 million children are chronically malnourished (DHS 2016). Though prevalence of stunting fell from 49 to 34 percent (figure 6.3), Tanzania was not able to meet its Millennium Development Goal (MDG) target on

Figure 6.3: Reductions in All Indicators of Stunting, Underweight, and Wasting



Source: DHS 1996–2016.

nutrition by 2015. Thus though progress has been made in under-nutrition related indicators, to also include the percentage of children underweight, there is still a long way to go.

Stunting by Wealth, Gender, Age, and Geographical Groupings

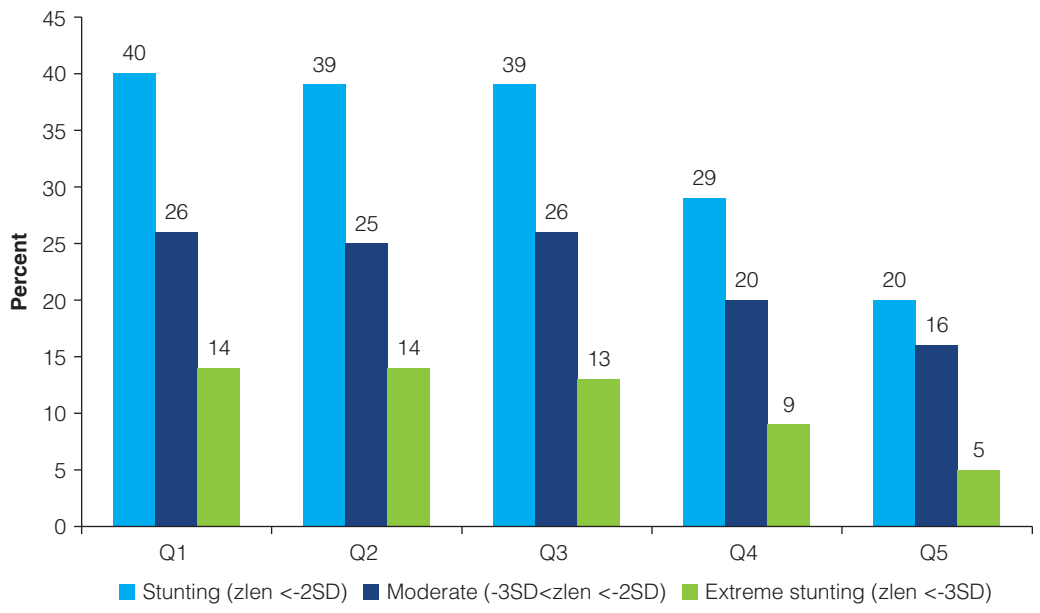
Stunting is not limited to the poorer quintiles of the population—indicating that in Tanzania, income is not the only determinant of stunting (figure 6.4). The prevalence of stunting in the poorest quintile of the national wealth distribution is almost twice as high as in the richest quintile (40 versus 20 percent). However, a 20 percent prevalence is relatively high even for richer populations, indicating that there are larger environmental, dietary, feeding, and social factors aside from wealth that are contributing to under-nutrition. Stunting has fallen for both the T60 and the B40 by almost equal amounts, again indicating that the reductions must be attributable to factors external to wealth (figure 6.5).

By gender, boys have consistently higher stunting prevalence in Tanzania, 37 percent compared to 32 percent for girls. Other studies have found this gender distinction not just in Tanzania, but across other countries in Sub-Saharan Africa (Wamani et al. 2007).

By age group, the prevalence of stunting sharply increases after a child is six months old. For the 0–5 month age group, stunting is about 14 percent, while in the 6–24 month age group, stunting rises to 33 percent. It increases even further to 44 percent for children aged 24–36 months (figure A.2). Theories about the higher stunting during these age categories include that there is greater variation in growth spurts, but that the pattern is also due to the different ways in which a child is able to interact with his or her environment through increased mobility (standing, crawling, and putting things in the mouth). This increases vulnerability to picking up germs and infections from surroundings.

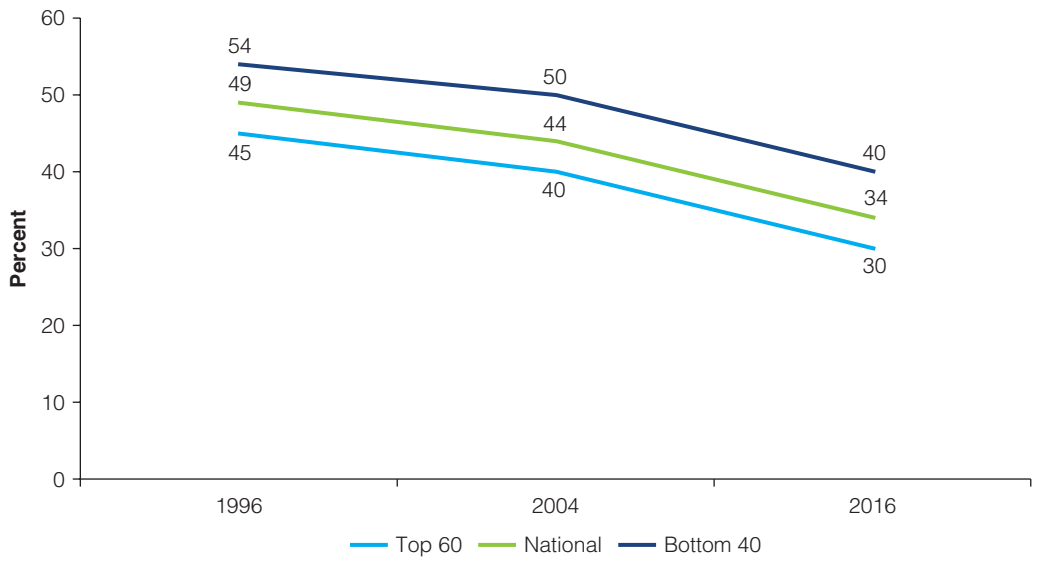
Rural children are far more likely to be stunted compared to their urban counterparts (37 versus 26 percent). Children living in urban areas may have better access to food, health services, and coping mechanisms that make them less likely to be stunted (map A.3). Part of this

Figure 6.4: Stunting by Wealth Quintiles



Source: DHS 2016.

Figure 6.5: Stunting over Time, by Bottom 40 and Top 60



Source: DHS 1999 to 2016.

explanation may be related to wealth, but it may be much wider than this and include a lack of access to health-care facilities for rural families. We do see that there has been a 14 percentage point reduction in stunting in rural areas since 1999 but there is still a long way to go to reach the MDG target.

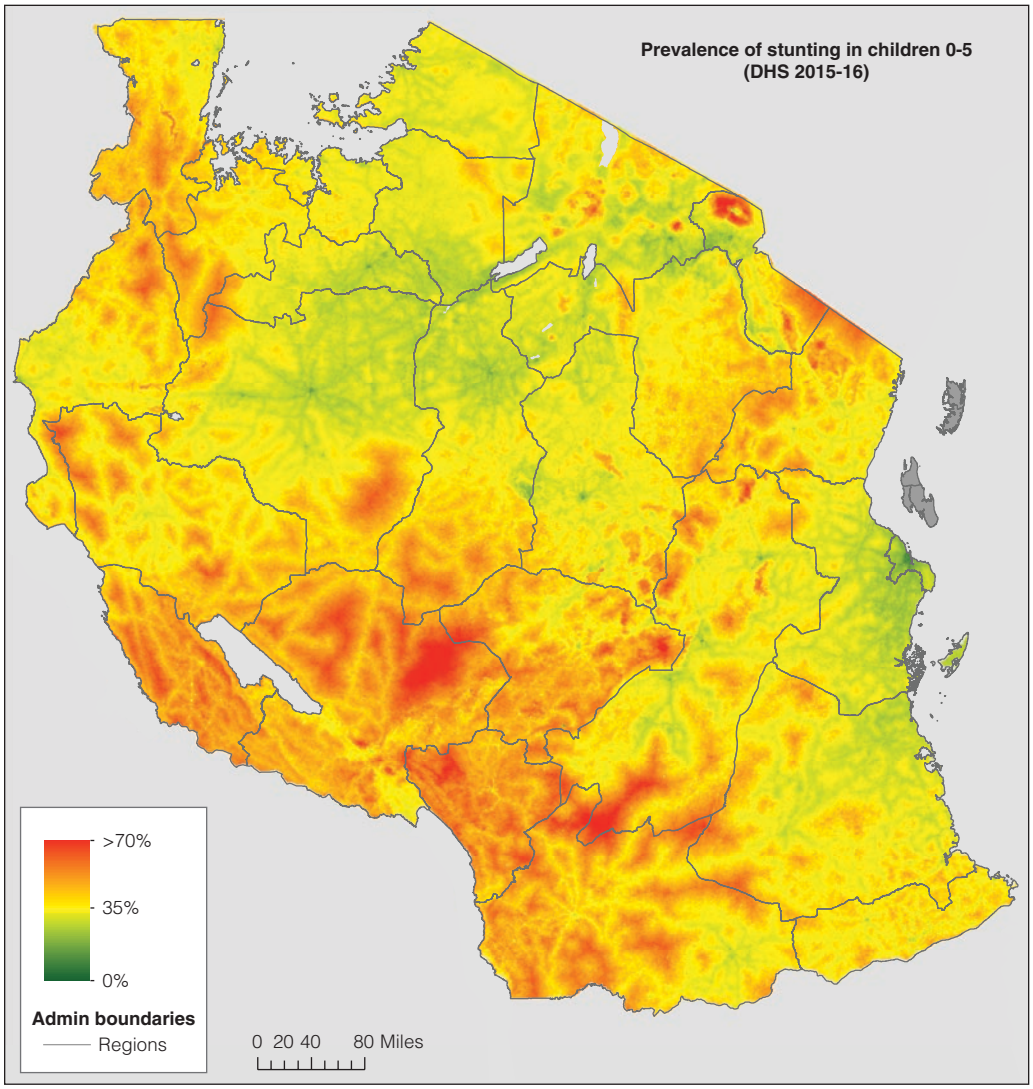
Considerable disparities in stunting prevalence is prevalent across regions. In Mainland Tanzania, the proportion of stunted children under five is more than 40 percent across the nine regions, with a third of regions exceeding 50 percent. Geospatial mapping reveals that stunting rates are highest in the southwestern area of Tanzania, which is also known to have the country's highest incidence of poverty. As pixel level analysis (map 6.1) shows, there are pockets with 50–80 percent stunting. At an aggregated regional level, the Njombe and Rukwa regions have the highest prevalence—up to half of all children under five there are stunted. Looking at this at a district level may be most helpful for targeting specific areas and detecting intra-regional variations. For example, despite Arusha having a lower stunting rate when examined at regional level, by district and on the pixel level we see that higher stunting rates are concentrated in the north-eastern part of the country, up to 42.8 percent in some districts. Maps of stunting by district and by region can be found in appendix 6.1

Geo-Spatial Mapping of WASH Nutrition Linkages: Searching Hotspots

High resolution maps that use geo-statistical estimation techniques enable us to first see where there is high stunting prevalence in the country (map 6.1) and then see spatial coincidence of stunting and low water or sanitation coverage. In this way, "hot spots" can be identified for targeting priority interventions.

Map 6.2 shows the overlap between areas of high stunting and low improved water coverage, while map 6.3 shows the overlap with improved sanitation coverage.[2] We see most importantly that there is similarity in the two cross-maps for overlap between high rates of stunting and low

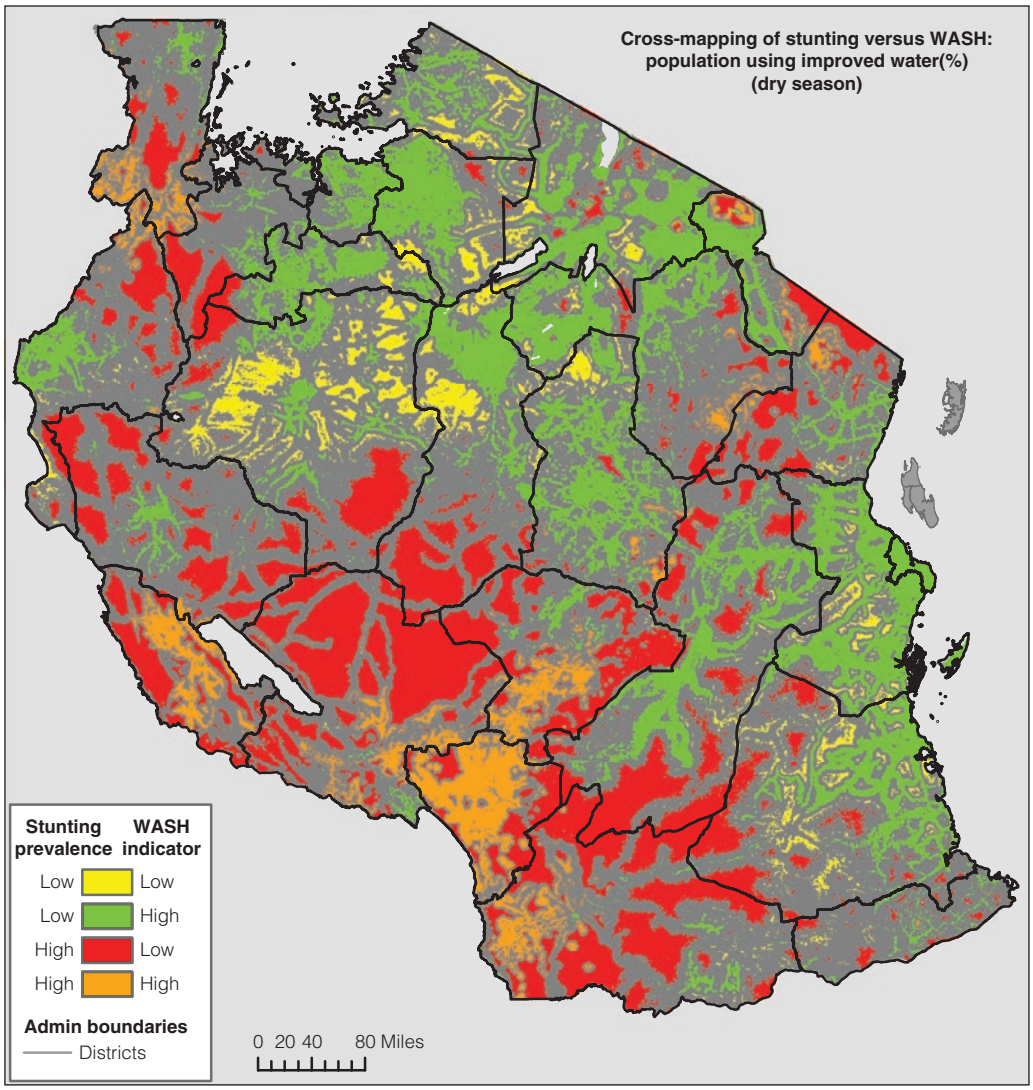
Map 6.1: Stunting in Children 0–5 Years, by 5 x 5 Kilometer Pixel Level, 2015–16



Source: DHS 2016.

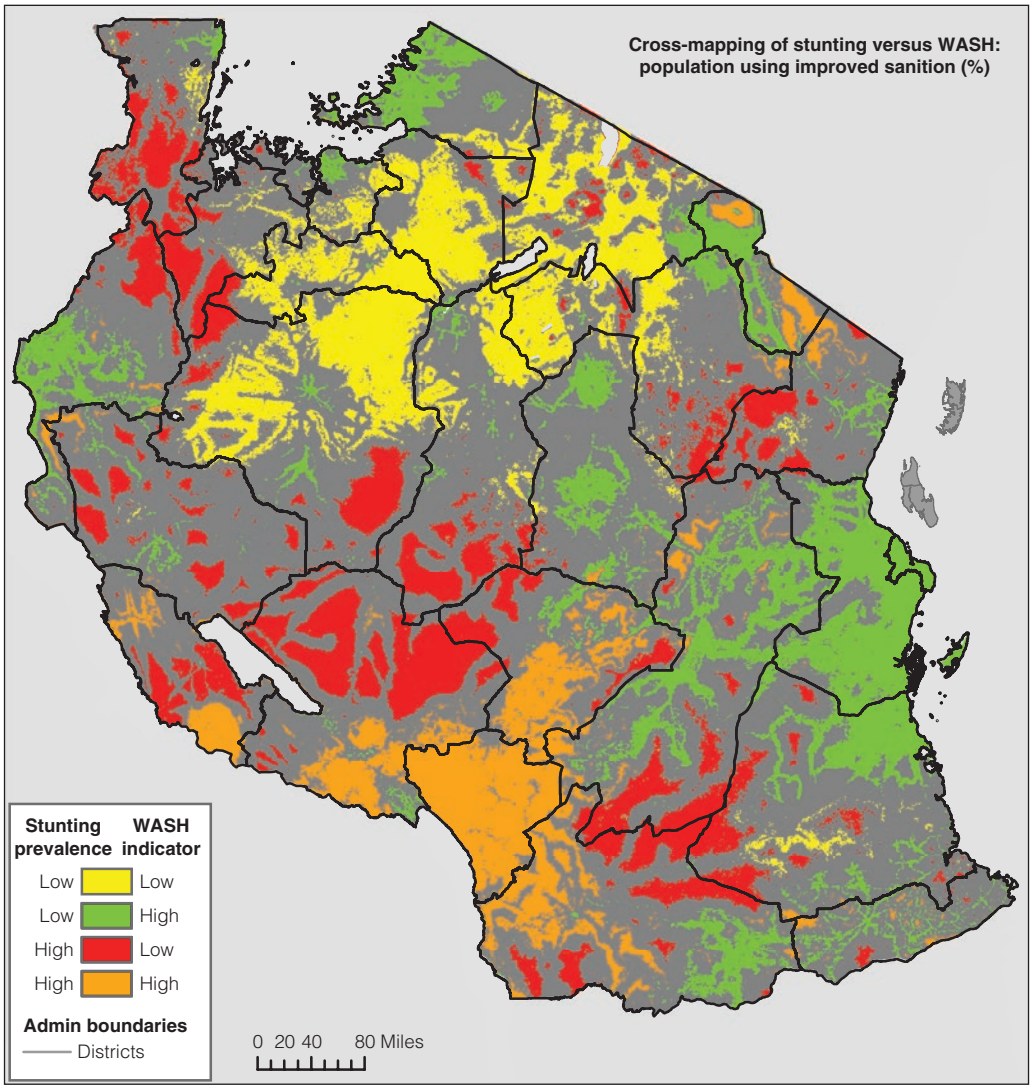
WASH in regions such as Kagera and the northern part of Kigoma in the north, Mbeya and Rukwa in the west; and Ruvuma and even parts of Morogoro in the south of Tanzania. These are the potential hotspots in Tanzania where nutrition focused interventions to reduce stunting needs to be explore synergies with nutrition sensitive WASH interventions to deliver the best results.

Map 6.2: Cross-Mapping of Rates of Stunting and Improved Water Coverage (Dry Season)



Source: DHS 2016 and RWS 2014.

Map 6.3: Cross-Mapping of Rates of Stunting and Improved Sanitation Coverage



Source: DHS 2016 and RWS 2014.

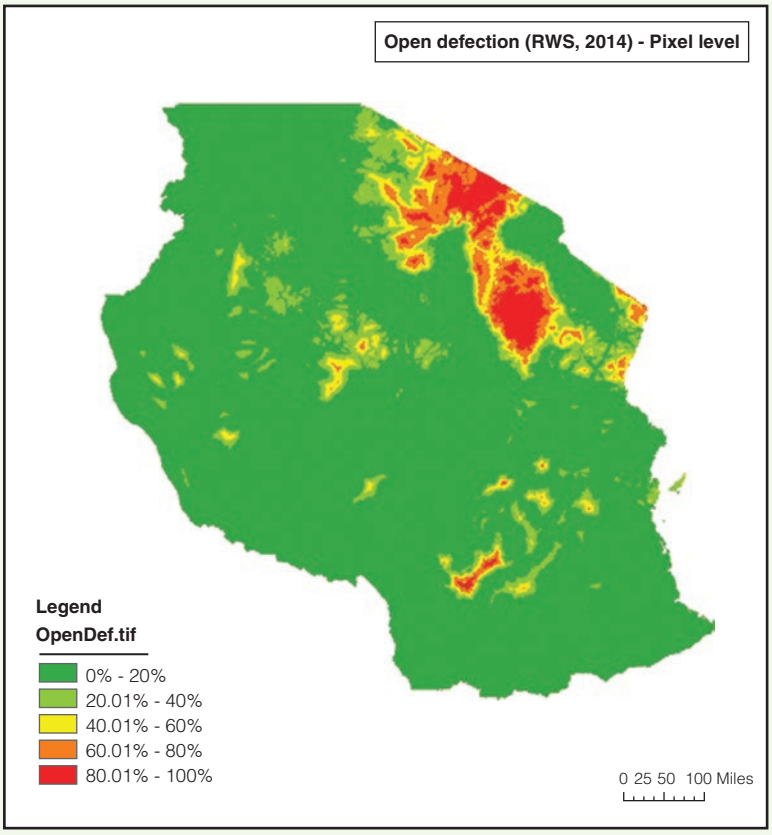
Box 6.3: Pastoral Communities in Northern Tanzania: Open defecation Outliers

Some of the highest rates of open defecation in the country can be found in the Arusha and Manyara regions of northeastern Tanzania (Figure B6.3.1). Since lack of sanitation and poverty tend to go hand in hand, one may easily assume that these regions are plagued by poverty. However, the Arusha and Manyara regions actually have a significantly lower incidence of monetary poverty compared to the national average (20% and 13%, respectively, compared to 28% – Gething PW and Rosas N (2015)). They also have disproportionate levels of open defecation with relation to improved

box continues next page

Box 6.3: Continued

Map B6.3.1: Rates of open defecation - Geospatial estimates based on RWS, 2014



Source: Gething et al. 2017

sanitation coverage (see graph below). This exemplifies that monetary poverty, and even a lack of facilities, alone cannot explain open defecation practices. Instead, social norms and customs are likely to be better predictors of sanitation access. For instance, poverty numbers alone do not reveal that pastoral communities, such as the Maasai, Rangi, Sukuma, and Meru tribes, are common to Arusha and Manyara. Some research has shown that open defecation may make more sense for some pastoralists whose lifestyle is still largely nomadic (Axweso 2011). The high rates of open defecation in these regions could thus be a result of behavioral and cultural norms rather than due to a lack of wealth or even a lack of infrastructure. Efforts to increase improved sanitation coverage in these regions would therefore need to place an added emphasis on behavioral approaches in addition to strengthening supply.

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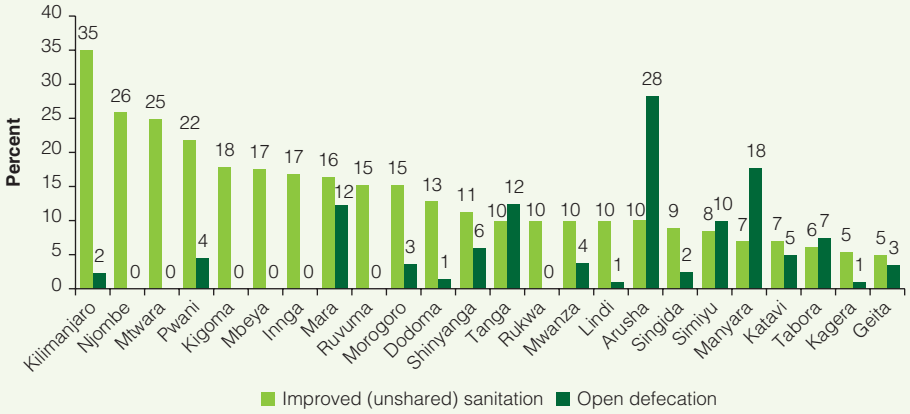
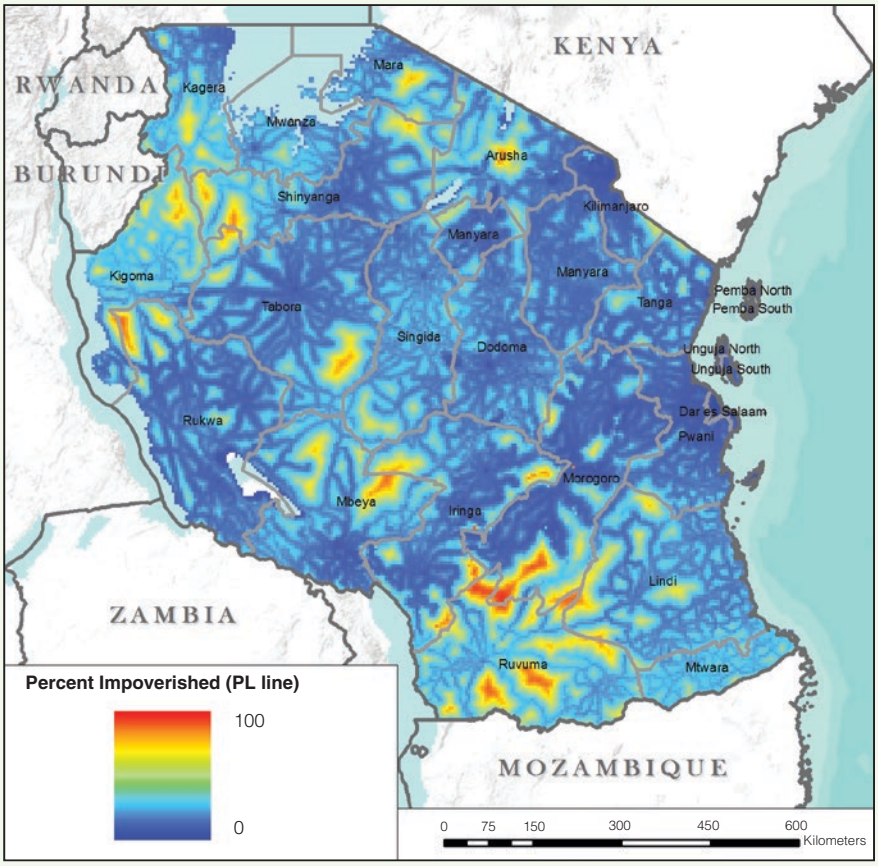
Box 6.3: Continued

Figure B6.3.1: Rates of Improved Sanitation and Open Defecation, by Region



Map B6.3.2: Map Showing Geospatial Estimates of Poverty



Source: World Bank 2017.

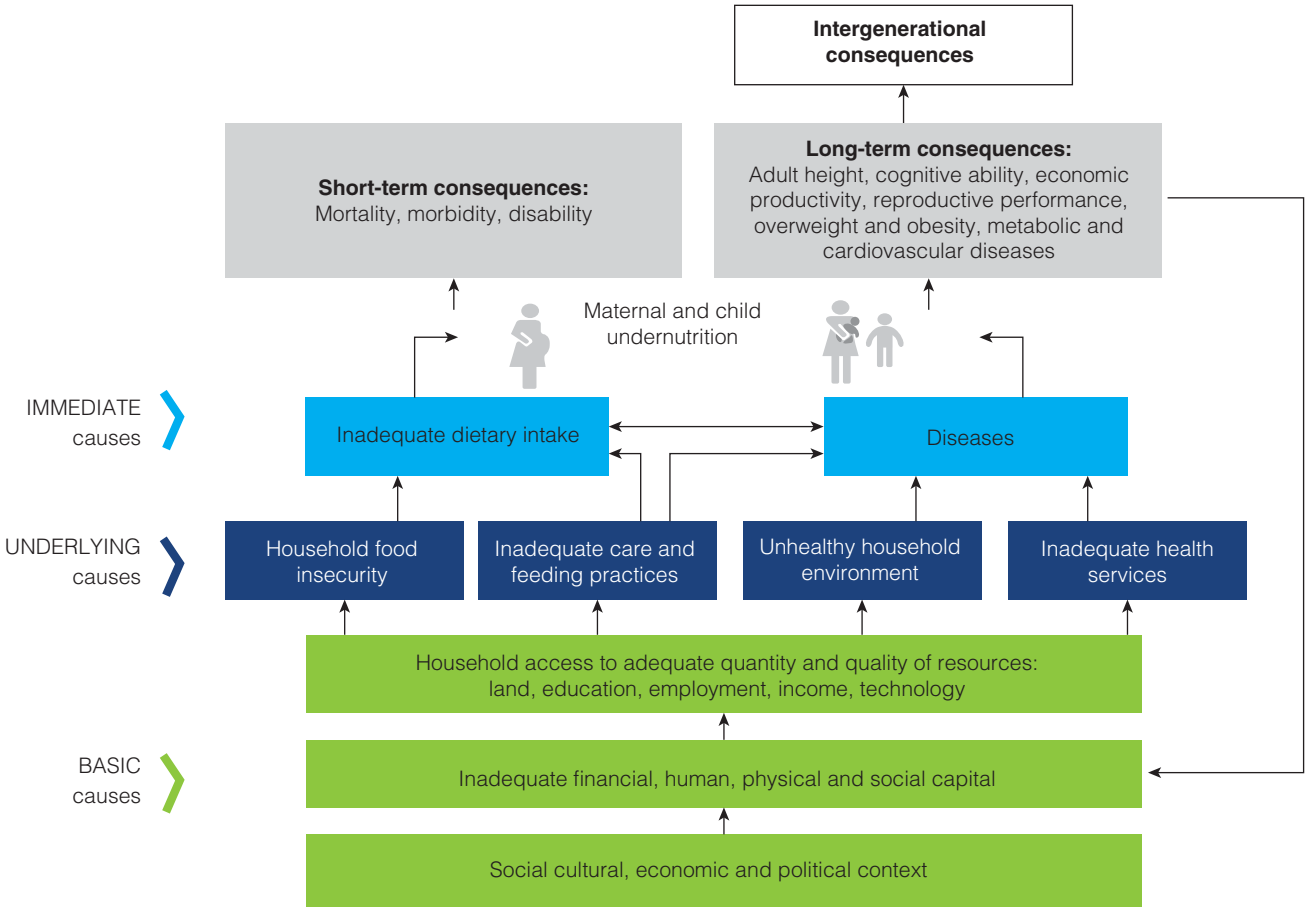
UNICEF Framework: Exploring the WASH Synergies in Combating Undernutriton

In 1990, UNICEF proposed a multi-sectoral nutrition framework that presented nutrition as a function of three underlying dimensions: food security, environment and health, and child care practices (figure 6.6). Skoufias (2015) have used an extension of the framework to analyze the association of child HAZ scores with these underlying correlates including WASH across different countries. The methodology allows for the identification of current data limitations, systematically explores the correlates and determinants of nutrition, identifies potential "binding constraints" in reducing malnutrition and potential interactions and synergies among different nutrition drivers. Some drivers may contribute more in combination with others than on their own. This approach provides guidance on whether synergies between different drivers can be used to channel investments in reducing chronic malnutrition.

Disease and inadequate dietary intake result from a variety of interrelated underlying factors. Figure 6.6 lays out the four dimensions of the model representing the four key drivers of undernutrition:

1. The first of these is **access to adequate food security.** A child is food secure when at all times he or she has physical, social, and economic access to sufficient, safe, and

Figure 6.6: Undernutrition Framework



Source: UNICEF (1990) "Strategy for Improved Nutrition of Children and Women in Developing Countries," as adapted by authors.

nutritious food that meets dietary needs and food preferences for an active and healthy life.

2. The second driver of nutrition is **access to adequate care**. This driver measures the ability of the primary caregiver to provide a safe and appropriate environment for the child to grow and develop.[3]

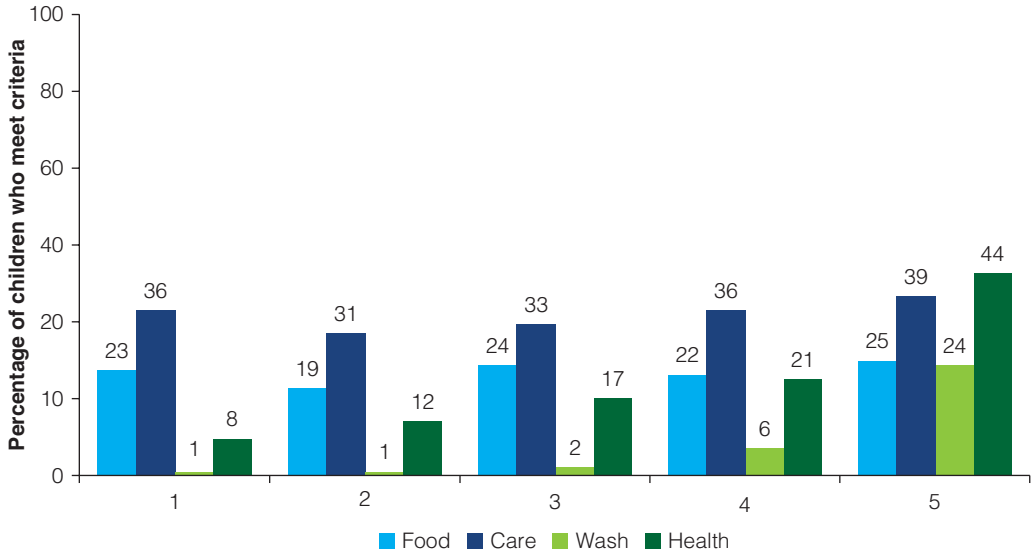
3. The third driver of nutrition is **access to an adequate WASH environment.** This driver measures the child's exposure to pathogens in the physical environment where he or she lives due to the lack of improved water, sanitation and hygiene access. The measure includes components on (1) access to improved drinking water, (2) access to improved sanitation, (3) adequate handwashing practices, and (4) adequate disposal of child feces. Given that it is not only the child's immediate environment, i.e., the facilities in the dwelling unit, but also those in the neighborhood that affect the degree of exposure to pathogens, community-wide access to improved sanitation is also included.

4. The fourth driver of nutrition is **access to adequate healthcare**. This driver measures the child's access to skilled medical care to minimize the effects of illness and preventively address health issues, especially those linked to malnutrition, such as diarrheal diseases. The measure encompasses the availability and use of healthcare services for pre-natal, birth, and post-natal care.

The relative importance of each driver may vary by age group, household economic status, and by location (urban/rural). For example, although access to potable water is important for all children, for those six months of age or younger who are exclusively breastfed and thus not directly consuming water, such access may not be as important (or even necessary) from a purely nutritional standpoint. Alternatively, the interaction of the nutrition drivers may look quite different in rural areas than in urban ones.

Below is figure 6.7, which shows the share of households in each wealth quintile with the different adequacy status in Tanzania as per the DHS 2016 data. There are considerable

Figure 6.7: Adequacy Status by Wealth Quintile, 2010



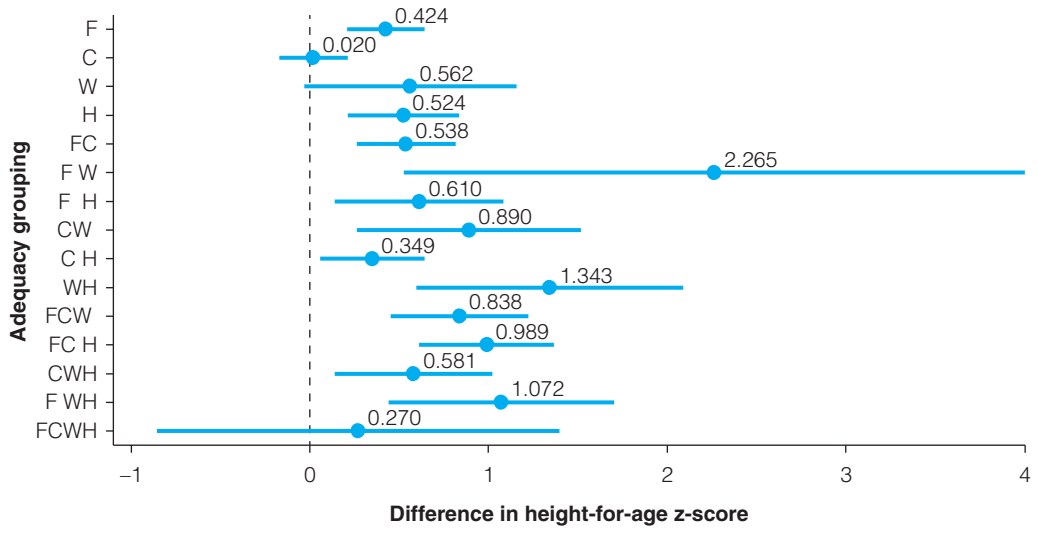
Source: Author estimates based on DHS 2010.

differences in all the adequacies except adequacy in care across the wealth quintiles. For health adequacy and WASH adequacy, the wealthier quintiles have progressively higher levels.

Based on the analysis at the national level, children adequate in two or three drivers, regardless of which two or three, are statistically significantly taller than those without access to any one driver. Also, the point estimates tend to be higher for having access to two or three drivers than having access to just one. Access to adequate food, adequate WASH, and adequate health are important correlates with height-for-age. Regardless of the definitions used, a child is on average about 0.5 standard deviations taller if he or she has access to adequate food only, adequate WASH only, or adequate health only, than if the child does not have access to any of the four adequacies. Figure 6.8, shows the importance of Food (F) and WASH (W) dimensions combining to generate a larger difference in the height-for-age score than other dimensions, demonstrating the benefit of having access to both food and WASH adequacies in conjunction[4]. Similarly, the WASH (W) and Health (H) combination has the second-largest combined effect. Of course, adequacy in all four dimensions brings the child over the average HAZ standard deviation score for his or her reference group.

When considering urban and rural children separately, differences arise between the two groups as to which combination of drivers is associated with taller children. For rural children, access to adequate food and another driver are, in general, associated with height gains, with the combination of food and WASH resulting in some of the largest point estimates. For urban children, the coefficients on access to food and WASH and food and health have larger standard errors and we cannot rule out there being no difference in the average HAZ score for these children and the reference group. This evidence suggests that for rural children in Tanzania, access to improved water and sanitation plays a critical role in improving nutrition outcomes in isolation as well as in combination with other drives such as food, care and health.[5]

Figure 6.8: Average Difference in Height-for-Age Score, 2010, Relative to the Reference Group



Source: Author calculations based on DHS 2010.
Note: Showing point estimates and 95% CI. Reference group:Children with access to none.

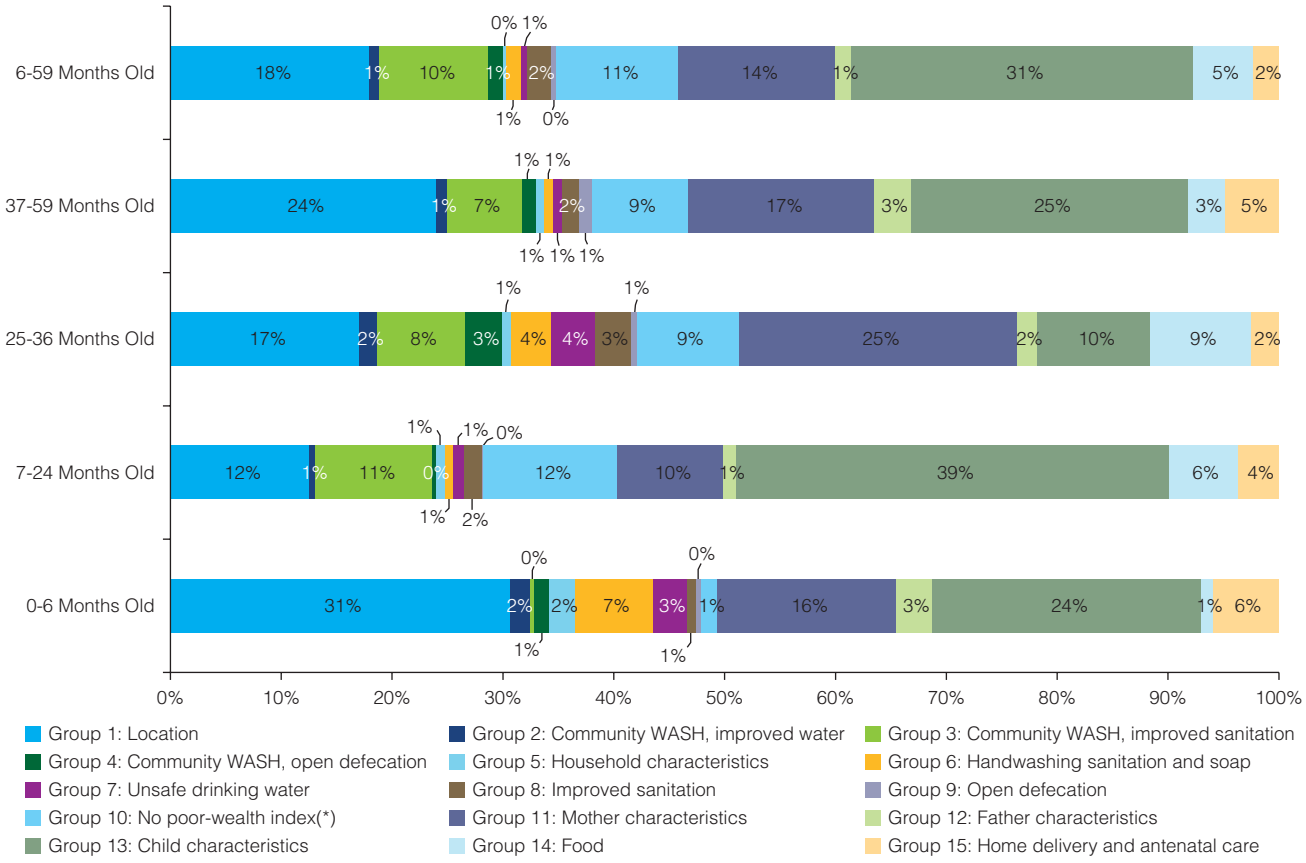
Shapley Decomposition to Identify the Relative Importance of WASH Variables to One Another in Determining Stunted Growth

Another way to examine the relationship of WASH variables to stunted growth is to look at their relative importance to one another as well as relative to other factors within a Shapley decomposition. Essentially, Shapely decomposition provides the percentage contribution of each of the variables provided in explaining the observed variation in stunting in Tanzania using the DHS 2016 data.

Relative Contribution of WASH in Explaining Stunting

Figure 6.9 shows the overall results of the Shapley decomposition for the various age groups of children, illustrating the contribution of each of the groups of correlates in explaining variation in stunting. The far left of figure 6.9, in Group 1 (bright blue) displays location (urban/rural). In Group 3 (green on the left) is the contribution of community improved sanitation. It is interesting as it contributes nothing in the first six months but 11 percent in the age groups where stunting occurs with the greatest consequence, and 10 percent overall. In group 10 (sky blue) we have the contribution of the wealth index score. This variable again does not appear to contribute to stunting prior to six months but kicks in thereafter.

Figure 6.9: Shapley Decomposition of Contributors of Stunting, by Age Group



Source: DHS 2016.

The characteristics of the mother are consistently important throughout the growth of the child and like the location, contribute more in early growth and development (the first six months). Child characteristics Group 13 (light green on right) including factors such as age, anemia and whether the child has had medical check ups and slept under a mosquito net the previous night, are the largest contributor. Food variables appear to contribute surprisingly little to the variation in stunting, only 5 percent overall.[6] Finally, home delivery and ante-natal care Group 15 (light orange on right) contribute a maximum of 6 percent in the early months after birth. This shows us that while WASH certainly does not determine everything, sanitation, in particular community sanitation, plays an important role in determining child nutritional status for children above the age of six months.

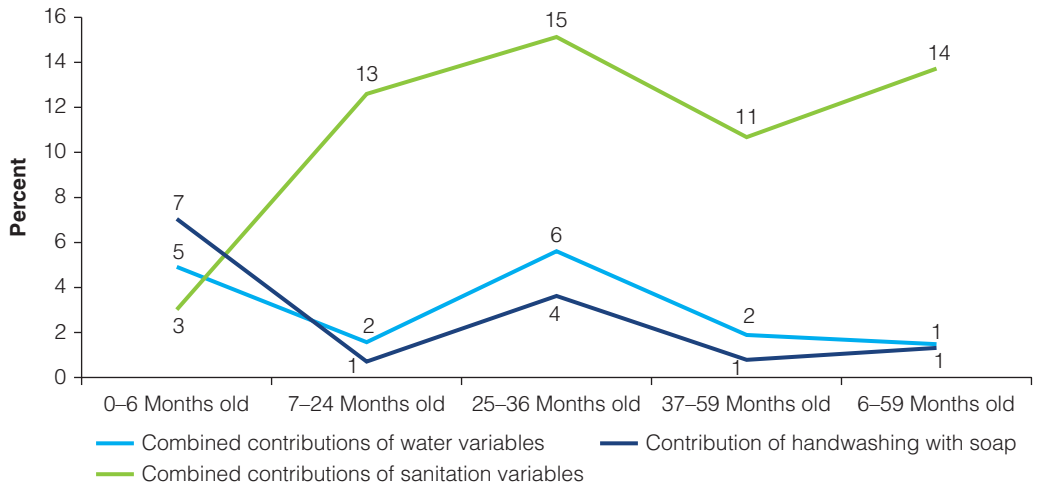
Water, Sanitation or Handwashing?

The results of the decomposition can be used to look at which factors among water, sanitation, and hand-washing are the most influential and at what ages in affecting child stunting. For the very young infant of 0–6 months, hand-washing with soap is the most important, as figure 6.10 shows. However, as the child gets older, sanitation factors, whether in the home or the community (to include open defecation and unimproved sanitation), contribute progressively more to stunting, in particular between the 7–36 month period when most stunting occurs (figure 6.11) This is significant as it reflects that at life's start, when the child is less mobile, the onus will be more on the mother or the caregiver to make sure to wash her/his hands and maintain proper hygienic practices around the child. However, as the child becomes more mobile and more exposed to the environment, sanitation conditions become more important. Improved water access still continues to play a role but has less relative significance.

The Primacy of Community Sanitation

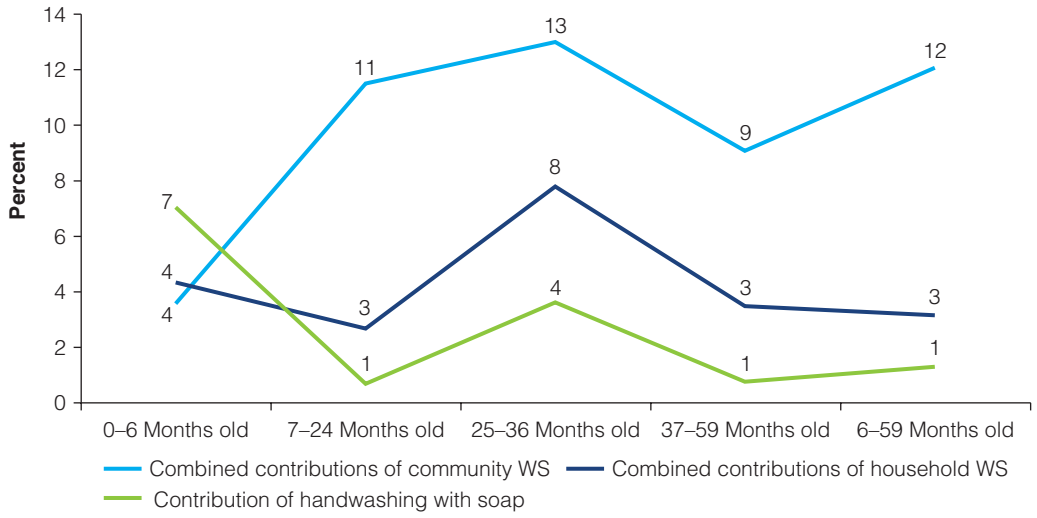
Meanwhile, when considering the relative contributions of community versus household WASH, we find that community water, sanitation, and hygiene combined consistently make a greater contribution over all age groups. The greatest contribution occurs between 25–36 months for WASH variables, with combined community improved water and sanitation conditions contributing up to 13 percent of the explanation for stunted growth

Figure 6.10: Contributions of Water, Sanitation, and Hygiene Variables Compared



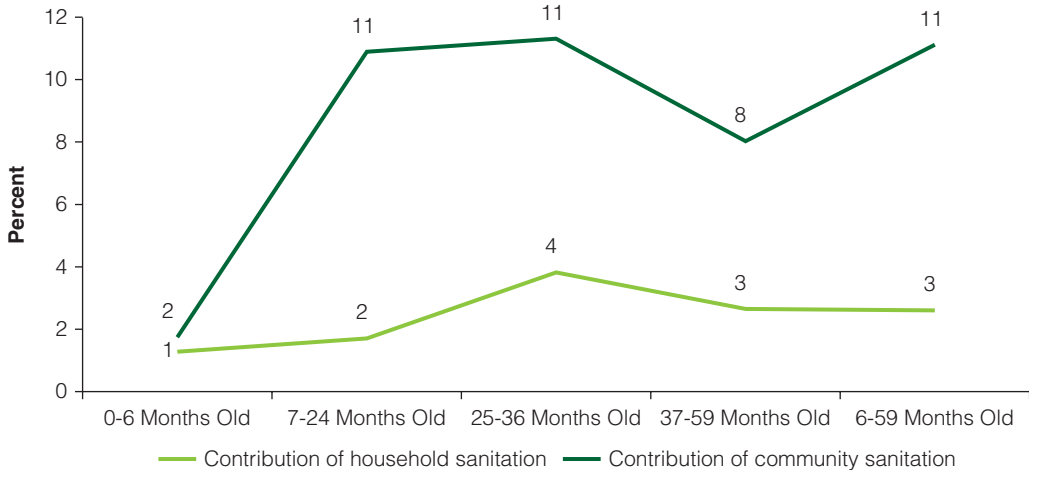
Source: DHS 2016.

Figure 6.11: Contributions of Community Versus Household Water and Sanitation versus Handwashing



Source: DHS 2016.

Figure 6.12: Contributions of Household versus Community Sanitation, 2016



Source: DHS 2016

between 25 and 26 months. This further highlights the externalities of WASH which manifest well beyond the household, the enhanced social benefits emanating from community wide improved access that calls for the need for achieving WASH targets at the community level.

Further disaggregating the sanitation category alone by community and household contributions, we find that community sanitation consistently contributes more (figure 6.12). This reflects research worldwide that emphasizes the importance of gaining complete sanitation coverage in the community (such as through Community Led Total Sanitation – CLTS approaches) in order

to eliminate the health risks of open defecation. Though in Tanzania we see that the majority of households have unimproved latrines, this does nonetheless reinforce the importance of community-wide approaches because a few unimproved latrines can impact the health of a whole community.

Using Machine Learning to Better Understand Stunting in Tanzania- The MARS Approach

Most of the analysis of drivers of stunting is based on parametric models that make strong assumptions on the nature of the relationship between stunting and its various determinants. However, theoretically a number of potential determinants can affect stunting at varying levels and for various age groups. This poses challenges to the design appropriate interventions appropriate in the country context as in the case of Tanzania. In order to overcome these difficulties and allow for flexible specifications, we use a type of machine learning technique known as Multivariate Adaptive Regression Spline—MARS- which combines machine learning with regression, through an algorithm that lets the data decide whether nonlinear effects, threshold effects, or interactive terms are needed to capture variation in the outcome of interest. Further information about methodology can be found in appendix 6.7.

The DHS data from 2010 and 2015/16 have been supplemented with data from other sources to include data on variables such as population density, aridity, friction (an index that measures the "friction" or cost of travel), and head count poverty rate at the district level. This flexible approach is shown to improve the predictive power of the model; help the selection of the relevant determinants (independent variables) from a large set of potential variables as dictated by theory; identify the threshold effects (cut-off points) in the data which shows the change in behavior of some variables and allows for a various simulations to understand the effect of the interventions of interest such as increase in water and sanitation access on stunting outcome.

Variables that MARS Identifies as Important in Affecting Stunting in Tanzania

The first stage of MARS is to enable machine learning to auto-select the variables (figure 6.13) that best explain the variance in stunting for children for the entire sample 0–59 months. The variables that MARS has selected accordingly concur with other research presented that underlines the higher risk increment of stunting detected around a similar age, 24 months.

Besides age, mother's BMI, mother's education in years, population density, and difficulty of transport all contained an important explanatory capability. Beyond this, community water supply, community and household sanitation, poverty, food security, gender, and the use of bed nets were retained in the model as relevant variables. Interestingly, variables that were dropped from the model included ones that other analyses, which have used a regular OLS approach, may well have considered important. Population density, aridity, improved water at the cluster (community level), and the mother's age at first pregnancy were found to be important in the MARS specification but not in standard OLS. On the other hand, breast-feeding and growth control are significant in standard OLS but were not kept in MARS. This may be because the MARS specification allows for a nonlinear effect of age on the HAZ score and does not impose any functional forms on the data.

Based on the age threshold found in the full sample, two samples were constructed such as children belonging to the age groups of 0–21 months and 21–59 months respectively. The

Figure 6.13: Relative Importance of Variables in the MARS Analysis, All Ages

Variable	Score
Age of child	100.00
Mother BMI	25.39
Mother ED years	23.00
Friction 1km	21.51
Year	21.33
Population density	18.62
Cluster PCT improved water	18.04
Girl dummy	17.58
Poverty	16.57
Food secure dummy	11.98
Improved water	11.17
Aridity	11.11
Wealth index	9.89
Cluster PCT improved toilet	8.19
Type toilet	7.75
Antenatal visits	7.31
Use bed nets	6.35
Mother age first pregnancy	5.57
Time to fetch water	0.00
Mother literate	0.00
Growth control	0.00
Assisted birth	0.00
Breast fed	0.00
Urban dummy	0.00

Source: Newman 2017.

decision to separate the sample into those below and above 21 months was based on the initial estimation of 0 to 59 months, which showed a distinct break in the relationship of height-for-age z-score at 21 months. Conducting these analyses for the subsets of below and above 21-month-old children, we found the results outlined in figure 6.14. Several variables such as gender, age of the child, mother's education, mother's education and poverty seem to have an impact on stunting in both the samples. However, when compared with the younger cohort (0–6 months), stunting among the older children is affected by additional determinants such as easiness in transport, household wealth, population density, mother's age at first pregnancy, food security, and use of bed nets. For the younger cohorts, household water seems to play a role while for the older ones, both improved sanitation at the household level and the level of improved sanitation in the community shows up as important correlates of stunting.

Key Threshold Effects and Interactions

In the process of identifying interactions between different variables which lead to significant impacts on stunting, MARS made it possible to identify certain cut-off points where values of certain variables were detected as important in the model. Threshold effects were found in many different variables using basis functions. Results are given in detail in appendix B.1.

Some threshold effects come about from two variables working in conjunction. For example, the positive effect of improved community water asserts itself only if more than 25 percent of the households per community have water *and* the population density is greater than 1,852.67 people per square kilometer.[7]

There is also a threshold effect for the percent of households with an improved toilet in the community. In 2010, having a higher percentage of improved toilets in the cluster for girls exerts an effect, but only if the percentage is at least 36.8 percent. In 2015, for both boys and girls, there is a negative effect of having especially poor community sanitation. The effect is greatest when no household in the cluster has an improved toilet. Between 11 percent and 36.8 percent,

Figure 6.14: Relative importance of variables in the MARS Analysis, ≤21 Months

Variable	Score
Age of child	100.00
Year	25.65
Poverty	23.30
Wealth index	23.30
Received vitamin A	17.28
Girl dummy	17.28
Mother BMI	17.09
Improved water	12.96
Antenatal visits	12.66
Growth control	12.66
Aridity	11.53
Mother ED years	1153
Mother literate	0.00
Adequate nutrition	0.00
Use bed nets	0.00
Complete vaccination	0.00
Breast fed	0.00
Assisted birth	0.00
Adequate nutrition mis	0.00
Urban dummy	0.00
Friction 1km	0.00
Population density	0.00
Time to fetch water	0.00
Mother age first pregnancy	0.00
Cluster PCT improved water	0.00
Type toilet	0.00
Cluster PCT improved	0.00
Food secure dummy	0.00

Source: Newman (2017).
Note: For children 21 months and under, the variables in order of importance in the model, in addition to the age of the child, include: poverty; receipt of vitamin A; gender of the child; mother's BMI; improved water in the household; number of antenatal visits; growth control; aridity; and mother's education in years.

Figure 6.15: Relative importance of variables in the MARS Analysis >21 Months

Variable	Score
Poverty	100.00
Age of child	87.90
Friction 1km	85.94
Mother BMI	76.81
Wealth index	76.72
Population density	76.29
Mother ED years	66.08
Aridity	52.80
Mother age first pregnancy	49.17
Year	48.93
Cluster PCT improved toilet	43.45
Food secure dummy	40.72
Type toilet	40.43
Girl dummy	38.51
Use bed nets	26.47
Improved water	0.00
Mother literate	0.00
Assisted birth	0.00
Cluster PCT improved water	0.00
Antenatal visits	0.00
Time to fetch water	0.00
Urban dummy	0.00
Growth control	0.00
Breast fed	0.00

Source: Newman 2017.
Note: For children over 21 months: the variables in order of importance in the model were poverty; age of the child; difficulty of transportation; mother's BMI; the wealth index; population density; mother's education in years; aridity; mother's age at first pregnancy; improved sanitation at the cluster (community) level; food security; type of latrine in the home; gender; and use of bed nets.

there is no effect of improved sanitation on height-for-age z scores. Thereafter, increases in the percent of improved toilets lead to an improvement in nutritional outcomes for girls.

The results also show some interesting contrasts between the two age groups. For example, the mother´s age at first pregnancy appears here as having quite low importance in the overall sample. However, on examining the interactions, we find that it holds significance in interaction with the mother´s education or with the mother´s BMI. In other words, the combination of a lower age at first pregnancy and fewer than five years of education holds a significant impact on the HAZ score of the child.

Such research can continue to find useful data points for policy targeting. For example, so far we understand that five years of education for the mother will make a difference to stunting in combination with a reduction in poverty. This can hold lessons for the number of years a young girl should be encouraged to stay in school.

Simulations to Guide Potential Interventions

A final benefit of MARS is the ability to tell us what could hypothetically happen to stunting if one were to "tweak" the values of individual variables usually through well-targeted interventions. In particular, we are interested in understanding how an improvement in water supply and sanitation access will affect stunting levels. One set of analysis is to compare the impacts of improved water and improved sanitation simulations at the household level for an affected population subgroup versus the whole population. When we look at the simulations in these terms, we can see how much more of an impact on stunting enhancements to improved water and improved sanitation make to subpopulations with particularly low levels of access as compared to the population as a whole. In the language of the program evaluation, this is conceptually somewhat similar to the Treatment on the Treated (TOT) when compared with the average. Here two types of simulations are described, first by simulating increases in improved coverage in 2010, and then in 2016. Three possible interventions are presented below.

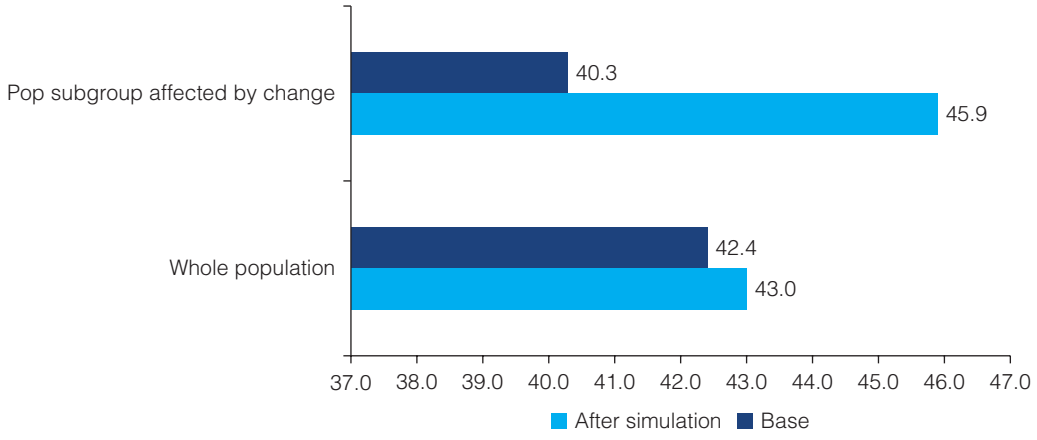
Improving Water Access

In 2010, an increase in the percentage of households with improved water from 39 to 50 percent can be simulated. The result of the simulation is a 0.6 percentage point reduction in stunting for the whole population (figure 6.16). However, if we look exclusively at the subgroup of the population affected by the change (that is for those households water access has in fact changed due to a simulated intervention) stunting goes down by 5.6 percentage points, a very large influence.

Improving Household Sanitation Access

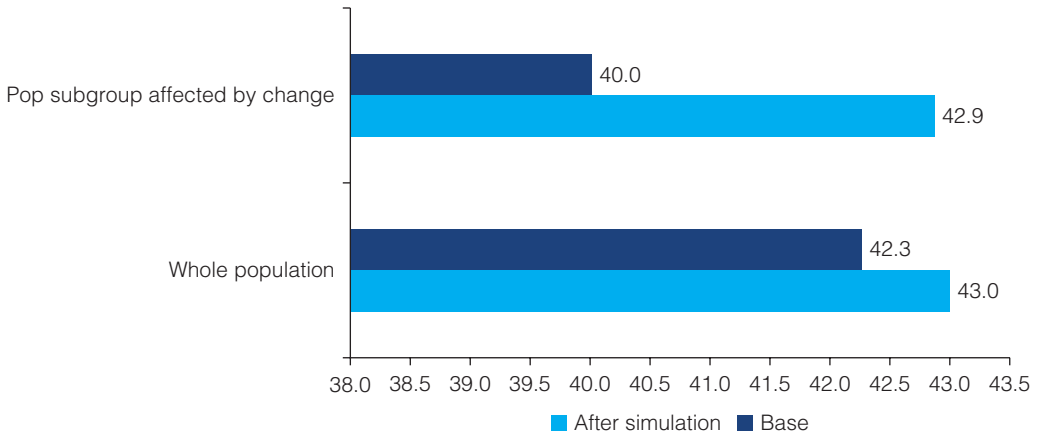
The same can be said for changes to improved household sanitation (figure 6.17). The simulation involved reducing the percent with unimproved sanitation from 74.6 to 50 percent. The result for the subset of the population who were affected by this change directly was a 2.9 percentage

Figure 6.16: Simulations to Increase the Percentage of Households with Improved Water for the Whole Population and Population Subgroup (2010), Percent



Source: Analysis for World Bank of DHS, 2016.

Figure 6.17 : Simulations to Increase the Percentage of Households with Improved Sanitation for the Whole Population and Population Subgroups (2010), Percent



Source: Analysis for World Bank of DHS, 2016.

point fall in stunting. For the whole population, the reduction was 0.7 percentage point reduction in stunting.

Improving Community Sanitation Access Levels and the Gender Impacts

A final set of simulations explore the impact of an improvement in the share of households with improved toilets in the community (improved sanitation in the community) on stunting levels. Two separate simulations were undertaken. The simulations in this case were as follows:

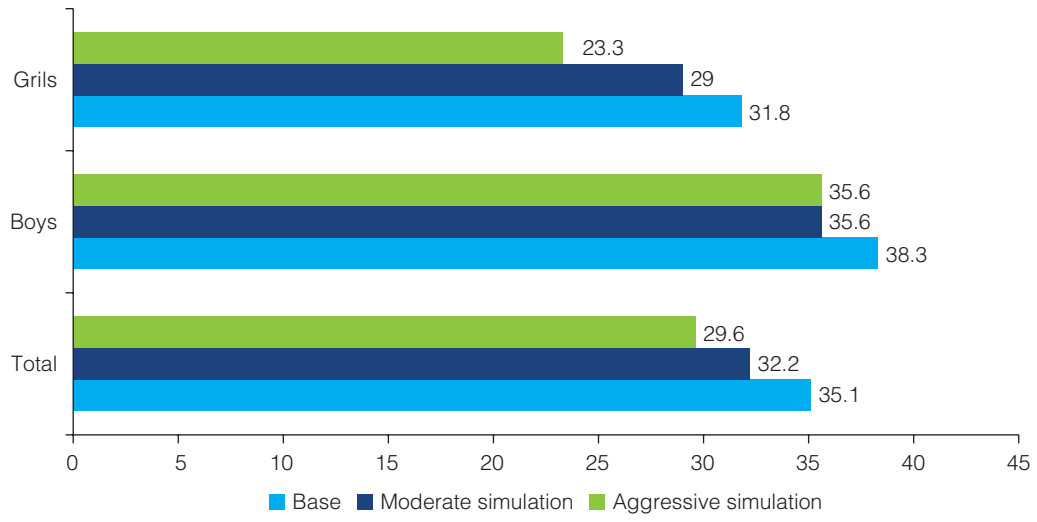
a. Modest simulation: Up to 20 percent with improved toilet in cluster for all clusters below 20 percent and 10 percent increase for all others, not to exceed 1;

b. Aggressive Simulation: Up to 40 percent with improved toilet in cluster for all clusters below 40 percent and 30 percent increase for all others, not to exceed 1;

The results of these simulations are shown in figure 6.18. As the graph shows, the change in stunting as a result of simulating improvements in community sanitation is entirely driven by the improvement in girls' nutritional outcomes. Second, the impact on nutritional outcomes is considerably greater for girls than for boys (provided that the improvement in the percent of improved toilets is substantial). Third, with an aggressive improvement in community sanitation, the impact is very large—more than 8 percentage points for girls and more than 3 for boys, leading to an aggregate impact of more than 5 percentage points. On the other hand, it is interesting to note that for boys, the size of the simulation (whether moderate or aggressive) makes no difference to the reduction in stunting.

Other simulations were carried out to vary the value of the wealth index (for individual households), the district level poverty, difficulty of transportation, aridity, population density, and food security in the household to provide valuable insights on the effectiveness of interventions for appropriate and cost effective policy choice.

Figure 6.18: Sub-Samples by Gender: Changes in Stunting as a Result of Modest and Aggressive Simulations for Boys and Girls on Community Improved Sanitation Coverage (Percent)



Source: DHS 2016.

Conclusions and Lessons Learned from WASH-Health Linkages

The primary focus of the analysis in this chapter is to highlight the linkages between WASH and health outcomes. In particular, various approaches were used to delineate the role of WASH in affecting stunting outcomes, which is a critical challenge that Tanzania is facing. Though Tanzania has achieved moderate reductions in stunting since 1995, there is still work to be done given that 35 percent of children under five are still stunted. Boys are more commonly stunted than girls. While poverty exacerbates stunting, even within the T60 of the wealth distribution, national stunting rates are still at 20 percent, indicating that nutritional problems are not caused just by lack of income. Geospatial mapping has further drawn our attention to overlaps between stunting and sanitation deficits, thus highlighting the 'hotspots' where immediate attention needs to be focused.

Compared to other factors, adequate WASH has the greatest impact on malnutrition in combination with adequate food. As the empirical application of the UNICEF multi-sector nutritional framework shows, children with inadequate WASH and food show the greatest negative deviation from the overall HAZ scores of the target population. Nonetheless, the analysis also shows that children need to have adequacies in all four dimensions to drive their nutrition and growth.

The analysis of stunting using regressions and Shapley decomposition shows the importance of community sanitation to stunting reductions, particularly for children aged 7–24 months. This is when most stunting occurs. It also shows the importance of hygiene factors- particularly handwashing- of the caregiver in early life (the first six months), which takes precedence over improved water and sanitation access. Nonetheless, between improved water, sanitation, and hygiene at household and community level, the lack of improved community sanitation appears to be the main contributor to stunting among the WASH variables.

Multivariate Adaptive Regression Spline (MARS) analysis has brought our attention to important variables affecting stunting in Tanzania, including difficulty of transport, population density, and the mother's BMI. Beyond this, it has also brought our attention to threshold effects at which key variables, often in interaction with others, have a greater impact on stunting than others. In the same way, the simulations demonstrate how small changes in these key variables can lead to considerable reductions in stunting rates, thus providing important guidance to policy.

Notes

1. https://data.worldbank.org/data-catalog/world-development-indicators.
2. Calculations of improved water are taken from Water Point Mapping data provided by Tanzania's Ministry of Water and Irrigation (MOWI). Calculations of improved sanitation are taken from the Rural Water Survey (RWS) carried out under World Bank supervision in 2014. In both cases, the data were taken at cluster level and a geostatistical mapping technique was used to predict access rates down to the pixel level. For more information on the methodology, see Gething (2017), produced for the TWPD.
3. The measure is based on the child's caregivers' (1) knowledge, practices, and beliefs regarding childcare, (2) health and nutritional status, (3) mental health, stress level, and self-confidence, (4) autonomy and control of resources, (5) workload and time constraints, and (6) social support received from family and community.
4. This estimate of FW´s differential impacts is unfortunately base don a very small simple as less tan 0.5% of children fall into this category due to the lack of children with suffficient adequacies in Tanzania.
5. Appendix 6.5 provides the detailed tables.
6. The analysis was conducted on DHS data from 2016. There are fewer food variables available, which could explain their relative lack of importance in the analysis.
7. In the first stage, MARS constructs an overly large model by adding basis functions, the formal mechanism by which variable intervals are defined. Basis functions represent either single variable transformations or multivariable interaction terms. As basis functions are added, the model becomes more flexible and complex and the process continues until a use-specified maximum number of basis functions has been reached. In the second stage, basis functions are deleted in order of least contribution to the model until an optimal model is found. For further explanation, see http://media.salford-systems.com/pdf/spm7/IntroMARS.pdf.

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Chapter 7
Binding Constraints in WASH Service Delivery—Understanding the Political Economy and Institutional Ecosystem

Water and sanitation service delivery in Tanzania is shaped by the political and institutional ecosystem that has evolved during its first years of independence, perpetuating and sometimes transforming the legacies of the former political system.[1] During the immediate years post independence, when the country has experienced high aid intensity, donors have influenced the shaping of legal and policy framework underlying the service delivery arrangements. This has sometimes led to the emergence of institutions that are considerably misaligned in *de jure* and *de facto* roles and functions, leading to significant service delivery failures. For Tanzania to make major strides in WASH service delivery, it has to address these institutional constraints, which are deeply embedded in WSS institutions.

KEY POINTS

Despite considerable efforts at decentralization, Tanzania retains key institutional features of a deconcentrated administrative set-up. Though the Local Government Authorities (LGAs) are mandated with the delivery of basic services, Improper and unclear assignment of functions, limited financial autonomy and human resources, and capacity constraints in implementation impede efficient service delivery by LGAs.

In the water sector, the country has a well-developed set of policy guidelines but in the sanitation sector it has neither a national policy nor a designated nodal institution to provide leadership. The sanitation sector needs new institutional and policy arrangements to clarify and coordinate the roles and responsibilities of different actors.

Administrative Structure and Decentralization

Political Environment and Administrative Structure

Tanzania is a unitary state with multiparty parliamentary democracy.[2] Since the country gained independence in 1961, the political party Chama Cha Mapinduzi (CCM) has been in power.[3] The CCM's long-standing position of authority stems also from the popularity of its main historic leader, Julius Nyerere, whose socialist policies fostered a strong sense of national identity following independence and during the 1964 unification of Tanganyika and Zanzibar. The centralised nature of government and blurred distinctions between party and state came to colour how business is conducted in Tanzania, including in the water and sanitation sector. For instance, water has long been a highly politicised public good which government has sought to prioritize and champion. "Provision of free water to all" was a political slogan in the pre-independence period, and the government followed through on it in the years after independence.

Tanzania's administrative structure is organized hierarchically combining elements of deconcentration and devolution (box 7.1). The mainland is divided into 26 administrative regions which are deconcentrated administrative units of the national government, headed by a regional administrative secretary appointed by the national government. The main level of the local government system is formed

In rural areas, systemic incentives favor construction of new water points, rather than maintenance and repair. Large numbers of water points fail in their first year of operation. Though LGAs are expected to oversee major repairs, those jobs are not properly defined, which in effect makes the COWSOs responsible for them.

Though in rural areas WASH challenges are substantial, the LGAs have been unable to mobilize sufficient resources due to delays budget disbursement processes. The budget allocation for sanitation have not been properly utilized at all due to the delays in the transfer of funds. In 2015-16, LGAs spent only 51 percent of the total allocation to Rural Water and Sanitation.

by elected Local Government Authorities (LGAs), comprising 133 District Authorities and 39 Urban Authorities. Urban authorities include Town Councils, Municipal Councils, and City Councils.[4] For administrative purposes, Urban Authorities are subdivided into *mitaa* (neighbourhoods or streets), whereas rural district councils are subdivided into villages and *vitongoji* (hamlets). Each district (LGA) is governed by a council consisting of councillors elected from each of the district's 20 to 40 wards. The LGA is led administratively by a district executive director (DED) who is appointed by the President's Office-Regional Administration and Local Government (PO-RALG) but reports to the local council.[5]

Box 7.1: Decentralization in Tanzania

Since the early 1990s, international donor agencies have been actively supporting decentralization in the developing world, as part of their broader policy of promoting "good governance and accountability." As a "donor darling," Tanzania has been an early adopter of "decentralization through devolution," promulgating policies as well as legal and institutional changes in the 1990s and early 2000s to facilitate the transition process.

Beginning in the late 1990s, the country's deconcentrated regional administrations were significantly reduced as part of this effort, and staff and resources were transferred to local governments at district and municipal levels. In 2000, a Local Government Reform Program (LGRP) was established to reform the legal framework and the local government finance and human resource management systems, and to enhance local participation. In 2004, significant progress was made in fiscal decentralization, as various sectors began employing formula-based grants as a means of transferring recurrent funds to local governments for the implementation of local government services (Tidemand and Msami 2010). In parallel, a Local Government Capital Development Grant System (LGCDG) was established to allocate discretionary development grants to local government authorities (LGAs), conditional on their fulfilment of basic minimum conditions regarding the quality of their development plans, financial management, and procurement systems and the degree of local transparency.

In the wake of these reforms, Tanzania's 175 LGAs have been responsible for more than 25 percent of public spending. They assumed responsibility for day-to-day delivery of many basic public services, including education, health, water, roads, and agriculture. In keeping with the principles of devolution, LGAs are corporate bodies with their own political leadership (the district council). LGAs have a degree of control over their own budgets and capital infrastructure investments within their functional responsibilities.

However, several shortcomings persist in the de facto implementation of decentralization in Tanzania. There exists a considerable gap between the de jure and the de facto assignment of functions and expenditure responsibilities of local governments, due primarily to fragmentation in the legal framework and inadequate implementation of the subsidiarity principle. Though in principle LGAs have autonomy

box continues next page

Box 7.1: Continued

over their financial plans, their budgets are scrutinized and often radically changed by the President's Office-Regional Administration and Local Government (PO-RALG) or the Finance Ministry during the annual budget process. The central government's influence also results from the local governments' heavy reliance on the central government for resources—typically 90 percent of their budgets were financed through the Central Government allocations, Also, infrastructure investment decisions are based on extensive guidance by the respective sector departments, affecting the autonomy of decisions. Furthermore, although LGAs are the statutory employer of local government staff, the management of this staff, as well as teachers and local health workers, is highly centralized. Although a performance-based, formula-driven Local Government Development Grant (LGDG) system was introduced in 2004, which in theory allows LGAs a meaningful degree of discretion on the development side of their budgets, this system no longer functions effectively. LGDG grants are not consistently and predictably funded, and there is no participatory process to identify local infrastructure priorities.

Policy and Institutional Environment Governing WASH Service Delivery

Policies and Strategies Guiding the WASH Sector

The evolution of water policies in Tanzania (box 7.2) reflect the slow transition from centralized and free provision by the state to a more decentralized demand-responsive approach emphasizing cost recovery and at the same time stressing a pro-poor objective. The first National Water Policy, adopted in 1991, established user charges and urban water utilities based on cost-recovery principles. The second National Water Policy (NAWAPO), adopted in 2002, has been the basis for the twenty year Water Sector Development Program (WSDP) that began in 2005 and is now into its second phase. The WSDP is based on a SWap (Sector Wide Approach) which envisaged a joint Government-development partner (DP) dialogue and a joint financing mechanism that includes a basket fund and an additional 'earmarked' funding allocated by a number of DPs outside of the basket to support special projects in selected subprojects. Phase I of the WSDP (2006- 2014) was evidently one of the largest water programs in Africa with a total commitment of about 1.357 billion with largest funding coming from the Government of Tanzania followed by the World Bank. Of the total disbursements of USD 1.414 billion by 2014 during when the first phase ended, the Government of Tanzania contributed about 28 percent and the World Bank contributed about 18 percent. The program was conceived with the objectives of bringing about improvement to water resources governance and management, increasing WSS service levels, as well as undertaking measures to develop sector capacity.

In NAWAPO, provisions for greater cost recovery were strengthened as well as the pro-poor outlook. For rural water, NAWAPO includes the definition of the roles and responsibilities of various stakeholders within the sector; an emphasis on community payment of capital costs and full cost recovery of operations and maintenance as opposed to a previous cost-sharing arrangement; a move towards demand-responsiveness in service provision; a more decentralized management of water supply at the lowest appropriate level; and promotion of private sector participation in service delivery. For urban water, it emphasizes efficient and

Box 7.2: Key Sector Policies and Acts Since 1991

1991 First National Water Policy introduces user charges and begins a decentralization process.

1997 Waterworks Act No. 8 enables the creation of Urban Water and Sewerage Authorities (UWSAs).

2001 Energy and Water Utilities Regulatory Act (EWURA) creates the national regulator.

2002 National Water Policy (NAWAPO) is adopted, setting out the vision for the sector through to 2022.

2003 Dar es Salaam water supply is leased to private sector company City Water Services (CWS).

2005 Dar es Salaam water supply is renationalized and DAWASCO is created.

2005 National Water Sector Development Strategy (NWSDS) is developed to strengthen legal and institutional frameworks for NAWAPO implementation.

2006 Water Sector Development Program (WSDP)—US$951 million over five years—begins.

2007 National Health Policy provides direction for sanitation and hygiene provision in the country.

2009 Water Supply and Sanitation Act makes LGAs responsible for "meeting part of the costs incurred by community owned water supply organizations in the major rehabilitation and expansions of water schemes and payment for costs of service rendered" and establishes District and Township Water Supply and Sanitation Authorities (WSSAs).

2009 Water Resources Management Act is passed, allowing the transformation of customary rights into statutory rights and empowering the Ministry of Water and Irrigation to limit groundwater abstraction to volumes that would not harm the quantity and quality of the water or the environment above.

2012 The National Sanitation Campaign (NSC) is launched to promote the use of improved latrines.

2014 Water Sector Development Program (WSDP) Phase II begins.

sustainable delivery; the creation of an enabling environment and incentives for reliable, sustainable, and affordable urban services; the development of an effective institutional framework to ensure financial autonomy; and efficient and effective income generation from sale of water and management of wastewater to enhance demand management in water and wastewater disposal.

However, sanitation policy and its legal framework remain weak though they have been partially integrated into the 2002 NAWAPO and are also a component of the National Health Policy of 2007.

Several ambiguities in the respective roles and responsibilities persist, particularly on the responsibility for operational costs of household sanitation. The Water Sector Development Program II Project Implementation Manual (PIM) assigns the communities to establish budget items to cover O&M costs for WASH in schools and health facilities (WSDP II PIM).

Institutional Framework Underlying WASH Service Delivery

Under the Local Government Acts, the functional responsibility for providing water and sanitation services lies with the local governments. However, the water sector—through its sector policies and strategies—has introduced additional water service delivery organizations that are supposed to provide water and sanitation services at the grassroots level in coordination with local governments (figure 7.1). In urban areas, the Energy and Water Utilities Regulatory Act (2001) provided for local Water Supply and Sanitation Authorities (WSSAs), which are corporate bodies established by and reporting to the Ministry of Water and Irrigation. In rural areas, the National Water Sector Development Strategy (2006) established Community Owned Water Supply Organisations (COWSOs) as bodies legally constituted by a community to own, manage, operate, and maintain water supply systems on behalf of the community.

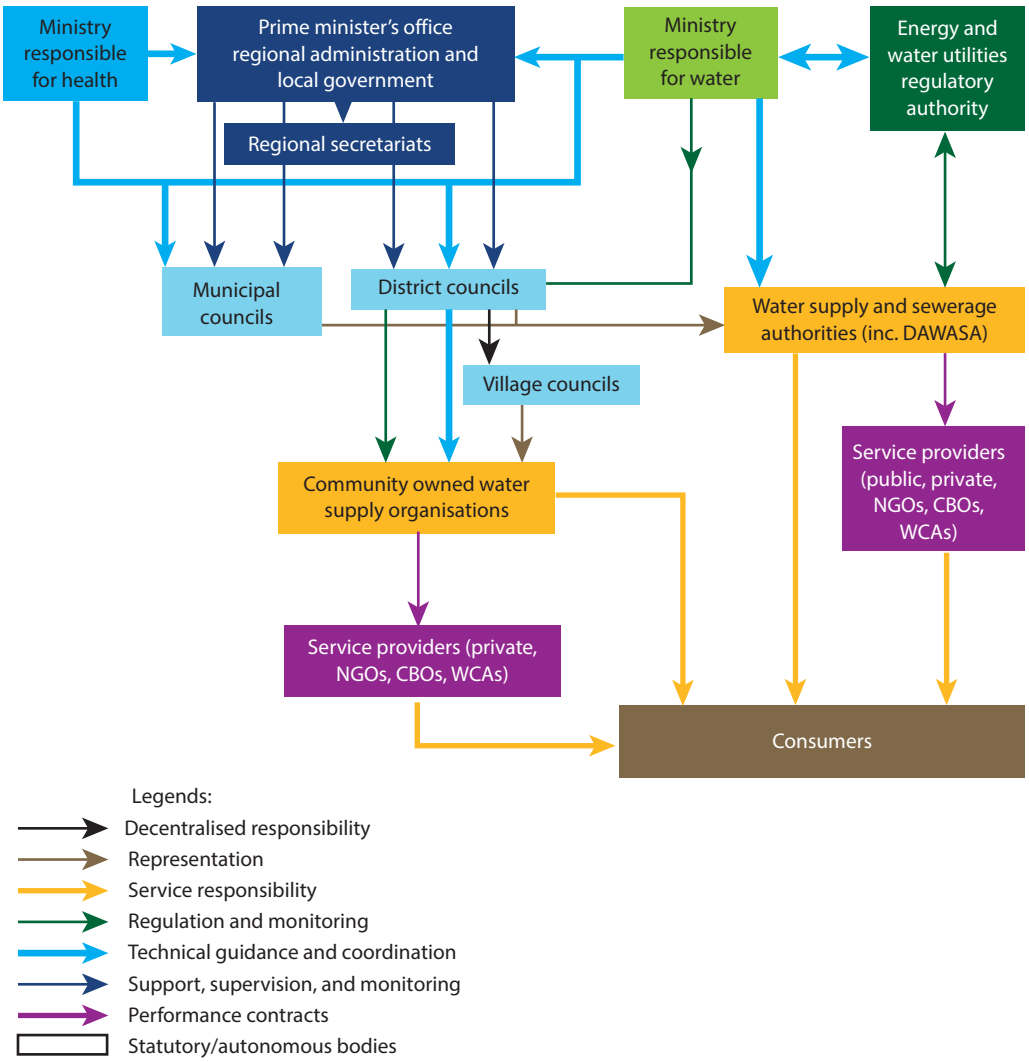
Institutional Structure of Water and Sanitation Provision at the National Level

Because of the decentralized nature of WASH provision under the LGA Acts and Water Supply and Sanitation Act of 2009, the Ministry of Water and Irrigation is not responsible for direct implementation of service delivery. It instead focuses on policy formulation, coordination, monitoring, and regulation, including approving tariffs chargeable for the provision of water supply. In addition, the ministry plays an important indirect role in the development of local water and sanitation infrastructure by coordinating and providing technical and financial support for construction of water supply and sanitation schemes and expansion or rehabilitation of existing schemes of national importance, and by securing capital finance for schemes of national importance

Subject to the approval by the Ministry of Water and Irrigation, the National Environmental Standards Committee, which is part of the Tanzania Bureau of Standards, is responsible for prescribing classifications and criteria and procedures for measuring standards for water quality, as well as for establishing minimum quality standards for different uses of water.

As the agency responsible for the oversight and coordination of local government, President's Office-Regional Administration and Local Government (PO-RALG) plays an important role in decentralized water and sanitation services. According to the Water and Sanitation Act, PO-RALG is responsible for coordinating planning and resource mobilization for water supply and sanitation authorities and for community owned water supply organizations through local government budgets, external support agencies, NGOs, and the public sector. It has the power to alter the budgets prepared by LGAs (Venugopal and Yilmaz 2010).

Figure 7.1: WASH Institutions in Tanzania and their Interaction



Source: The United Republic of Tanzania Ministry of Water and Irrigation "National Water Sector Development Strategy 2006 to 2015" https://www.maji.go.tz/sites/default/files/u12/natinalwaterstrategy1.pdf

When it comes to sanitation, each LGA is responsible for services in consultation with the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC), but a nodal organizational structure for implementing sanitation programs is absent.

Institutional Structure of Water and Sanitation Provision in Urban Areas

In Dar es Salaam and two peri-urban districts of the adjoining Pwani Region, responsibility for water supply and sanitation is split between an asset holding company that is responsible for capital investments (the Dar es Salaam Water and Sewerage Authority—DAWASA) and an operating company that runs the water and sewer system on a day-to-day basis and bills the customers (the Dar es Salaam Water and Sewerage Corporation—DAWASCO). In other cities, operation, maintenance, and development of water and sewerage infrastructure is carried out by Urban Water Supply and Sanitation Authorities (UWSSAs). UWSSAs have been established in 23 major cities

in accordance with the Waterworks Act No. 8 of 1997.[6] In addition, the Water Supply and Sanitation Act of 2009 established District and Township Water Supply and Sanitation Authorities (DT WSSAs). There are currently 83 DT WSSAs serving about three million people. These include 69 utilities operating in district headquarters and 14 utilities in townships (EWURA 2016b).

WSSAs are autonomous legal entities that are meant to operate based on commercial principles. They are corporate bodies that are accountable to, and monitored by, the Ministry of Water and Irrigation. Urban water utilities are not responsible for on-site sanitation (i.e., non-sewered sanitation), which remains in the hands of relevant local councils.

Institutional Structure of Water and Sanitation Provision in Rural Areas

Under the Local Government (District Authorities) Act, local governments (LGAs) are responsible for water and sanitation provision in rural areas. As of 2006, the National Water Sector Development Strategy directed that responsibilities for operations and maintenance of rural water schemes be transferred to COWSOs, which are supposed to be established for each rural water scheme. COWSOs replaced village water committees (VWCs) as the main authority responsible for the community management of water. Unlike COWSOs, VWCs were not independent of village governments and lacked clear mandates, which in turn made them open to political interference and a greater probability of corruption (Gin´e Garriga 2007). Such experiences motivated the shift to independent legal entities (i.e., COWSOs) as the preferred management body (Tilley 2013).

LGAs are supposed to provide technical support to COWSOs, and fund major repairs and rehabilitation when community-generated COWSO funds are insufficient. It is important to note that as of September 2016, the 1,089 COWSOs in existence covered only about 10 percent of all the villages in the country.[7] The situation in villages where COWSOs have yet to be registered is somewhat unclear, though anecdotal evidence suggests that water is being managed in a similar fashion by appointed Water User Committees (WUCs).

Rural sanitation services are limited. LGAs are responsible for promotion, planning, and skills development for sanitation and hygiene within their jurisdictions. However, the initiative for on-site sanitation as well as the funding for on-site infrastructure is to be provided by the households themselves (NRWSS 2015).

Binding Constraints in WASH Service Delivery in Tanzania

As described in the previous section, the institutional arrangements for water and sanitation provision in Tanzania underwent considerable changes during the decentralization period. However, despite policy and legal changes and a significant amount of devolution of responsibilities, local governments have limited capacity—human, technical, and financial—to deliver on these responsibilities. Some of key challenges facing the WASH service delivery are outlined below.

Misalignment of Functions and Unclear Roles and Responsibilities

The organizational structure of water and sanitation services is hampered by several overlapping functions and responsibilities, particularly in comparing *de jure* and *de facto* functions. There is also tension between sector legislation and broader local government

(decentralization) legislation, in terms of the roles and responsibilities of local government authorities vis-à-vis water and sanitation service providers. Water users can find it difficult to determine who bears responsibility for ensuring provision of water and sanitation. This is particularly true in rural areas where users bear the primary responsibility for operations and maintenance through COWSOs, which are independent bodies over which LGAs have limited authority. Further, while the legal status of most stakeholders is clear, it is less obvious how things are organized in the many rural areas where COWSOs have yet to be registered. Though responsible for WASH service delivery in their respective jurisdictions, urban LGAs also have inadequate control over the administration and delivery of water and sanitation services. Given their independent, autonomous status, WSSAs have considerable control over their own operations.

Furthermore, lack of clarity in responsibilities places burden on the maintenance of rural water supply infrastructure. For instance, the Water Supply and Sanitation Act No. 12 stipulates that local government authorities are responsible for "meeting part of the costs incurred by community owned water supply organizations in the major rehabilitation and expansions of water schemes and payment for costs of service rendered" (United Republic of Tanzania 2009; Sec. 39,b). The Act does not, however, define "major" rehabilitation or make clear how it is distinct from minor repairs, leaving it up to districts to interpret the division of responsibilities.

The responsibilities for overseeing sanitation in Tanzania are even more fragmented than with water. Responsibility for oversight is divided across water, environment, health, education, and local government ministries. Service provision is delegated to a variety of para-statal organizations, the private sector, NGOs, and Community-Based Organizations—without a clear policy direction.

Overlapping Jurisdictions and Duplication of Effort

A related concern on the sector's organizational structure is the duplication of effort between LGAs and WSSAs in fields of service delivery. In urban areas, WSSAs provide networked water services, but LGAs are responsible for non-networked services. To the extent that there is at best a weak link between the LGA and the WSSA, it is unlikely that this arrangement exploits economies of scale. Likewise, the parallel mechanisms in rural LGAs—with some areas served by COWSOs, some by DUWSSAs or TUWSSAs, and other areas being the direct responsibility of the LGA—are unlikely to capture scale economies.

Limited Control of Local Officials

LGAs are also significantly constrained in administration of local employees. In urban areas, local governments have very little local control over the technical staff in the WASAs, given that the boards of WSSAs are centrally appointed and regulated. Similarly, LGAs in rural areas have little effective personnel control, given that they lack hiring and firing authority over the District Water Engineer and other technical staff. Furthermore, staff salaries are almost entirely paid by central government transfers, and decisions on staff budgets and staff numbers are made by the President's Office for Public Service Management (PO-PSM), a central government ministry. Finally, district pay scales are centralized. Although LGAs are in theory allowed to establish local incentive schemes, in practice few can afford to do so (Tidemand and Msami 2010).

Fiscal Autonomy and Financial Management and Planning

The lack of local fiscal autonomy and the weak local financial management constrain provision of effective water and sanitation services at the local level. LGAs have very little control over their budgets, given the high proportion of fixed costs and own-source revenue that covers only

a little over 10 percent of recurrent expenditure at the LGA level. Hence, they rely heavily on the central government for most their revenues, which serves to promote upward accountability, ultimately increasing the power and authority of the central state.

In principle, the annual budget process in Tanzania follows a participatory process aggregating the requirements from the LGAs and adjusting it based on the overall sector budget envelopes. However, district plans frequently do not reflect local development needs. At almost every level of government, centrally appointed officials have considerable decision-making power, which they can use to undermine their elected counterparts (Venugopal and Yilmaz 2010). Considerable delays occur in the disbursement of funds, particularly development funds, to the LGAs from the Ministry of Finance. As a result, the projects that are ultimately implemented often differ from those that communities originally proposed (HakiElimu and Policy Forum 2008).

Budget allocations tend to be more for construction and less for maintenance and repair of infrastructure, thus posing challenges to their long-term sustainability. Concerning LGA finances, budget allocations for maintenance activities have consistently been very low. The water sector budget is dominated by development funds, which accounted for 92 percent of the budget in FY 2013/14 (Water Sector RBA 2013-14). Moreover, in FY 2012/13, development expenditure accounted for 80 per cent of the total sector spending. That year, just under half of the central government development spending was budgeted for maintenance and rehabilitation of infrastructure and equipment.

COWSO members are most often not remunerated, since their pay must come from COWSO fee collections, which are generally insufficient for cost recovery. Low or non-existent stipends can reduce the motivation of those involved in managing water supply schemes (Fonseca et al. 2016). In addition, COWSOs tend to have limited capacity for financial administration, operations management, and business planning—again reflecting that they are largely made up of volunteers from rural communities (Nathan Associates Inc. 2016).

There are challenges with respect to the willingness and ability of water users to pay the agreed water charges, particularly in rural areas. These challenges are particularly relevant for diesel-pumped schemes because fuel costs inevitably rise. However, similar issues of user payment exist for gravity piped schemes whose intakes, reservoirs, and pipelines age and need upgrades, and for hand-pumped schemes which have limited technical support and weak supply chains for spare parts (Oxford Policy Management 2013). Rampant poverty and seasonality of earnings as well as political promises discouraging water payment affect the willingness and ability of users to pay.

Finally, in the absence of financial autonomy, local organizations have difficulty maintaining long-term plans. Since funds from the central government often arrive late and tend to be less than the amounts for which LGAs have budgeted, LGAs can only plan for a short-term horizon on an ad hoc basis. Moreover, central government directives—issued outside of the national budget process—have sometimes forced LGAs to reallocate funds away from their planned-for priorities.

Regulatory Deficiencies

In Tanzania, though regulatory responsibilities in the urban and rural sectors are in principle specified, implementation of such regulations is absent in practical terms, particularly in rural areas. Under the 2001 Energy and Water Utilities Regulatory Authority Act, WSSAs are subject to regulation by the Energy and Water Utilities Regulatory Authority (EWURA). EWURA is also responsible for monitoring water quality and standards of performance for provision of water supply and sanitation services in urban areas as well as establishing guidelines and approving

tariffs chargeable for water supply and sanitation services. Despite the proliferation of informal water providers in urban areas, they are hardly regulated on the price and quality of their water. For on-site sanitation, private enterprises provide pit-emptying services and transport which tend to be unregulated. Private operators often dump waste into already over-worked oxidation ponds, which leads to untreated waste being released into the environment.

In rural areas, the Ministry of Water and Irrigation holds the responsibility for regulation of COWSOs, but this is delegated to LGAs (United Republic of Tanzania 2006), with less clear mandates on details. Further, it is not entirely clear who is responsible for regulating and inspecting private wells and boreholes and other private sources of water. In rural areas, regular water quality monitoring at the water point level is largely absent. Systematic regulation in the sanitation sector is absent in urban and rural areas alike.

Deficiencies in Monitoring and Evaluation Arrangements

Tanzania lacks a centralized, comprehensive monitoring system to track the provision and quality of water supply and sanitation services. This inhibits evaluation of the sector's progress towards the SDG goals. As noted earlier, in most rural areas non-functioning water points present a significant challenge and a need to beef up monitoring. However the Water Point Monitoring Systems currently in place is plagued with problems that render the available date less useful. The absence of an integrated information system that tracks spatial and intertemporal changes in water's supply (from both surface and ground) and demand (from various sectors that use water, such as agriculture, industry, and households) is a basic and serious limitation. Fixing it would furnish improved information for assessing the effectiveness of policy, and create a more credible system for leveraging more resources for the sector (Fisher 2005).

Issues in Financial Allocations and Utilization

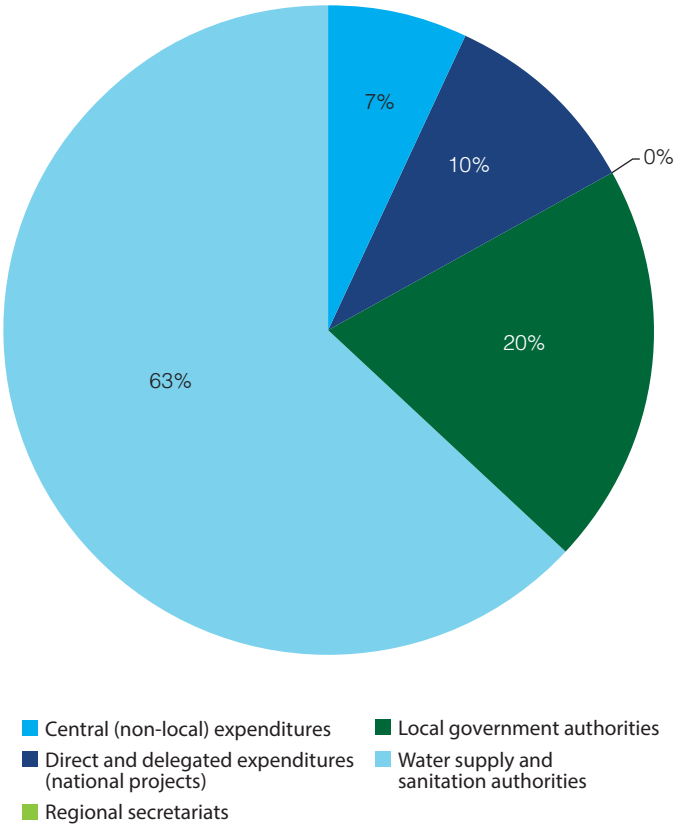
As indicated earlier, a development partners (DP) have been financing a major portion of the resources in the sector since the Water Sector Development Program.

In Tanzania, a clear majority of spending on water and sanitation services consists of devolved central government funds to LGAs and WSSAs, with very limited mobilization of their own revenue. Together, these two line items account for more than 80 percent of WASH spending. For instance, despite significant devolution of expenditures, the central sector ministry still incurred about 63 percent of all expenditures in the WSS sector in FY 2015/16, and the LGA share was only about 20 percent (figure 7.2).

All subsectors except urban water supply and sanitation suffer significant capacity constraints in absorbing allocated resources. As table 8.1 shows, while the amounts budgeted for rural water supply were considerably higher than those for urban water and sanitation, actual spending on urban WSS dwarfed the rural sub-sector nearly four-fold in FY 2015/16. Consequently, rural WSS had significant problems with budget execution, while urban WSS spent more than twice the budgeted amount. This exhibits not only an urban bias in implementation but highlights the expensive technologies that are used in urban areas. It is interesting too to note that in sanitation and hygiene not only was allocation low, but hardly any activities occurred in that subsector in FY 2015/16. That reflects neglect of the sanitation and hygiene sector.

In the rural sector, 80 percent of all expenditure in FY 15/16 went toward capital expenditure which financed construction of new water points and networked water schemes. This focus on new construction, without insufficient attention to operation and maintenance, is perhaps linked to the high incidence of water point failure in the country, as earlier chapters of this report demonstrated.

Figure 7.2: Vertical Expenditure for Water and Sanitation Services, FY 2016, in Billions of TZ Shillings

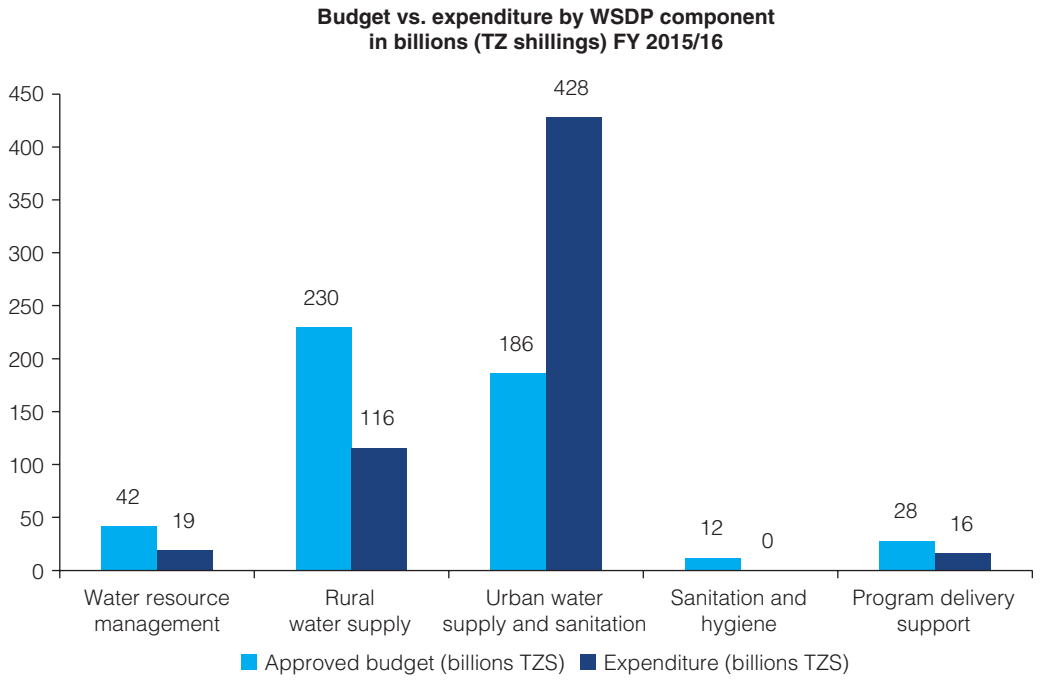


Source: MOWI MIS, accessed June 6, 2017.

Poor Enabling Environment for the Private Sector

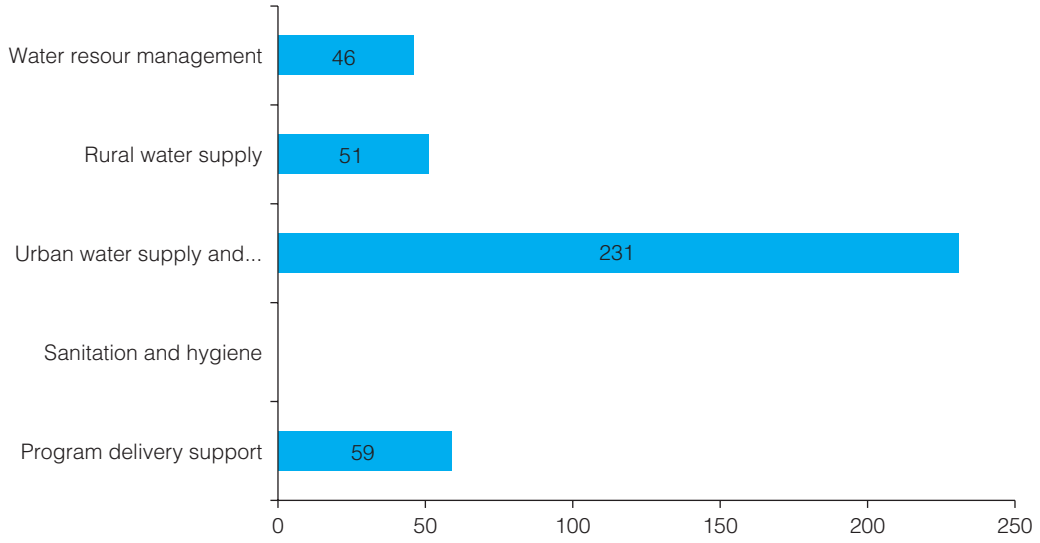
There is increasing need to involve the private sector in providing WASH services in Tanzania alongside the government. That will require an enabling environment. In Tanzania, potential benefits of private sector participation in the WSS sector include (1) mobilization of private resources to meet growing investments needs; (2) competition through entry of more investors; (3) increased innovation and efficiency; (4) lower prices; and (5) universal coverage. A large majority of toilets have been installed by private households, with their own funds, relying on a small-scale hardware market for the necessary goods and services, including a host of local masons and other technicians. Development partners including the World Bank Water and Sanitation Program have played a major role in creating an enabling environment for the private sector through sanitation marketing programs. There currently exists a small-scale service market (for example, sludge management in rural areas and semi-formal and informal water supply by private entities in low-income urban settlements). But this market lacks crucial regulation of service quality and tariff options that cater to the increasing needs of the sector. For example, in the large-scale urban utilities market in Dar es Salaam, private-sector participation in segments such as operation and maintenance, complaint redressal, and decentralized management of waste water needs further encouragement. In the rural water sector, given the high number of non-functioning water points, exploring private sector involvement for regular maintenance and repair on a large-scale may be warranted.

Figure 7.3: Budget vs. Expenditure by WSDP Component in Tanzanian Shillings 2015/16



Source: MOWI MIS, accessed June 6, 2017.

Figure 7.4: Budget vs.Expenditure by WSDP Component as a % of Approved Budget



Source: MOWI MIS, accessed June 6, 2017.

Limited Public Participation and Civic Engagement

Despite increasing per capita incomes and an expanding middle class in Tanzania, public involvement in demanding improved services and environmental quality is relatively low. It is the high preference for current consumption due to low-income levels as well as high marginal cost of regulation that could be credited for the low demand for improved water supply and sanitation provision with higher order quality dimensions. Though water is a politically salient issue to Tanzanian voters, they can find difficulty expressing concerns over service delivery in ways that generate responses from government officials. For one thing, information asymmetries make it hard for water users to know what they can reasonably demand from the state concerning better service. In general, users tend to be ill-informed about the decision-making processes at the district level. In addition, confusion over responsibility for "major" vs. "minor" repairs makes it difficult for citizens to know when they have the right to press LGA officials for improvements. Because citizens rarely bring pressure on this issue, there is limited incentive for the government or political establishment to improve service—such actions do not necessarily lead to electoral gains. As seen in several countries across the world, increasing awareness among citizens about the quality of services they receive can improve accountability. Moreover, the policy and legal infrastructure needs to provide space for vigilance and monitoring by citizens and community groups.

Gender roles create another constraint on the ability of water users to demand accountability. In most Tanzanian households, women and girls are primarily responsible for water collection. Their lack of empowerment under prevailing social norms makes it hard for them to make demands for improved WASH service (Carlitz 2017).

Improper assignment, mixed roles, warped accountability, and poor capacities thus combine to produce a policy and institutional setting that responds poorly to Tanzania's needs to scale up access—especially for the poor—to water systems that ensure quality, sanitation and safely managed excreta. There is merit then in re-visiting the roles and functions of the LGAs, WASAs, COWSOs, and other institutions in the sector to accord national priority to this challenge, and to set out a clear roadmap of actions to help these nascent institutions fulfil their functions effectively. The fact that in chapter 4 we see how improved sanitation coverage has increased for urban residents since 2005 is mainly as a result of the impetus of individual households in upgrading their facilities in the home. The role of institutions is still imperative in providing safe management beyond the household of fecal sludge and sewerage.

Conclusions on Constraints in Water and Sanitation Service Delivery in Tanzania.

This chapter has sought to map out the administrative structures under which Tanzania's water and sanitation sector operates, in both urban and rural areas, from central government, to regional authorities, to Local Government Authorities and finally in rural areas to the village committees as COWSOs or VWCs. It also seeks to describe the key policies, strategies and frameworks that have guided the WASH sector since the early 1990s and how these have attempted to bring about decentralization over time. It outlines how these decentralization efforts have at times been incomplete and that this in turn has created binding constraints in ensuring a smooth delivery of services. These binding constraints can come as a result of blurred role definition and overlapping jurisdiction. While in the water sector, a set of institutional roles and policies has been defined, there is limited control and accountability at local levels. Meanwhile in the sanitation sector, a clear nodal institution and national policy are lacking, that would provide clearer direction for ensuring greater progress. Regulatory deficiencies and limitations on fiscal autonomy are also highlighted as constraints to ensure downward accountability and smooth financial flows between tiers of government.

More could be done to ensure greater public participation and civic engagement. Finally, more could be done to foster an enabling environment for the private sector to fill gaps in service delivery where community-based models of service delivery in rural areas are underperforming.

Notes

1. This chapter draws heavily on Carlitz and Boex (2017).
2. Multi-party democracy was legalized in 1992.
3. Tanzania is one of only four African countries (the others are Botswana, Angola, and Mozambique) in which the same ruling coalition has held power since independence.
4. An anomaly in the local government structure is the Dar es Salaam City Council, which functions like a metropolitan council covering the same area as the five municipalities that make up Dar es Salaam region (the municipal councils Kinondoni, Kigamboni, Ilala,, Temeke, and Ubungo.
5. In addition, in parallel to the elected local government structure, each region and district has a Regional/District Commissioner appointed by the President, who plays an advisory, monitoring, and coordination role.
6. There are also eight National Project WSSAs operating in various areas in mainland Tanzania (EWURA 2016a). Furthermore, about 100 District Urban Water Supply and Sanitation Authorities (DUWSSAs) have been established in districts and small towns. Similar to UWSSAs, DUWSSAs are legally separate entities under the control of the Ministry of Water and Irrigation, rather than the LGA in whose jurisdiction they are located.
7. Although some COWSOs cover more than one village, the majority do not.

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Chapter 8
The Way Forward

The Tanzania WASH Poverty Diagnostic has framed the current status of water supply, sanitation, and hygiene deficits in the country in light of the new Sustainable Development Goals (SDGs). The SDG framework has enabled us to conduct analysis to understand how, where, and why water and sanitation services need to be improved in Tanzania, by subgroup and for the population as a whole. In the process we have gone from classifying "improved water" primarily based on the source and "improved sanitation" primarily on the type of facility to a broader and more realistic conceptualization that encompasses concepts of accessibility, quality, affordability, and reliability of service in water and safe disposal and treatment in sanitation. This diagnostic finds that accessibility considerations in rural areas can lower improved water coverage figures by more than 13 percentage points, with more than 65 percent of the population having to travel more than 30 minutes to and from their nearest improved water source. In urban areas, meanwhile, low reliability, affordability, and coverage of utility supply have resulted in a growth in informal provision and quality of water as a point of concern. A study by JMP over eleven developing countries found that Tanzania has the highest proportion of its population (one in ten people) devoting more than 5 percent of their household expenditures to water. Data from other studies also reveal concerns over water quality in major Tanzanian cities such as Dar es Salaam and Morogoro, where 35 percent and 52 percent of water samples, respectively, were found to have unacceptable levels of *E. coli* contamination (Rostapshova et al. 2015).

By drawing out poverty linkages and analyzing the data by B40 and T60 wealth distinctions, we are able to see more clearly than ever the inequalities in WASH along economic and geographical lines, in particular for sanitation. The TWPD has also demonstrated where and how inequalities exist along quintiles of wealth, as well as along urban-rural dividing lines. As the Human Opportunity Index (referenced in chapter 2) has shown, Tanzania is unusual in the extent of inequality in WSS access that the urban-rural divide explains. Fifty percent of access to improved water on premises and 40 percent of access to improved and unshared sanitation can be explained by rurality. We find that sanitation is even more unequal than water, with members of the B40 being ten times less likely to have improved and unshared sanitation than those in the T60 nationally. At the same time, mapping work has shown that unimproved sanitation is still the norm for the majority of the population. With less than 2 percent of people using an unshared toilet facility with a sewer connection, there is an urgent need to look at City Wide Inclusive Sanitation (CWIS) for urban areas and to re-assess sanitation promotion approaches in rural areas.

Above all, the scale of the sanitation challenge comes into focus around the health linkages analysis, in particular between sanitation and stunting. As we have noted, improved sanitation coverage is only 20 percent nationwide. The fact that open defecation is at little more than 10 percent shows how the major challenge both in rural communities and urban areas is to make the transition from unimproved to improved facilities with safe treatment and disposal. Open defecation seems to be concentrated in a few rural hotspots that overlap with pastoral communities. However, more data are needed to confirm this theory and gain a better understanding of the reasons behind persistence of open defecation in disproportionate numbers in Arusha and Manyara regions.

Nonetheless, the diagnostic has shown that unimproved sanitation seems to have higher linkages with stunting in Tanzania than does open defecation. Providing some very rich analysis

on the exact nature of the relationship, the diagnostic reveals that before age 21 months, handwashing and hygiene contribute more to variation in stunting than other WASH variables. However, between 21 and 60 months, when stunting rates increase, the importance of improved sanitation kicks in. Other factors not previously recognized as important to stunting were also revealed by the TWPD's analytical work. For example, difficulty of transport and population density were found to contribute more than expected to explaining stunting variation, using machine learning analysis techniques. Of course, WASH cannot be considered in isolation. It is in combination with other factors, such as adequate food, that adequate WASH will have the greatest impact on reducing under-nutrition. The mother's characteristics, such as her BMI and education, also show up as important, reinforcing existing research to this effect. In Tanzania, boys are consistently more stunted than girls. However, interestingly, the diagnostic finds that simulating improvements in community sanitation leads to much stronger reductions in stunting for girls than for boys—more than 8 percentage points for girls vs. 3 points for boys in the most aggressive simulations. This provides useful additional insights into the gender dimensions of WASH and stunting.

Tanzania faces several other health challenges for which WASH has strong implications. In the diagnostic we briefly touch on how poor WASH also affects cholera, malaria, HIV/AIDS sufferers, and child mortality. Moving forward, more analytics in this area will help to ensure further integration of WASH with SDG 3.

Poor conditions of service are partly symptomatic of sector bottlenecks and institutional constraints. The TWPD provides an overview of the WSS sector and policy context that has given rise to the current status and distribution of poor water and sanitation in the country. In terms of clearer definition of WSS policy, the sector's organization began to improve following the 2002 National Water Policy and its subsequent acts and strategy documents. Nonetheless, there is still much work to be done, in particular in sanitation, in setting up and consolidating institutional arrangements necessary to assure that future investments reach their full potential. Beyond the de jure set up, dialogue about the sector should give due attention to harder to pin down de facto political arrangements that color the history of the sector. At the policy level, recently created decentralized structures need reinforcement of their respective roles through proper communication and sector dialogue between national, local, and community actors. In programs and development practice, strategies in areas such as rural sanitation should learn from the constraints that held back progress in previous interventions in order to ensure more progress in future investments.

The purpose of the diagnostic is to make the link between knowledge and operations with a view to informing future policy. All of the analytical work presented serves little purpose if it remains locked away and uncommunicated to actors in the sector. Such actors include those inside the Bank and involved in operations in-country. But more broadly, the diagnostic should be used as an entry point for dialogue with the client in order to foster cooperation toward meaningful policy advancements in the sector. The GoT is making progress in addressing water and sanitation coverage in Tanzania, but it also faces daunting challenges ahead in the SDG environment. In addition to providing financial assistance, the Bank should heighten its impact through technical support whenever possible. It can do so by providing recommendations based on the most up-to-date analysis of existing sources and on knowledge of similar experience internationally.

Our seven key recommendations coming out of this diagnostic, and presented in the executive summary in detail, are:

1. Integrate the SDG framework into poverty-reduction strategies and WSS programmatic approaches such as Water Sector Development Program (WSDP) II.

2. In making further investment in rural water and sanitation, take stock of lessons learned on what brought past water point failure, and how to enhance sustainability in the future.

3. Address utility inefficiencies, the growth in dependence on informal private providers, and the need for expanded regulation.

4. More clearly define and assign responsibilities for sanitation, identify sanitation champions, and formulate a more coherent policy.

5. In urban areas, adopt City-Wide Sanitation Approaches that recognize that different solutions are suitable in different contexts.

6. Design WASH interventions with a "nutrition-sensitive" lens and seek to integrate WASH into multi sectoral strategies addressing education, health, and nutrition outcomes.

7. Facilitate efficient, transparent, and predictable financial flows between WSS actors—from donor, to government, to community—to promote sustainable governance.

None of the WASH challenges that Tanzania faces will be easily met. Nonetheless, through a combination of effective collaboration, cross-sector institutional dialogue, and use of the latest evidence to inform policy-making and practice, the country can make greater strides toward the Sustainable Development Goals and the better life for Tanzanians that will result.

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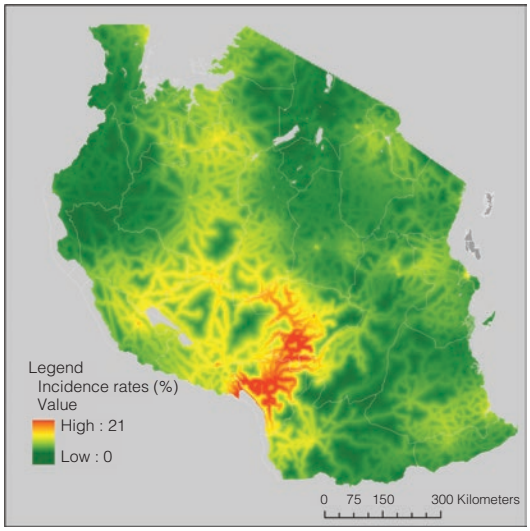
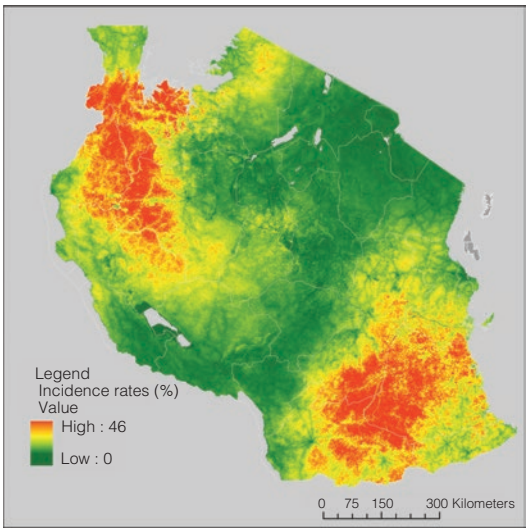
Appendix A
Maps Showing HIV, Malaria, Stunting Rates and Cross-Maps

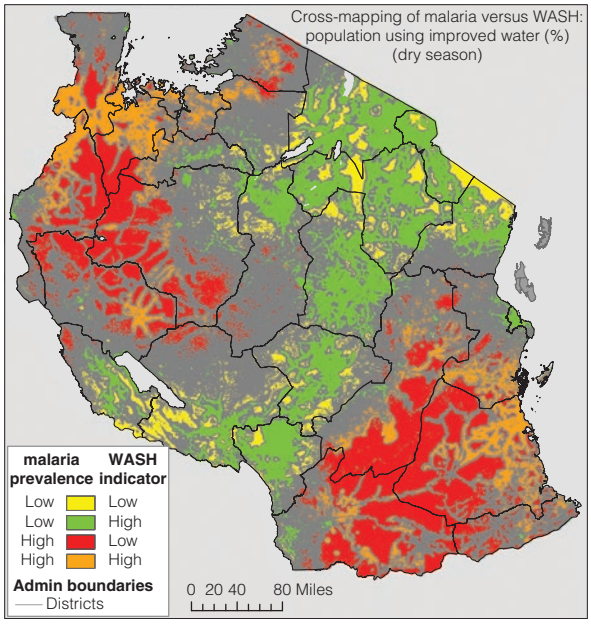
Map A.1: HIV Incidence Rates, DHS 2016 Data



Map A.2: Malaria Rate at 5*5km Pixel Level, DHS 2016 Data

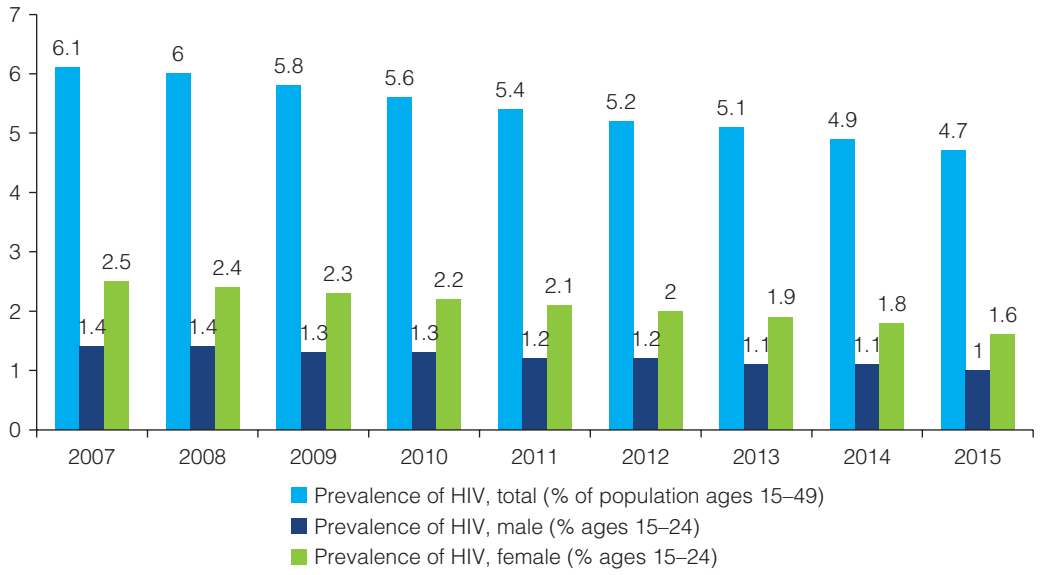


Map A.3: Malaria Cross-Mapped with Improved Water Access



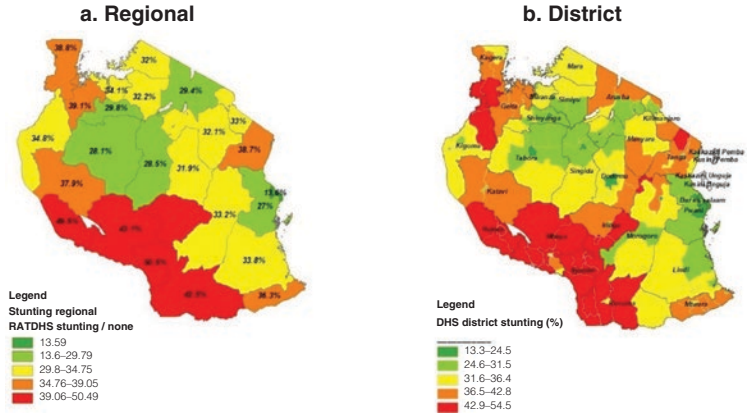
Appendix B
Figures on HIV Rates and Stunting Rates, by Age and Urban and Rural Subgroups

Figure B.1: Prevalence of HIV by Gender, Nationally in Tanzania 2007–15



Source: WDR accessed 2017

Map B.1: Stunting in Tanzania, by Region and District



Source: DHS 2016.

Figure B.2: Stunting in Tanzania, by Age Group, 2016

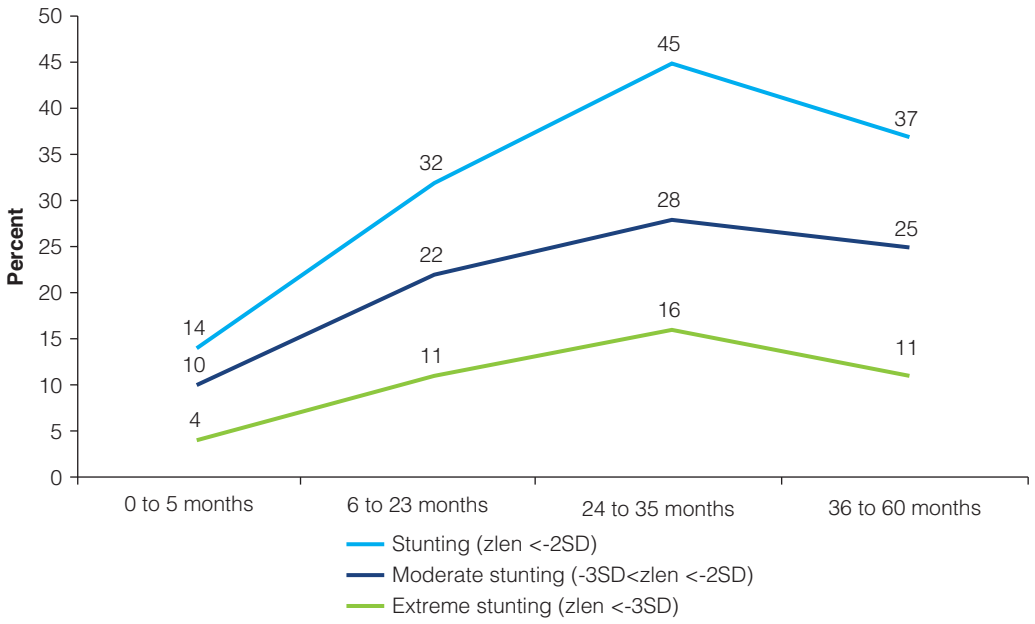
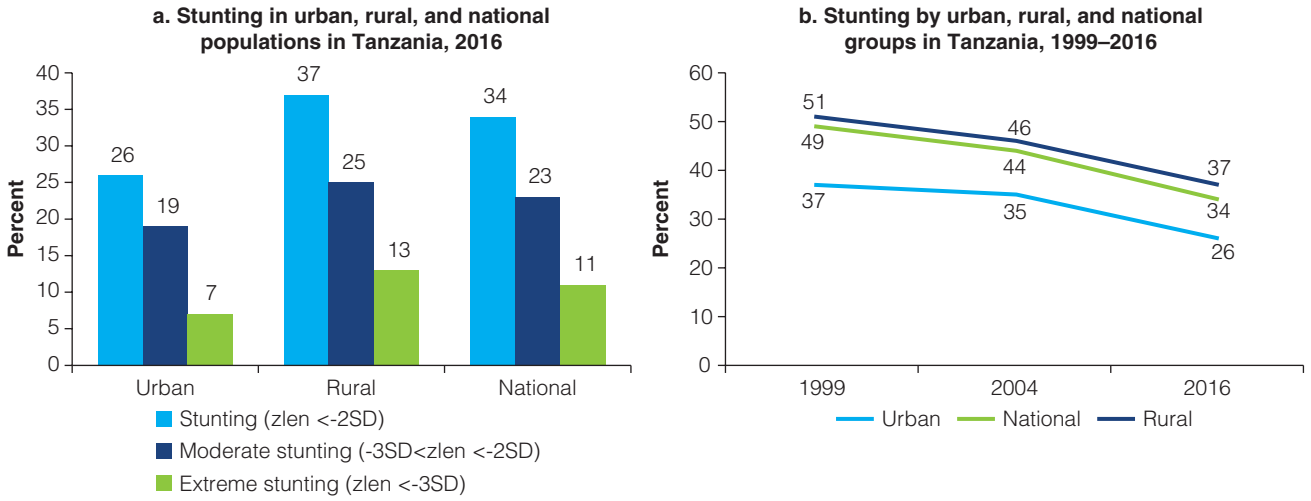


Figure B.3: Stunting by Urban and Rural Subgroupings



Source: DHS 1999–2016.

Appendix C
UNICEF Framework Results

Table C.1: Correlation of HAZ with Access to Adequacies, Exclusive Categories

	B40	T60	B80
Adequate Food	**0.511*** **	**0.345** **	**0.374*** **
	(0.152)	**(0.163)**	**(0.114)**
Adequate Care	0.095	−0.028	0.043
	(0.142)	(0.141)	(0.105)
Adequate WASH	0.007	0.591	0.547
	(0.165)	(0.360)	(0.547)
Adequate Health	0.115	**0.576*** **	**0.464*** **
	(0.243)	**(0.193)**	**(0.176)**
Adequate in Food and Care	**0.568** **	**0.491** **	**0.588*** **
	(0.226)	**(0.194)**	**(0.146)**
Adequate in Food and WASH	**2.613*** **	**2.592* **	**2.514*** **
	(0.083)	**(1.367)**	**(0.065)**
Adequate in Food and Health	**1.072*** **	0.369	**0.991*** **
	(0.344)	(0.294)	**(0.248)**
Adequate in Care and WASH	**2.031*** **	**0.726** **	**1.107** **
	(0.373)	**(0.333)**	**(0.482)**
Adequate in Care and Health	0.216	**0.308* **	0.249
	(0.242)	**(0.173)**	(0.168)
Adequate in WASH and Health	0.208	**1.296*** **	0.641
	(0.929)	**(0.396)**	(0.656)
Adequate in: Food, Care, and WASH	**0.907*** **	**0.956*** **	**1.025*** **
	(0.349)	**(0.224)**	**(0.285)**
Adequate in: Food, Care, and Health	**−0.400*** **	**0.549** **	**1.106*** **
	(0.148)	**(0.241)**	**(0.184)**
Adequate in: Care, WASH, and Health	−0.027	**1.157*** **	0.176
	(0.083)	**(0.323)**	(0.217)
Adequate in: Food, WASH, and Health		**0.723*** **	**1.255*** **
		(0.204)	**(0.407)**
Adequate in: All Four		0.154	**1.493*** **
		(0.577)	**(0.172)**
Constant	−1.733***	−1.489***	−1.634***
	(0.083)	(0.075)	(0.065)
Observations	1,029	1,554	2,162
R-squared	0.029	0.051	0.036

Source: Newman 2015.
Note: *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.1$.

Reference

Newman, J. 2015. *Important Factors Affecting Nutritional Outcomes in 2010 and 2015/16 in Tanzania*. Unpublished manuscript. World Bank, Washington DC.

Appendix D
Multivariate Adaptive Regression Splines

MARS combines machine learning with regression, through an algorithm that lets the data decide whether nonlinear effects, threshold effects, or interactive terms are needed to capture variation in the outcome of interest. From a methodological perspective, MARS offers more flexibility than a typical OLS regression. MARS is well suited to a situation where theory may suggest the type of variables that should be included in the analysis, but may not help on *how* those variables would likely affect the outcome of interest. The assumption of OLS estimation, that the variables would affect nutritional outcomes in a linear fashion, is quite restrictive, especially when considering that there is a very strong pattern of the height-for-age z-score with age and the possibility that threshold effects could be present with different variables. This greater flexibility allows MARS to explain more of the variation in height-for-age z scores than traditional OLS, with a higher R squared on regressions.

In this case, on comparison with other models, the R squared for the OLS regression of height-for-age z score is almost twice as high for the final MARS model (19 percent) as for the traditional OLS linear specification (10 percent). Similarly, the pseudo R squared for the Probit Analysis is almost twice as high for the MARS analysis (9 percent) as for the traditional specification (5 percent).

In short, this model allows for more flexible specifications of the relationships between the variables related to food, environmental health, care, and nutritional outcomes in three key ways:

First, it enables a more precise identification of the variables that seem to hold most importance for stunting by enabling the analyst to see *interactions* between variables. For example, a mother's BMI may affect the child's nutritional outcomes, but only if the mother's BMI is low enough to have caused problems in either the birth or subsequent breastfeeding. In this sense, MARS allows us to understand how combinations of different variables can be stronger determinants than any single variable on its own.

Second, it enables the identification of cut off points or *threshold effects* for independent variables to see where they start to have an effect on the outcome (stunting). For example, it enables us to discover the percentage of coverage of improved sanitation where we might start to see a significant impact on stunting.

Third, by using *simulations* of data from both 2010 and 2016 DHS surveys, we are able to explore the possibility of what "could have been" concerning the impact of individual variables on stunting by substituting in values either from one year to another, or by adjusting up or down around a threshold. For example, if we find that the threshold effect of a mother's education affecting stunting is at five years, we can simulate the addition of one year's education to all the mothers who have four years' education and see the percentage point reduction in stunting as a direct consequence of that alteration.

As we stated earlier, we are using MARS to help us answer three very specific questions:

1. What variables are most important in determining stunting, and in what combination?
2. At what point do each of these determinants become important and are there threshold effects?
3. By simulating changes in these determinants, how much of an impact on reducing stunting results?

Table D.1: Mars Analysis: List of Threshold and Interaction Effects Identified

Variable(s) combined with an impact on higher HAZ-score	Threshold effect identified	Sample age group
Mother's BMI	<14.73 → lower HAZ score	Children <6 months & all children
Higher Mother's education & lower poverty	>5 years of mother's education & <64.7% poverty → higher HAZ score	Children 22–60 months
Food security & mother's education	<5 years of education & food secure family → higher HAZ score	All children
Antenatal visits	More than 1 antenatal visit → higher HAZ score	Children <21 months
Unimproved toilet & high difficulty of transport	Unimproved toilet & high difficulty of transport → lower HAZ score	Children <21 & >21 months but higher for children <21
Mother's age at first pregnancy & mother's education	<28 years & <5 years education → lower HAZ score	
Cluster improved water & population density	>25% improved water →lower HAZ score & higher population density >1852.7	All children
Household improved toilet & girls	>36.8% improved toilet & female child → higher HAZ score	
Improved community sanitation	>11% improved sanitation in the community in 2015 → higher HAZ score	

Appendix E
Type 1 Simulations: Results of Simulations between 2010 and 2016

The graph below shows the results of simulations from individually substituting values from 2016 into the 2010 dataset and the impact that these substitutions have on overall stunting rates for combined samples of children below and above 21 months. The analysis found that changes in mother's education between 2010 and 2015 would have made the biggest single difference to reduce stunting rates by 0.7 percentage points. Changes in Mother's BMI, increases in percent of Household's with Improved Water and change in age distribution (probably due to reductions in fertility) are the next most important variables – around 0.4 to 0.6 percentage points each. Being food secure is important for women with lower education, and the overall effect on the entire distribution accounted for 0.3 percentage points. The effect on the families who are at risk of being food insecure is higher. Changes in the number of antenatal visits between the two years would have made a marginal, almost undetectable change to stunting rates – not because antenatal visits are not important, but because the change between the two years was small.

Combined, these changes would have reduced stunting by 2.9 percentage points between 2010 and 2015/16, when the total stunting reduction between these two years was about 7.6 percentage points. Thus, small changes of individual variables which occurred between 2010 and 2016 combined could have made a 38% reduction in the difference in stunting in the sample. Therefore, about 38 percent of the overall reduction in stunting between 2010 and 2016 can be explained by the changes that have occurred in the characteristics of the population between these two time points using this simulation.

Figure E.1: Simulation of Impacts of Replacement of 2010 Values with 2016 Values of Stunting for Selected Variables

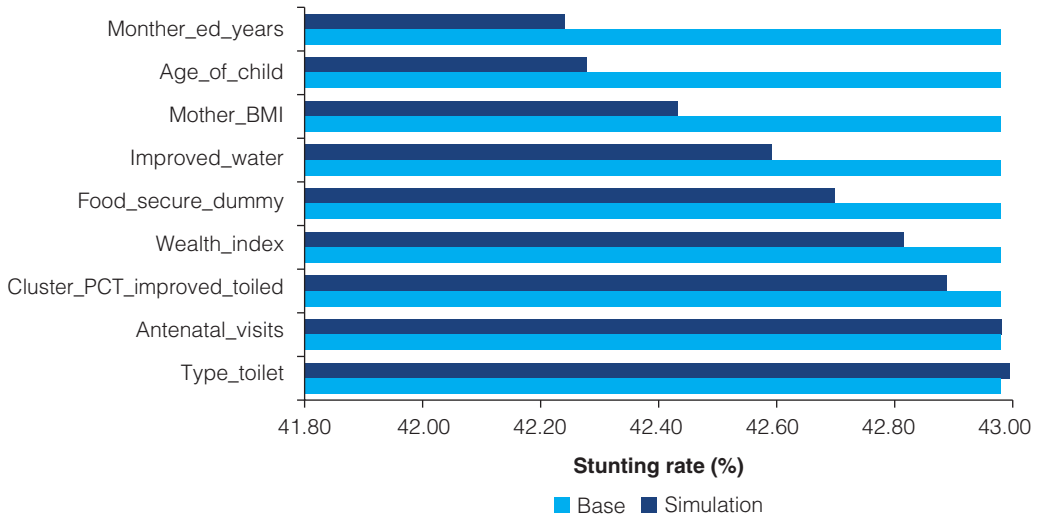


Table E.1 shows the full results from this analysis.

Table E.1: Mars Analysis: Simulated Values of 2010 Height-for-Age Z-Scores and Stunting Obtained by Substituting 2015/16 Values of Distribution of Covariates for 2010 Values

	Simulation: Replace 2010 values with values of 2015/16					
	One sample (all ages)			Two samples (aged le 21 and gt 21 months) Estimated and simulated separately, then aggregated		
	Base	Simulation	Difference (Simulation – Base)	Base	Simulation	Difference (Simulation – Base)
AGE_OF_CHILD						
HAZ	−172.47	−171.21	1.26	−172.56	−170.15	2.41
STUNT	0.4298	0.4267	−.0031	0.4298	0.4228	−0.007
MOTHER_BMI						
HAZ	−172.47	−170.72	1.75	−172.56	−170.86	1.7
STUNT	0.4298	0.4248	−0.005	0.4298	0.4243	−0.0055
MOTHER_ED_YEARS						
HAZ	−172.47	−168.83	3.64	−172.56	−170.62	1.94
STUNT	0.4298	0.4173	−0.0125	0.4298	0.4224	−0.0074
ANTENATAL_VISITS						
HAZ	−172.47	−172.50	−0.03	−172.56	−172.56	0
STUNT	0.4298	0.4299	0.0001	0.4298	0.4298	0
WEALTH_INDEX						
HAZ	−172.47	−172.68	−0.21	−172.56	−172.06	0.5
STUNT	0.4298	0.4306	0.0008	0.4298	0.4282	−0.0016
FOOD_SECURE_DUMMY						
HAZ	−172.47	−171.42	1.05	−172.56	−171.78	0.78
STUNT	0.4298	0.4265	−0.0033	0.4298	0.4270	−0.0028
CLUSTER_PCT_ IMPROVED_WATER						
HAZ	−172.47	−171.95	0.52	−172.56	N/A	N/A
STUNT	0.4298	0.4284	−0.0014	0.4298		
CLUSTER_PCT_ IMPROVED_TOILET						
HAZ	−172.47	−171.75	0.72	−172.56	−172.28	0.28
STUNT	0.4298	0.4270	−0.0028	0.4298	0.4289	−0.0009
IMPROVED_WATER						
HAZ	−172.47	−170.62	1.85	−172.56	−171.14	1.42
STUNT	0.4298	0.4230	−0.0068	0.4298	0.4259	−0.0039
TYPE_TOILET						
HAZ	−172.47	−172.61	−0.014	−172.56	−172.62	−0.06
STUNT	0.4298	0.4303	0.0005	0.4298	0.4299	0.0001
TOTAL CHANGE						
HAZ			10.54			9.03
STUNT			−0.0335			−0.0291

Appendix F
Type 2 Simulations: Simulated Variable Value Modifications within Years

This type of simulation was carried out on a variety of variables affecting household or community conditions identified to affect stunting. In this summary document we will focus on just the results for water and sanitation variables.

For both community water in 2010 and 2016, the modest and more aggressive simulations were as follows:

1. **The modest simulation** was to increase the community level improved water coverage to 50% coverage for those below, and up by 20% for all others.

2. **The more aggressive simulation** was to increase to 75% improved water coverage for all those with below that figure and a 20% increase for those above up to 100%.

For community sanitation in 2010 and 2016:

1. **The modest simulation** was to increase up to 20% with improved toilet in cluster for all clusters below 20% and 10% increase for all others, not to exceed 1;

2. **The more aggressive simulation** was to increase up to 40% with improved toilet in cluster for all clusters below 40% and 30% increase for all others, not to exceed 1;

Meanwhile for improved water and sanitation at household level the simulations were as follows.

1. **For water** Increase percent of households with improved water from 39% in 2010 to 50% in 2010, randomly assigning 11% of households to switch from not having improved water to having improved water

2. **For sanitation** Reduce percent with unimproved toilet from 74.6% to 50%.

Results for each of these were presented either for the whole population or for subgroups of the population who the change affected. This subgroup comparison is presented in the subgroup section.

The graphs and explanations below elaborate on the results.

For improved water, community level water coverage was only found to have an impact on stunting where population density was greater (than 1852.67). For this reason, an additional simulation is carried out across the most densely populated clusters, the effect is almost 7 percentage points in 2010 for the more aggressive change and just over 3 percentage points in 2015/16. There was a smaller effect in 2015/2016 (below) because there had already been an improvement in the data, so the simulation did not increase the values of the Basis Functions by as much.

In contrast for the community improved sanitation coverage, it takes an aggressive improvement in the percent with improved toilet in the cluster in 2010 to get an improvement in nutritional

Figure F.1: Moderate and Aggressive Simulations on 2010 Water and Sanitation Values at HH and Community Level and their Relative Impact on Stunting Rates, DHS 2010 Data

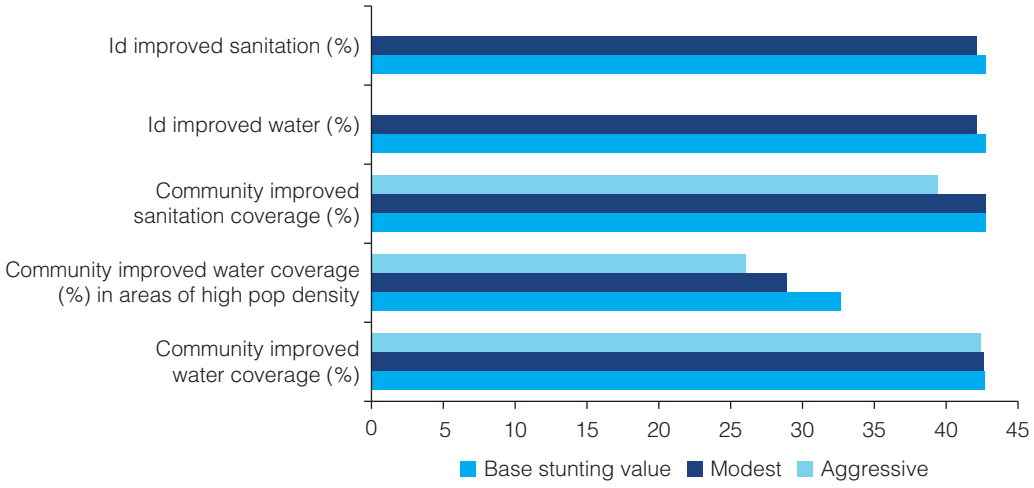
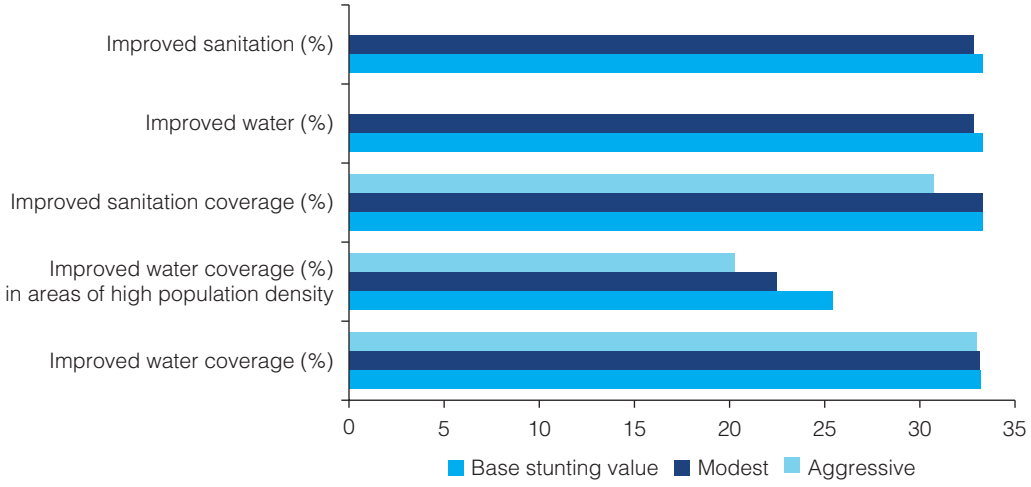


Figure F.2: Moderate and Aggressive Simulations on 2016 Water and Sanitation Values at HH and Community Level and their Relative Impact on Stunting Rates, DHS 2016 Data



outcomes which we can see in the graphs above, this is equivalent to 3.4 percentage points in 2010 and 5.6 percentage points in 2016.

The difference between simulations across the two years is most likely due to the very low values of community improved sanitation in 2010. In other words, in 2010 the starting point for community improved sanitation was far lower than the threshold for the majority. The situation in 2015/16 is better, but the improvement kicks in around the 70th percentile. This greater availability of significant values allowed for the positive impact to be detected. It is likely going forward that similar positive effects of the community-level sanitation variables will be felt. Given the size of this impact, it is worth exploring how the government could move more aggressively to improve community sanitation values.

Table F.1: Simulation Results Related to Household Level Water and Sanitation

Simulation Results for IMPROVED_WATER			
	Base	Simulation (a) Increase percent of households with improved water from 39% in 2010 to 50% in 2010, randomly assigning 11% of households to switch from not having improved water to having improved water Results for all households - the 11 percent who switched from unimproved to improved water as well as the 89 percent who retained their same values in the simulation	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	–172.47	(a) –170.62	(a) 1.85
STUNT	0.4298	(a) 0.4237	(a) –0.0061
		Note: The estimated effect in 2015/16 is zero	
		Simulation (a) Increase percent of households with improved water from 39% in 2010 to 50% in 2010, randomly assigning 11% of households to switch from not having improved water to having improved water ; Results only for the 11 percent who switched from unimproved water to improved water	
HAZ	–181.32	(a) –164.22	(a) 16.78
STUNT	0.4594	(a) 0.4033	(a) –0.0561
Simulation Results for improving distribution of TYPE_TOILET			
	Base	Simulation (a) Reduce percent with unimproved toilet from 74.6% to 50%. Results for all households – the 24.6% who changed from having unimproved toilet as well as the 75.4% of the sample that did not change.	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	–172.47	(a) –170.46	2.01
STUNT	0.4298	(a) 0.4227	–0.0071
2015/16 Simulation Results			
HAZ	–149.89	(a) –147.73	2.16
STUNT	0.3513	(a) 0.3443	–0.0070
		Simulation (a) Reduce percent with unimproved toilet from 74.6% to 50%. Results only for the 24.6 percent who switched from having an unimproved toilet	
HAZ	–171.88	(a) –163.62	(a) 8.26
STUNT	0.4288	(a) 0.3999	(a) –0.0289
HAZ	–153.74	(a) –144.97	(a) 8.77
STUNT	0.3634	(a) 0.3350	(a) –0.0284

Table F.2: Simulation Results Related to Cluster Level Water and Sanitation

Simulation Results for CLUSTER_PCT_IMPROVED_WATER			
	Base	Simulation (a) Up to 50% with improved water in cluster for all clusters below 50% and 20% increase for all others, not to exceed 1. (b) Up to 75% with improved water in cluster for all clusters below 75% and 20% increase for all others, not to exceed 1; (Results for all households – the 472 in clusters with POPULATION_DENSITY > 1852.67 and hence an impact and all others in clusters with POPULATION_DENSITY <= 1852.67 where there is no estimated impact of CLUSTER_PCT_IMPROVED_WATER)	Difference (Simulation – Base)
2010 Simulation Results – All observations			
HAZ	−172.47	(a) −171.81 (b) −171.31	(a) 0.66 (b) 1.16
STUNT	0.4298	(a) 0.4279 (b) 0.4265	(a) −0.0019 (b) −0.0033
2015/16 Simulation Results – All observations			
HAZ	−149.89	(a) −149.16 (b) −148.61	(a) 0.73 (b) 1.28
STUNT	0.3513	(a) 0.3497 (b) 0.3487	(a) −0.0016 (b) −0.0026
		Simulation (a) Up to 50% with improved water in cluster for all clusters below 50% and 20% increase for all others, not to exceed 1. (b) Up to 75% with improved water in cluster for all clusters below 75% and 20% increase for all others, not to exceed 1; (Results only for the 472 households in clusters with POPULATION_DENSITY > 1852.67)	
2010 Simulation Results - Only for those with POPULATION_DENSITY > 1852.67			
HAZ	−135.58	(a) −122.13 (b) −111.75	(a) 13.45 (b) 23.83
STUNT	0.3289	(a) 0.2900 (b) 0.2618	(a) −0.0389 (b) −0.0671
2015/16 Simulation Results - Only for those with POPULATION_DENSITY > 1852.67			
HAZ	−107.00	(a) −98.03 (b) −91.22	(a) 8.97 (b) 15.78
STUNT	0.2332	(a) 0.2141 (b) 0.2018	(a) −0.0191 (b) −0.0314
Simulation Results for CLUSTER_PCT_IMPROVED_TOILET			
	Base	Simulation (a) Up to 20% with improved toilet in cluster for all clusters below 20% and 10% increase for all others, not to exceed 1; (b) Up to 40% with improved toilet in cluster for all clusters below 40% and 30% increase for all others, not to exceed 1;	Difference (Simulation – Base)
2010 Simulation Results – Boys and Girls			
HAZ	−172.47	(a) −172.38 (b) −165.08	(a) 0.09 (b) 7.39
STUNT	0.4298	(a) 0.4294 (b) 0.3957	(a) −0.0004 (b) −0.0341
2015/16 Simulation Results- Boys and Girls			
HAZ	−149.89	(a) −144.14 (b) −137.16	(a) 5.75 (b) 12.73

table continues next page

Table F.2: Continued

STUNT	0.3513	(a) 0.3232 (b) 0.2955	(a) −0.0281(b) −0.0558
2010 Simulation Results - Boys			
HAZ	−179.51	(a) −179.51 (b) −179.51	(a) 0 (b) 0
STUNT	0.4601	(a) 0.4601 (b) 0.4601	(a) 0 (b) 0
2015/16 Simulation Results - Boys			
HAZ	−157.05	(a) −151.67 (b) −151.67	(a) −0.0244 (b) −0.0244
STUNT	0.3830	(a) 0.3556 (b) 0.3556	(a) −0.0244 (b) −0.0244
2010 Simulation Results - Girls			
HAZ	−165.50	(a) −165.08 (b) −150.80	(a) 0.42 (b) 14.7
STUNT	0.3998	(a) 0.3990 (b) 0.3321	(a) −0.0008 (b) −0.0669
2015/16 Simulation Results - Girls			
HAZ	−142.45	(a) −137.16 (b) −122.08	(a) 5.29 (b) 20.37
STUNT	0.3183	(a) 0.2896 (b) 0.2331	(a) −0.0287 (b) −0.0852

Table F.3: MARS Analysis: Simulation Results Related to Food Security

4.15*BF36 where BF36 = BF13 if FOOD_SECURE_DUMMY=1; 0 otherwise; and BF13 = max(0, 5 - MOTHER_ED_YEARS);			
Simulation Results for FOOD_SECURE_DUMMY			
	Base	Simulation Eliminating Food Insecurity. Replacing FOOD_SECURE_DUMMY with a value of 1 if it has a value of 0. Results for all households, including the 23.3 % food insecure in 2010 and 11.1% food insecure in 2015/16 as well as those households who are not food insecure	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	−172.47	(a) −170.41	(a) 2.06
STUNT	0.4298	(a) 0.4233	(a) −0.0055
2015/16 Simulation Results			
HAZ	−149.89	(a) −149.21	(a) 0.68
STUNT	0.3513	(a) 0.3491	(a) −0.0022
		Simulation Eliminating Food Insecurity. Replacing FOOD_SECURE_DUMMY with a value of 1 if it has a value of 0. Results only for those who were food insecure and whose value was changed from 0 to 1	
HAZ	−184.76	(a) −175.93	(a) 8.83
STUNT	0.4696	(a) 0.4419	(a) −0.0277
HAZ	−163.34	(a) −157.28	(a) 6.06
STUNT	0.3947	(a) 0.3756	(a) −0.0191

Table F.4: Simulation Results Related to Household Characteristics and District of Residence

Simulation Results for WEALTH_INDEX			
	Base	Simulation (An increase of 1 std dev of wealth index, 1.49, provided the increase does not exceed the max observed value of the wealth index)	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	–172.47	–167.29	5.18
STUNT	0.4298	0.4088	–0.021
2015/16 Simulation Results			
HAZ	–149.89	–144.98	4.91
STUNT	0.3513	0.3321	–0.0192
Simulation Results for POVERTY			
	Base	Simulation (A 10 percentage point reduction in poverty, provided Poverty does not go negative)	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	–172.47	–170.79	1.68
STUNT	0.4298	0.4236	–0.0062
2015/16 Simulation Results			
HAZ	–149.89	–147.17	2.72
STUNT	0.3513	0.3422	–0.0091
Simulation Results for FRICTION_1KM			
	Base	Simulation (A reduction of 1 std dev in value of FRICTION_1KM index, provided the decrease does not generate a value of FRICTION_1KM lower than min observed value)	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	–172.47	–165.10	7.37
STUNT	0.4298	0.4007	–0.0291
2015/16 Simulation Results			
HAZ	–149.89	–142.34	7.55
STUNT	0.3513	0.3226	–0.0287
Simulation Results for improving distribution of ARIDITY			
	Base	Simulation (a) Reduce ARIDITY index by one std dev, subject to not going below min observed value; (b) Increase ARIDITY index by one std dev, subject to not going above max observed value;	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	–172.47	(a) –184.57 (b) –171.81	(a) –12.1 (b) 0.66
STUNT	0.4298	(a) 0.4736 (b) 0.4255	(a) .0438 (b) –.0043

table continues next page

Table F.4: Continued

2015/16 Simulation Results			
HAZ	−149.89	(a) −151.55 (b) −151.01	(a) −1.66 (b) −1.12
STUNT	0.3513	(a) 0.3579 (b) 0.3536	(a) .0066 (b) .0023
Simulation Results for POPULATION_DENSITY			
	Base	Simulation (a) If bottom 25% were brought to value of 25th percentile; (b) If top 10% brought down to value of 90th percentile;	Difference (Simulation – Base)
2010 Simulation Results			
HAZ	−172.47	(a) −172.53 (b) −171.33	(a) −0.06 (b) 1.14
STUNT	0.4298	(a) 0.4300 (b) 0.4248	(a) .0002 (b) −.0050
2015/16 Simulation Results			
HAZ	−149.89	(a) −149.95 (b)−149.42	(a) −0.06 (b) 0.47
STUNT	0.3513	(a) 0.3515 (b) 0.3486	(a) 0.0002 (b) −.0027

For household level water and sanitation, the simulated effects of increasing the percentage of improved water from 39 to 50 percent are to lower stunting rates by 0.6 percentage points in 2010 for the entire sample.

Appendix G
Human Opportunity Index (HOI) Variables

Opportunities used in HOI analysis	
Water	• Access to improved water
	• Access to basic water (improved + within 30 min. roundtrip from household)
	• Improved water on premises
	• Piped water on premises
Sanitation	• Fixed-point sanitation
	• Access to an improved sanitation facility shared with other households
	• Access to an improved sanitation facility that is not shared
	• Access to a sewerage system

Circumstances used in HOI analysis at national level
• If household is in bottom 40 percent of wealth distribution
• If household is located in a rural area
• If head of household is single
• If head of household is female
• If education of household head is incomplete primary (including illiterate)

WORLD BANK GROUP

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