WASH
Poverty Diagnostic | SERIES

Glass Half Full

Poverty Diagnostic of Water Supply, Sanitation, and Hygiene Conditions in Tajikistan

TAJIKISTAN

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Please cite the work as follows: World Bank. 2017. *Glass Half Full: Poverty Diagnostic of Water Supply, Sanitation, and Hygiene Conditions in Tajikistan*. WASH Poverty Diagnostic. World Bank, Washington, DC.

Cover design: Bill Pragluski, Critical Stages, LLC.

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Acknowledgments

This report was prepared by a team led by Emcet O. Taş and previously by Rob Swinkels, with support from Alisher Rajabov and Sana Al-Nimer. The core team members were William Seitz, Evgeny Kochkin, Jiarui Pu, Syed Usman Javaid, Shideh Hadian, Faridun Sanginov, and Farzona Mukhitdinova. In addition, Craig Kullmann, Libbet Loughnan, and Robert Bain provided technical guidance throughout the research process. Victoria Bruce-Goga, Gohar Grigorian, Shahlo Norova, and Farangis Dakhte provided administrative support.

The team would like to thank Patricia Veevers-Carter, Jan-Peter Olters, Michael Haney, and Nina Bhatt for their guidance and support. Special thanks are due to peer reviewers Emmanuel Skoufias, Claire Chase, George Joseph, Libbet Loughnan and Saki Kumagai. Comments received from Pier Mantovani and Lizmara Kirchner on an earlier draft, and additional feedback from Richard Damania, Luis Alberto Andres, Richard Rheingans, Rob Wrobel, Georges Comair, Kamila Galeza, and Vivek Srivastava are gratefully acknowledged. The team also thanks Rouselle Lavado, Alessia Thiebaud, Aibek Baibagysh Uulu, Shiqing Lee, Pallavi Sengupta, Harika Masud and Deepti Samant Raja for their support on various parts of the analysis. Special thanks are also due to Nancy Morrison, Erin Barrett, and Rick Ludwick for editorial and publication support.

This research could not have been possible without the support of the State Utility Enterprise Khojagii Manziliyu Kommunali (SUE KMK), the Ministry of Energy and Water Resources, the Statistical Agency under the President of Republic of Tajikistan (TajStat), and the Sanitary Epidemiological Service (SES). Support from the World Bank Tajikistan Country Office staff was key. Special thanks are due to researchers from the Center for Sociological Research Zerkalo and Central Asia International Consulting who collected the data. Other organizations that provided inputs in various phases of this research include United Nations Children's Fund (UNICEF), the Swiss Centre for International Health (SCIH), the Swiss Tropical and Public Health Institute (TPH), Oxfam-Tajikistan, the Consumer Union of Tajikistan, and various members of the Tajikistan Water Supply and Sanitation Forum (TajWSS).

This work could not have taken place without the financial contributions of the Water and Sanitation Program, the Water Partnership Program, and the Multi-Donor Trust Fund for Poverty and Social Impact Analysis at the World Bank.

The team is grateful to the individuals, households, and communities that participated in this research and provided details about their living conditions.

Abbreviations

B20	bottom 20
B40	bottom 40
DALY	Disability-Adjusted Life Year
DHS	Demographic and Health Survey
DRS	Districts of Republican Subordination
GBAO	Gorno-Badakhshan Autonomous Oblast
HBS	Household Budget Survey
JMP	Joint Monitoring Programme
KMK	Khojagii Manziliyu Kommunali
KII	key informant interview
L2T	Listening to Tajikistan
LLC	limited liability company
MCS	mini case study
MDG	Millennium Development Goal
MICS	Multiple Indicator Cluster Survey
MPI	multidimensional poverty index
PMT	proxy means test
PPP	purchasing power parity
PRM	poverty risk model
PSU	primary sampling unit
SCIH	Swiss Centre for International Health
SDG	Sustainable Development Goal
SES	Sanitary Epidemiological Service
SUE	State Unitary Enterprise
T20	top 20
T60	top 60
TajStat	Statistical Agency under the President of Republic of Tajikistan
TajWSS	Tajikistan Water Supply and Sanitation Network
TDS	total dissolved solids
TLSS	Tajikistan Living Standards Survey
TPH	Swiss Tropical and Public Health Institute
UNICEF	United Nations Children's Fund

UN-Water	United Nations-Water
WASH	water supply, sanitation, and hygiene
WSP	Water and Sanitation Program
WUA	Water Users Association

Note: All dollar amounts are in U.S. dollars. Tajikistan currency amounts are in somoni (TJS).

Overview

Tajikistan, a landlocked country located on the western tip of the Himalayas, is among the poorest nations in Central Asia. While monetary poverty has fallen fairly rapidly in the past 15 years—with the poverty headcount declining from 72 to 49 percent (2003–09) and then from 37 to 31 percent of the population (2012–15)—poverty remains high by global standards. Some 2.6 million of the country's 8.6 million residents live under the national poverty line. Poverty is also unequally distributed, with poverty most severe in remote and mountainous settlements, and with 76 percent of the poor living in rural areas. Multidimensional poverty (which accounts for demographics, labor, education, and access to services), at 64 percent, is much higher than monetary poverty. The country is heavily dependent on remittances and two-thirds of the working population is employed in low-productivity agriculture. Poverty varies greatly across and within regions, with deep pockets of poverty in the Gorno-Badakhshan Autonomous Oblast (GBAO), Khatlon, and the Districts of Republican Subordination (DRS).

Access to improved drinking water sources, and to sanitation connected to a functioning sewerage system, are among the most severely limited and unequally distributed services in the country. Tajikistan has abundant fresh water resources, with lakes containing 20 km^3 of water resources, and glaciers holding an additional 845 km^3. However, outside the capital of Dushanbe, the availability and quality of water supply, sanitation, and hygiene (WASH) services remain poor. Much of the existing drinking water and sewerage infrastructure was built before the 1980s and has not been updated since the fall of the Soviet Union. It is either in poor condition or absent, especially in rural areas and small towns.

It is increasingly recognized that WASH conditions pose a major development challenge and the Government of Tajikistan has taken concrete steps in this area in recent years. The government has adopted more than 15 programs, strategies, and plans of actions, and passed a series of legislation to address poor WASH conditions across the country. These efforts were accompanied with public and donor-funded investments focusing on the rehabilitation of urban water systems, and on the installation of latrines, boreholes, pumps, and small-scale water systems in rural areas and small towns. At the global policy level, Tajikistan is a member of the High-Level Panel on Water launched by the World Bank and the United Nations, and has announced its commitment to the Sustainable Development Goal (SDG-6) to "Ensure availability and sustainable management of water and sanitation for all." Tajikistan has also made significant attempts to improve access to WASH and address the various well-being impacts, such as on health and nutrition outcomes for children, through its National Development Strategy.

This report presents a diagnostic of WASH conditions in Tajikistan and documents the characteristics, realities, and priorities of the country's WASH-deprived population. The report is structured around four core questions that go beyond issues of "access" to WASH services and incorporate a wider range of contextual factors that collectively determine WASH conditions on the ground, such as affordability, service quality, and accountability of service providers. The core questions are compatible with the recently established WASH targets under the Sustainable Development Goals (SDGs). Thus, the report not only addresses country-level issues, but the data it collected will contribute to efforts to monitor the global SDG targets. The report uses a combination of qualitative and quantitative data sources and methods:

- It generated new primary data through two nationally representative surveys carried out for this study: the Household WASH Survey and the School WASH Survey. These surveys fill gaps and constitute some of the most comprehensive data collection efforts on WASH issues in Tajikistan.

- The report also draws on preexisting data sources that include information on WASH conditions in Tajikistan (the 2015 Household Budget Survey, the 2010 Population and Housing Census, and the 2009 Tajikistan Living Standards Survey, as well as the 2000 and 2005 Multiple Indicator Cluster Survey and the 2012 Demographic and Health Survey), and a monthly phone survey, Listening to Tajikistan.

- The primary qualitative data were collected through focus group discussions, key informant interviews, and mini case studies in 15 research sites covering regional (oblast) centers, district (raion) centers, and rural villages. The qualitative data illustrate consumer experiences across contrasting research sites; capture hard-to-measure impacts; and provide information on institutional constraints for service delivery.

- The report also draws on information from case studies of eight water and sanitation schemes that experimented with various WASH service delivery models across Tajikistan. The case studies were supplemented with a desk review of broader institutional issues in WASH service delivery

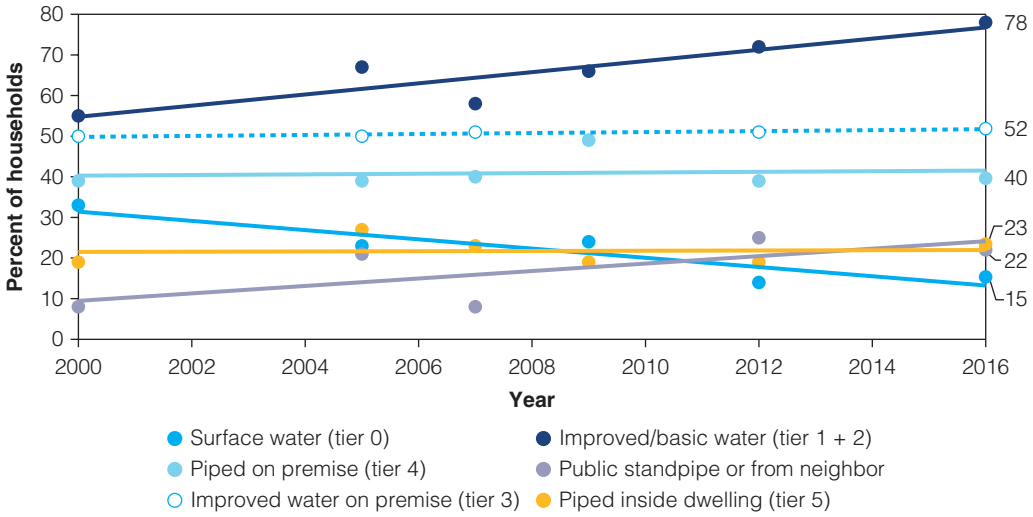
Drinking Water Conditions

The findings show that although Tajikistan has made progress in access to improved drinking water sources since 2000 (figure 0.1), it failed to reach the Millennium Development Goal (MDG) on drinking water, and large inequalities persist across the country (map 0.1). Improvements since 2000 have occurred in the lowest tiers of service and have varied by rural-urban locale. Access to improved/basic water increased from 45 to 71 percent of the rural population from 2000 to 2016, but this was driven mainly by replacement of surface water with water from public standpipes and neighbors. Private piped connections reach only limited segments of the rural population. In contrast, over 80 percent of the population in urban areas has piped water connections in their dwelling or premise. Taking into consideration the amount of time that households spend on collecting water, measures of access to improved water sources decline almost everywhere in Tajikistan.

Even when households have access to water, there are significant challenges in the availability and continuity of water supplies. One in four households in Tajikistan does not have access to sufficient quantities of water when needed. Service is interrupted for long periods because of breakdowns in water supply infrastructure. Rural residents experience more instances of major service interruptions that last a week or more. Water outages increase in frequency and length during winter months, mainly because of frozen water sources, frozen pipes, or electricity outages. Only 15 percent of water connections nationally, and only 5 percent in rural areas, are metered. Thus, it is likely that households do not use water efficiently and underpay for the amount of water they consume. Given the unreliability of the main drinking water sources, many households rely on multiple sources throughout the year, particularly in rural areas. In winter, households compensate for service interruptions in piped water supply with other (nonpiped) improved water sources. In summer, households must turn to unimproved water sources in the face of heightened water scarcity and increased demand.

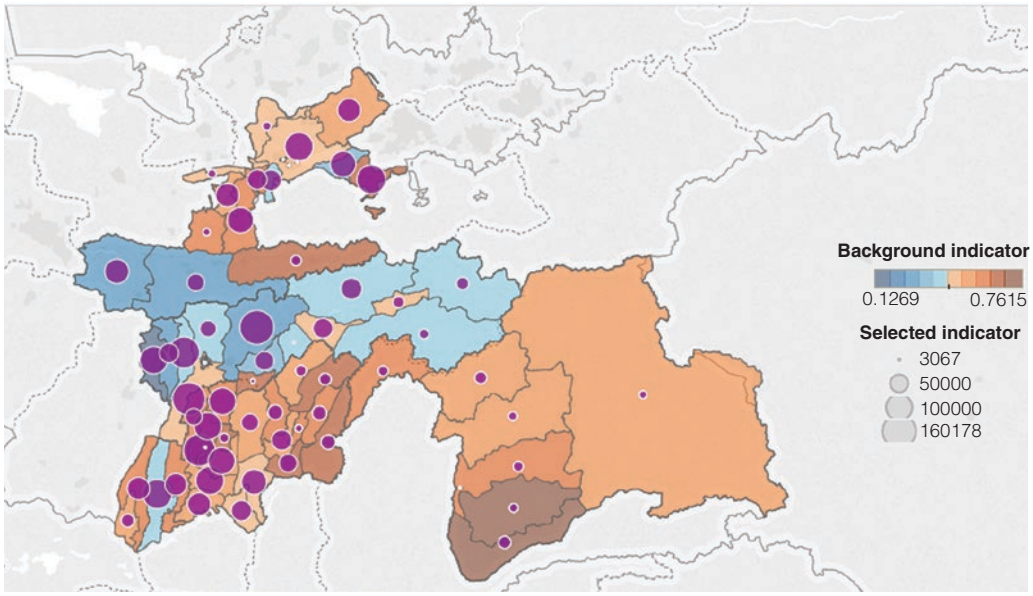
Drinking water in Tajikistan contains high levels of coliform bacteria and has low palatability, but low *E. coli* rates suggest that fecal contamination is not a major concern. Because open and unprotected water sources are more commonly used in rural areas, coliforms are more commonly detected in water sources used by rural households (58 percent) than by urban households (49 percent). Despite the high presence of bacteria, only a few incidences of *E. coli* presence are detected in drinking water. This can partly be explained by the fact that less than 1 percent of the population practices open defecation. Access to safely managed water sources (those that are improved, available when needed, and free of fecal contamination) varies, however. While 57 percent of urban households have access to safely managed water, only 31 percent of rural households do. Furthermore, the chlorine concentration in drinking water is dangerously low and does not comply with national or

Figure O.1: Trends in Multi-Tier Levels for Household Access to Main Water Source, 2000–12 (Percent of Households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Tajikistan Living Standard Survey (TLSS) 2007, 2009; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: For the 2016 data point, tier 1 + 2 shows improved water. WASH = water supply, sanitation, and hygiene.

Map O.1: Number of People Whose Main Source of Drinking Water Is Open Water or an Improved or Unimproved Well, as Reported in Census 2010



Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census. Estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this water condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Photo O.1: Water Trucks
(Rudaki Raion, DRS)

Source: World Bank.

Photo O.2: A Container for Collecting Rain Water
(Rudaki Raion, DRS)

Source: World Bank.

global health guidelines. Chlorine remains unavailable in local markets. Thus, the population is overly dependent on boiling as their main water treatment method.

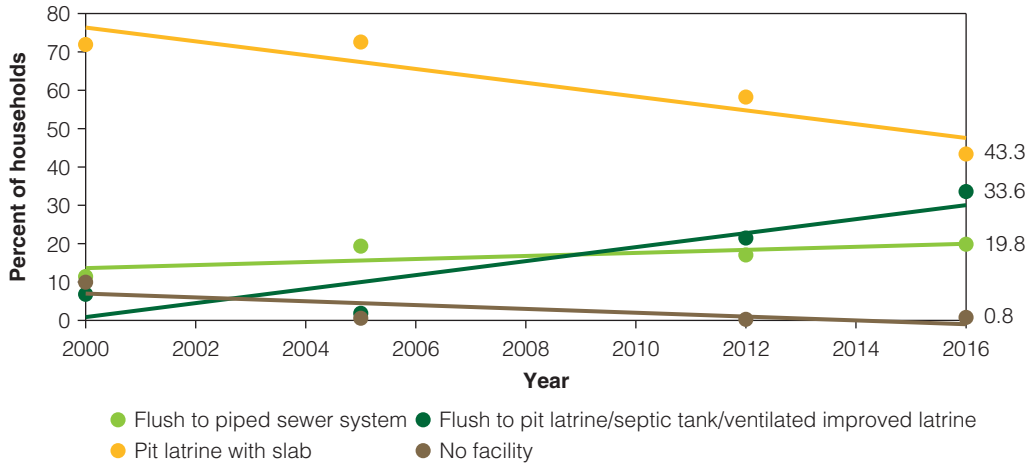
Schools rely on the same water sources as households, and thus face similar conditions in terms of access, availability, and quality of drinking water services. Most schools in Tajikistan have access to piped water sources in their yard, but a significant proportion rely on open drinking water sources that may pose a health risk for children. A greater proportion of schools in urban areas (74 percent) have access to water piped into the compound or yard as their main source of drinking water than schools in rural areas (50 percent). Moreover, a larger proportion of primary schools (grades 1-4), which younger children attend, use open water as their main source of drinking water than basic schools (grades 5-9). The chemical quality of the drinking water is lower in rural areas. Thus, rural students are more likely to consume water with higher concentrations of inorganic salts, organic matter, and traces of heavy metals. The average free and total chlorine concentrations are alarmingly low and may pose a significant health risk for children.

Sanitation and Hygiene Conditions

Access to sanitation has improved, particularly over the last decade, but Tajikistan continues to have some of the poorest conditions in Central Asia. The share of the population that does not have access to a sanitation facility has steadily declined. Open defecation in Tajikistan has all but vanished, falling from 6 percent in 2005 to less than 3 percent in 2012 to just below 1 percent in 2016 (figure 0.2). GBAO has the largest share of people without toilets, although in absolute terms the largest populations without toilets live in selected districts of Khatlon, Sughd, and DRS (map 0.2). This overall decline was accompanied by an increase in access to flush/pour toilets and pit latrines with slab. In urban areas, the majority of the population has access to flush toilets connected to a sewage system. By 2016, this proportion had increased to 60 percent. In rural areas, the share of the population using unimproved sanitation facilities has declined, while improved sanitation has increased to 41 percent of the rural population. That said, access to flush toilets connected to a sewer system in rural areas is chronically low, at only 1.7 percent. Inequalities in access to improved sanitation are even more pronounced across regions. Dushanbe accounts for more than four-fifths of all sewer connections.

Spatial inequality in sanitation conditions is high and suggests a possible association with poverty (map 0.2). In rural areas, particularly in remote and mountainous settlements,

Figure O.2: Trends in Household Sanitation Facilities in Tajikistan, 2000–16 (Percent of Households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: The response categories are slightly different for the 2000 data point, where flush to pipe sewer does not exclude flush to septic tank. Improved and unimproved latrine types that constitute less than 1 percent of responses are not shown. WASH = water supply, sanitation, and hygiene.

the availability and affordability of the materials required for building improved latrines are constrained, reinforcing wealth-based inequalities. Because of the high cost of building and maintaining permanent sanitation facilities, pit latrines in rural areas are usually replaced with new pits dug in yards. Many latrines are located outside the house, making access difficult for certain household members, such as the elderly and people with disabilities. In urban areas, where sewage connections are more common, 5 percent of urban households still rely on shared sanitation facilities because of the poor condition of the sewer system and discontinuities in water supply. Many latrines also fail to meet basic hygiene standards because they are poorly constructed or have no running water supply. Household sanitation facilities, including those that are considered improved facilities, typically do not have protective lids or running

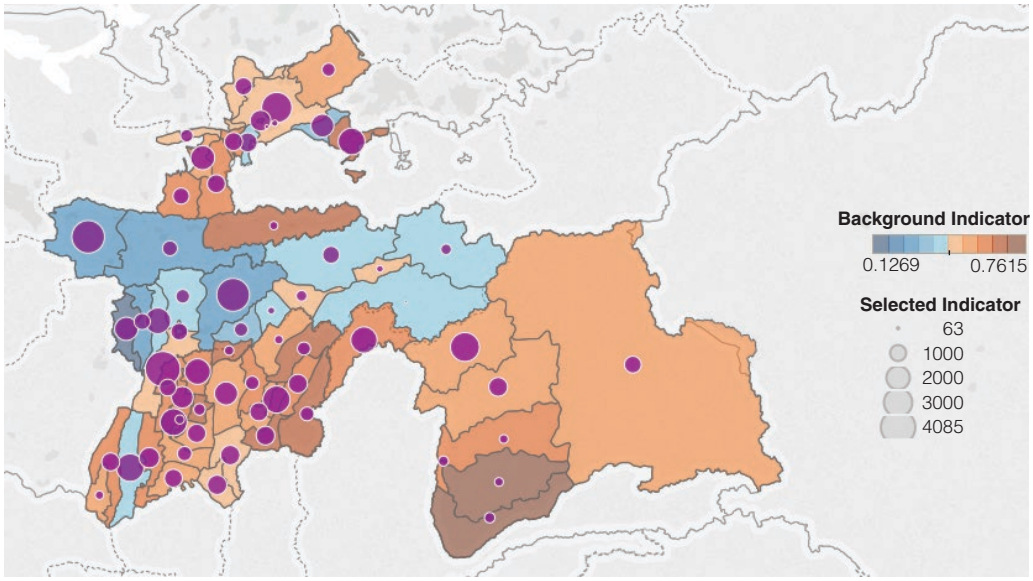
Photo O.3: Unimproved Pit Latrine (Rudaki Raion, DRS)

Source: World Bank.

Photo O.4: Unimproved Pit Latrine (Farkhor Raion, Khatlon)

Source: World Bank.

Map O.2: Number of People with No Access to Toilets, as Reported in Census 2010



Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this sanitation condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

water. In addition, only a few latrines are equipped with hygienic cleansing material or disinfectants, largely because these items are costly in local markets. Limited water supply also makes it difficult to practice hand washing regularly.

Sanitation facilities are generally available on site for schools in Tajikistan, but the availability and quality of improved facilities is significantly lower in rural areas. Pit latrines with slabs are by far the most common sanitation facilities across all regions, except for Dushanbe. In most schools, separate sanitation facilities exist for girls and boys, but only a few schools have special facilities for younger students or for students with disabilities. Availability of soap is generally limited—a problem that is least common in Dushanbe and most common in Sughd. About 45 percent of schools in urban areas report not having soap, compared to 31 percent of schools in rural areas.

Well-Being Costs and Consumer Experiences in Meeting WASH Needs

Poor WASH conditions overlap with the risk factors for diarrhea, stunting, and childhood mortality, resulting in significant health costs for the population, especially children. Overall disease risk is negatively associated with wealth and largely driven by exposure factors (WASH-related parameters considered to influence the risk of disease), as opposed to susceptibility factors (parameters that increase a child's ability to cope with the adverse impacts of disease). Children in poorer households carry 55 percent of the cumulative share of exposure risk and overall disease risk. The 40 percent of children suffering the highest risk shoulder 95 percent of the overall risk in urban settings and 75 percent of the overall risk in rural areas. This supports the pattern that higher risk is often found in the

poorest and most vulnerable communities. Exposure and susceptibility are positively associated, suggesting that children with access to poor WASH conditions are likely to also suffer from poor access to health care and adequate nutrition. This relationship is further exacerbated by disparities in wealth. Children in rural communities are more vulnerable to exposure and overall risk, whereas children in urban areas are subject to a slightly higher susceptibility risk.

Childhood stunting is strongly associated with deprivations relating to access to adequate drinking water and sanitation, food deprivation, and care practices. Access to "adequate water and sanitation" reduces the relative risk of stunting by about 29 percent; "adequate care" reduces it by 35 percent; and "sufficient daily calories" reduces it by about 37 percent. Children living in Dushanbe and GBAO are at significantly lower risk of stunting, after controlling for other risk factors, than children living in Khatlon. As has been found in other countries, the results suggest significant synergies among dimensions of adequate food, child care, environmental factors, and health with respect to reduced stunting risk. Better targeting the determinants of stunting could lead to more rapid improvement. This is particularly important because stunting not only affects the well-being of the current population but can have significant and irreversible impacts on the well-being of the next generation.

Photo O.5: Water Collected from a Spring (Gonchi Raion, Sughd)

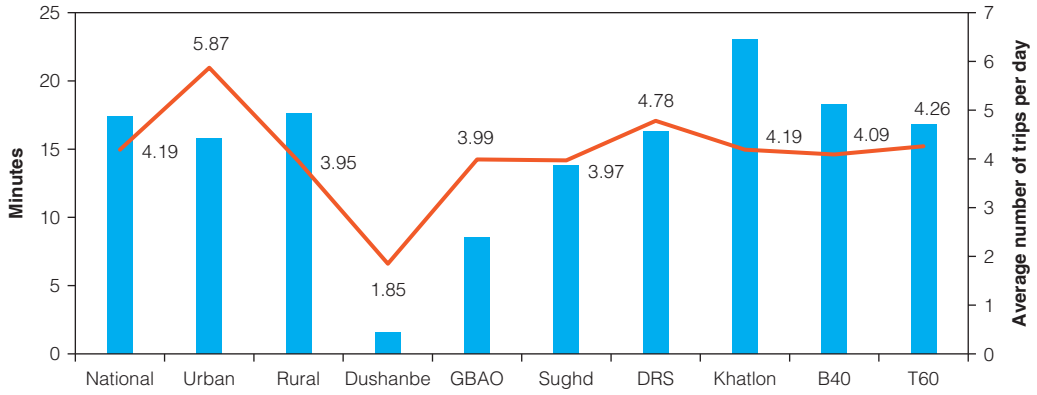
Source: World Bank.

Photo O.6: Water Collected from a Public Tap (Rudaki Raion, DRS)

Source: World Bank.

Beyond the adverse health impacts on children, households in Tajikistan incur a range of monetary and nonmonetary costs related to their main drinking water supply. Among households that report that they pay for water, expenditures on cold water supply make up 5 percent of their total annual expenditure. Households in the bottom 40 percent and households living in rural areas and in the regions of GBAO incur even higher expenditures. Households that pay for nonpiped water services also incur higher per unit costs than households with piped connections. Typically, households also pay for the costs of repairs, water treatment, and water transportation. Time costs are also significant. Households spend an average of 17.4 minutes to reach their water source, collect water, and return home. Considering that households average 4.19 trips per day, the amount of time spent on water collection quickly adds up (figure 0.3). Over 80 percent of these trips take place on foot and include carrying heavy buckets of water from long distances, making water collection a physically demanding experience. For example, 21 percent of the Household WASH Survey respondents reported having back pain and 12 percent of respondents reported having musculoskeletal problems because of carrying water.

Figure O.3: Average Time to Reach the Main Water Source and Average Number of Trips per Household, by Location and Wealth, 2016



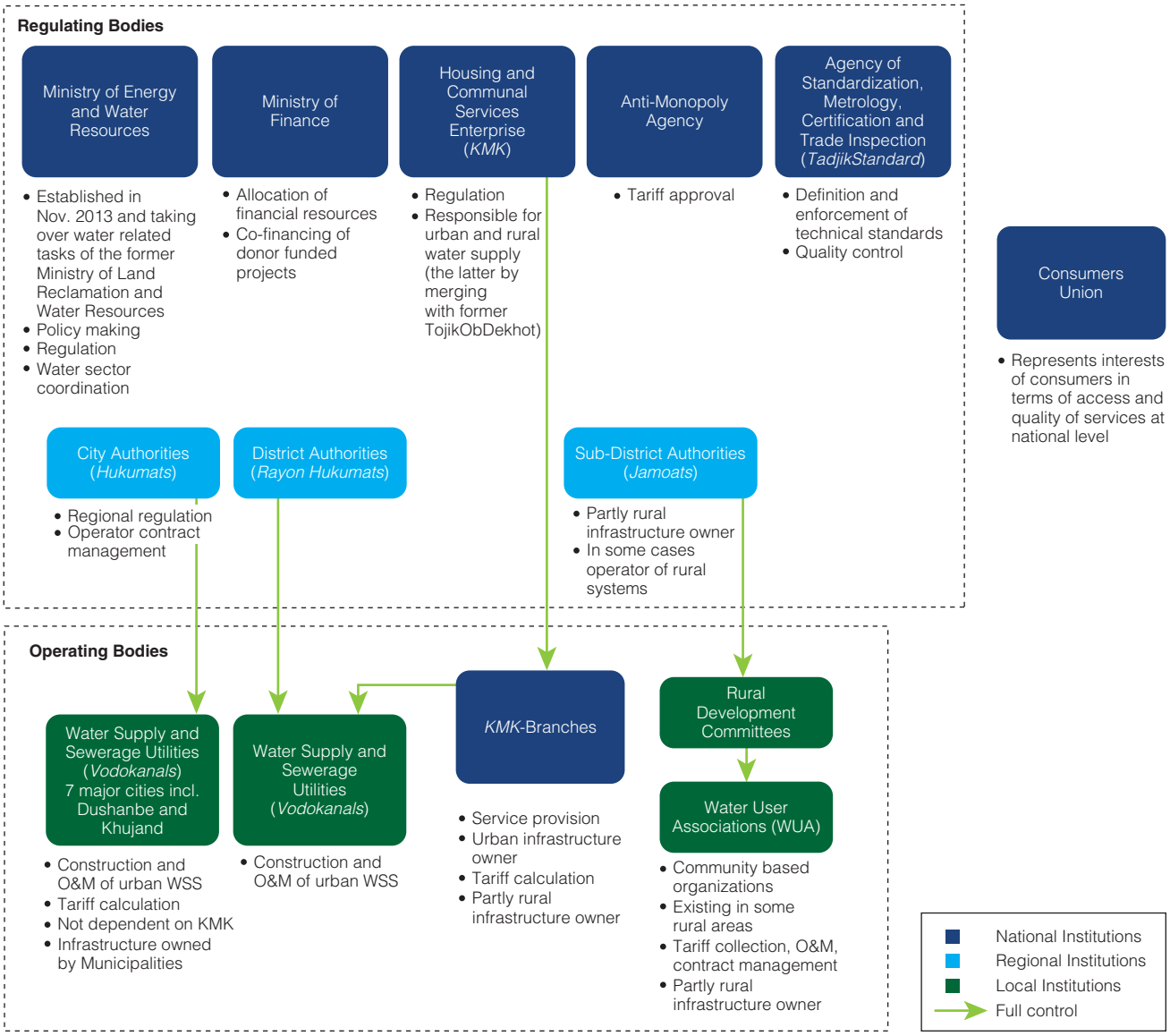
Source: Household WASH Survey 2016.
Note: Blue bars indicate how long it takes to go to the main source, get water, and come back. Orange line indicates average number of trips per day. B40 = bottom 40; DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; T60 = top 60.

Institutional and Service Delivery Constraints

As in many post-Soviet contexts, water utility tariffs are below cost-recovery, and the relationship between service providers and water users can be improved. About 75 percent of surveyed households connected to a piped water supply did not know their tariff rate, while 90 percent stated that they did not know how the tariffs are determined. Generally, consumers do not have a favorable view of service providers; they consider them to be unresponsive or unable to resolve drinking water problems. About 54 percent of households that had recently interacted with their service providers stated that this interaction was related to water outages. The role of local leaders and civil society organizations in facilitating the interaction between communities and service providers is not fully utilized. Partly because of limited consumer engagement and partly because of affordability, more than one-third of rural respondents and nearly half of urban households are not willing to pay any price for water connection or the higher tariff this connection would require. The same holds for sanitation services. Those who are willing to pay, on the other hand, report being willing to pay lower amounts than what the services would require.

The complex institutional structure of the drinking water and sanitation sector—a reflection of Tajikistan's centralized yet fragmented governance structure—serves as a barrier to service improvements. After the collapse of the Soviet Union, most state farms were reorganized into smaller units, with little clarity on transfer of responsibilities over collectively owned social infrastructure. The ownership, regulation, and operation responsibilities for drinking water services in Tajikistan are collected under a single agency. However, the sector is characterized by a plethora of stakeholders operating at the national, regional, and district levels. The State Unitary Enterprise (SUE) Khojagii Manziliyu Kommunali (KMK)—the government agency for public utilities, including water supply—is the main actor with the largest range of assets, but it coordinates with at least seven other ministries and agencies (figure O.4). The lack of explicit boundaries between the regulatory functions of state authorities has resulted in widespread duplication of responsibilities and led to a pattern of inefficient resource management. The direct conflicts of interest that evolve from the dual nature of SUE KMK as a public governor and a for-profit entity deprive the sector of a robust accountability structure.

Figure O.4: Regulatory and Operating Agencies in the Drinking Water Sector in Tajikistan



Source: Adapted from World Bank 2016.
Note: O&M = operations and maintenance; WSS = water supply services.

Recently, attempts have been made to address these issues through a reform program, spearheaded by the government and assisted by other development partners. While it is too soon to assess the effectiveness of the program, at the outset the process runs the risk of establishing duplicative structures to the existing formal institutional arrangements. Implementation of reforms has proven to be challenging due to political economy considerations. Moreover, the sanitation sector is almost entirely missing from the reform discussions. The limitations in asset acquisition and scheme privatization continue to stymie potential for investor engagement.

The identified gaps in the administrative, policy, and regulatory spheres can be addressed by greater collaboration between government and development partners in the drinking water

supply and sanitation sector. An example is collaboration between the government of Tajikistan and the European Bank for Reconstruction and Development (EBRD) on the implementation of the current sector reform program. Development partners can assist government efforts to define and draft the roles and responsibilities of the regional utility companies that are being set up as subsidiary branches of KMK. At the same time, development partners can play a critical role in assembling dedicated funding, creating incentives for hitting targets, and providing technical assistance and capacity building for service providers at the national and regional levels. Civil society groups can be meaningfully engaged for information sharing on local needs and social mobilization, which is evidently lacking in this sector.

As the future of the sector reform is being determined in collaboration with the government, stand-alone schemes can provide an effective means to alleviate deprivation of WASH services across Tajikistan, particularly in rural settlements. This report examined three delivery models: community-led, public, and private schemes. The schemes reviewed offer compelling lessons on the value of stand-alone schemes in overcoming institutional barriers in order to provide services to rural communities that are disconnected from central water supply networks. Involving communities early, in the design state, and continuing that involvement, seems particularly effective. Communities' involvement could reduce financial costs, strengthen the sense of ownership, and increase willingness to pay cost-recovery tariff levels. Local government and community leaders can assist the service provider in conducting feasibility studies; providing a better understanding of the local context; appealing to donors, central government agencies, and vendors; and engaging community members in decision-making processes.

In the design and implementation of stand-alone schemes, sector realities at the macro level, as well as local service conditions and population characteristics at the local level, need to be properly taken into consideration. For example, future projects can consider underlying issues such as population growth, seasonal variations in demand, dependence on the reliability of local electricity, abundance of water treatment resources, availability of water testing expertise, and the ability of metered water to minimize overconsumption of limited water supplies. In addition, rural schemes also tend to face issues of low payment collection rates, a lack of external sources of funding, and tariffs that are lower than cost-recovery rates. Available evidence indicates that these considerations are often overlooked, but play a critical role in the sustainability of water supply and sanitation schemes, as well as in building community ownership and satisfaction with the delivered services. This calls for upstream feasibility studies and preparation activities that not only address technical aspects of the infrastructure of the water schemes, but also attempt to understand the social characteristics of the local populations in order accommodate their needs and perspectives through a community-centered approach.

Implications for the Way Ahead

The diverse evidence synthesized in this report can inspire the government, civil society, and the international community to accelerate their actions toward addressing severe deprivation of WASH services in Tajikistan. At the policy level, the report can inform the ongoing sector reform discussions, which aim to address the complexities of sector governance through greater regionalization of certain service delivery functions. The regional companies are envisaged to support their affiliate utilities by providing technical back-up, engineering support, and enhanced financial management. Each of these components can be informed by the legal and regulatory gaps identified in this report. The findings on consumer engagement and perceptions regarding service providers can be used to build capacity and enhance the skills of staff in the newly created regional branches. The prioritization of regional utility companies that are being created can be informed by the detailed spatial analysis, which highlights the intersection of population density and most severely deprived population groups that would benefit the most from service improvements.

As the reform process continues at the macro level, the findings of this report can also inform the targeting, design, and monitoring of future investments in the WASH sector in Tajikistan. In a complex institutional reform environment, a two-pronged approach that promotes stand-alone investments across rural Tajikistan alongside the macro-level reform discussions is necessary. Stand-alone WASH schemes, in this context, can provide much-needed service improvements to remote areas that are otherwise unlikely to see service improvements in near future. They can also provide an impetus toward challenging the status quo, which is characterized by only a few investments in the most severely deprived areas of Tajikistan (such as GBAO region), as well as low cost recovery (by service providers) and low affordability (among consumers). Because of the population density in Khatlon and Sughd, these two regions remain as the priority locations for large-scale stand-alone investments. These investments would be the most efficient in terms of cost per beneficiary. The sparsely populated and remotely located GBAO region, on the other hand, is the priority location for smaller, decentralized, and community-based WASH schemes.

Future investments, whether small or large, can build on the lessons learned from the stand-alone schemes studied in this report. These lessons pertain to strengthening the legal status and ownership of schemes; ensuring affordability of services by consumers and recovery of costs by service providers; and utilizing the resources of communities in the design, construction, operation and maintenance stages. Across the three service delivery models identified in this report—public enterprises, private enterprises, and water user associations (WUAs)—mobilizing local authorities and communities early on, in the design stage, and sustaining their involvement in the construction and operation of these decentralized schemes, seems particularly effective for the sustainability of stand-alone schemes in rural areas. Local government and community leaders can assist the service providers. The early and continued involvement of communities could reduce financial costs, increase the sense of ownership, and increase willingness to pay cost-recovery tariff levels for services. The interaction between communities and service providers can be enhanced through feedback loops that allow consumers to report infrastructure breakdowns, receive up-to-date information about service interruptions, and demand information about tariffs and other costs.

In the short term, there are immediate measures that the government, civil society, and the international community can take to improve the availability and quality of drinking water across Tajikistan. The analysis has shown that even in the capital Dushanbe, the majority of the population does not have water meters. This results in inefficient use of water resources by consumers, interruptions in water availability (especially in summer months), and difficulties in fee collection by service providers. Installation of water meters in areas where water supply networks already exist can lower the rate of overconsumption and water waste. Water meters can help increase the rate of fee collection, which can contribute to cost recovery by the local water utilities, Vodokanals, and improve the accuracy of water bills received by the consumers. Another relatively straightforward intervention that can yield quick results relates to water treatment methods. According to the results of the water quality tests conducted for this study, even though drinking water in Tajikistan is not contaminated with *E. coli*, it contains other types of bacteria and has low concentrations of chlorine. The most common water treatment method used by the households (boiling water) further reduces chlorine concentration in drinking water, which can impair public health. Therefore, providing sufficient quantities of chlorine to Vodokanals, schools, and health facilities across Tajikistan, as well as promoting the supply of bleach and water filters in local markets, can significantly improve the quality of water consumed by the population. Experience shows that such interventions are most effective when they are supplemented with information campaigns on safe and affordable water treatment methods, not only among water users, but also among service providers.

Several sanitation and hygiene interventions can also yield results in the short term, particularly in rural areas, schools, and health clinics where facilities tend to be in poor condition.

At the household and community level, awareness campaigns can promote the construction of safe sanitation facilities that minimize contact with human excreta and promote personal hygiene. These efforts need to be complemented with measures that promote availability and affordability of latrine materials in local markets, as well as those that underscore the interdependent nature of total sanitation measures among community members. In urban areas, where public toilets and shared facilities are common, establishing sanitation zones and sanitation zone management committees that work with the city and regional governments (hukumat) and local service providers, can help improve the condition of shared facilities and prevent the spread of disease. Finally, donor and government resources can be directed toward provision of soap, materials to practice safe menstrual hygiene, and other hygiene materials in schools and health clinics, as well as in rural markets, where a significant share of the population does not have access to personal hygiene.

The extensive data sources collected for this study can be used for additional research to inform evidence-based decision making and interventions in the WASH sector. While the findings presented in this report provide a diagnostic of key issues across the WASH sector, various data sources can inform specific interventions on a range of subtopics. For example, one of the unique features of the Household WASH Survey is the availability of detailed information on WASH conditions for people with disabilities. Future research agenda can also focus on the integrated nature of the various data sources. For instance, future research can exploit the integration of the Household WASH Survey and the School WASH Survey to analyze the link between availability and quality of WASH services in schools and households, as well as how these services relate to observed health, education, and other well-being outcomes of children. Similarly, the integration of the Household WASH Survey and the UNICEF Nutrition Survey can be analyzed further to explore the synergies among WASH conditions, nutrition, and care, particularly for infants and children under the age of five. Household-level data can be examined in relation to the division of labor within the household with regard to treatment methods and related water quality results. The extensive qualitative data and case studies can provide additional information to inform the design of future programs. Together, these data sources can provide a solid analytical foundation for future interventions in WASH sector in Tajikistan.

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Chapter 1
Introduction

Tajikistan's gross national per capita income positions it among the poorest countries in Central Asia. Monetary poverty declined fairly rapidly over the past decade and a half. The poverty headcount declined steadily, from 72 to 49 percent of the population from 2003 to 2009, and then from 37 to 31 percent from 2012 to 2015.[1] Yet poverty remains high by global standards, with 2.6 million out of the country's 8.6 million residents living under the national poverty line. It is also unequally distributed, with 76 percent of the poor living in rural areas. The progress in reducing nonmonetary measures of poverty, such as access to water supply, sanitation, and hygiene (WASH), has been even slower. Tajikistan, along with Uzbekistan, was the only country outside Africa where the Millennium Development Goals (MDGs) for access to clean water and sanitation, as well as for maternal and child health, were not achieved (World Bank 2014). The multidimensional poverty rate, which accounts for access to basic services along with a demographics, labor, and education, is 64 percent and varies significantly across regions, with deep pockets of poverty in the Gorno-Badakhshan Autonomous Oblast (GBAO), Khatlon, and the Districts of Republican Subordination (DRS). (World Bank, 2017 forthcoming).

Access to improved drinking water sources, and to sanitation connected to a functioning sewerage system, are among the most severe and unequally distributed services in the country. Located on the western tip of the Himalayas, Tajikistan has large fresh water resources. Fresh water resources in its lakes total amount of 20km^3, and another 845 km^3 of water resources are concentrated in its glaciers (Republic of Tajikistan 2015). However, outside the capital city, Dushanbe, the quality and continuity of WASH services remain poor. The majority of the existing infrastructure was built before the 1980s. It is either in poor condition or absent, especially in rural areas and small towns. In 2016, for example, 59 percent of the urban population had access to flush-to-sewer connection, but this figure was only 1.6 percent in rural areas. Similarly, only half the population had access to an improved water source on premises, ranging from 87 percent in urban areas to 36 percent in rural areas.[2] Because service conditions are so poor, many households resort to unsafe and costly coping methods.

In a context of high deprivation and unequal access to basic services, unsafe WASH conditions can have significant adverse effects on well-being. Unsafe WASH conditions enable the transmission of enteric pathogens that can cause diarrhea and lead to chronic problems in absorbing nutrients, leading to stunting, wasting, and being underweight (WHO 2014). In the economic realm, health problems can lead to productivity losses, lost work days, and school absenteeism (Banarjee and Morella 2011), as well as affecting other well-being indicators included in the Sustainable Development Goals (UN-Water 2016). Infectious diarrhea and other waterborne illnesses are also recognized as leading causes of infant and child mortality and malnutrition. According to research based on epidemiological modeling, Tajikistan's incidence of diarrhea and diarrhea-related mortality rates are among the world's highest (Walker et al. 2012). Diarrhea is also the second leading cause of death (after pneumonia) in children ages 1–59 months, accounting for 16 percent of all deaths in this age group (Liu et al. 2014).[3] In 2015, the under-five child mortality rate was higher in Tajikistan than all other countries in Central Asia (except Turkmenistan), at 44.8 per 1,000 live births (World Development Indicators 2016). Large differences across regions suggest geographic inequalities in the living conditions of children across the country.[4]

The Government of Tajikistan has taken concrete steps in recent years to improve WASH conditions across the country. It has adopted more than 15 programs, strategies, and plans of actions, and passed a series of legislation to address poor WASH conditions across the country (Republic of Tajikistan n.d.). These efforts were accompanied with public and donor-funded investments focusing on the rehabilitation of urban water systems, and on the installation of

latrines, boreholes, pumps, and small-scale water systems in rural areas and small towns. At the global policy level, Tajikistan is a member of the High-Level Panel on Water launched by the World Bank and the United Nations, and has announced its commitment to the Sustainable Development Goal (SDG-6) to "Ensure availability and sustainable management of water and sanitation for all." Tajikistan has also made significant attempts to improve access to WASH and address the various well-being impacts, such as on health and nutrition outcomes for children, through its National Development Strategy.

It is increasingly recognized that WASH conditions pose a major development challenge to the country, but accelerating progress in this area requires robust evidence that can guide policy discussions and investments across the sector. As the sector gears up to address poor WASH conditions and inequalities in service delivery, there is a need to better understand the characteristics of the poor and those who are deprived of WASH services; the constraints in serving them with improved services; and opportunities to reach them, whether through utility reform, overall sector reform, or improved targeting in investment plans.

Scope and Objectives

This report presents a diagnostic of WASH conditions in Tajikistan and documents the characteristics, realities, and priorities of the country's WASH-deprived population. The report presents quantitative and qualitative evidence on the coverage and quality of current WASH service conditions, along with their poverty and health impacts, with a focus on the poor and the bottom 40 percent of the income distribution. It documents the chemical quality of drinking water sources; basic WASH conditions in primary and secondary schools; and the linkages between WASH and chronic health conditions. Finally, the report identifies a range of supply- and demand-side issues in WASH service delivery, and discusses possible reform options and service delivery models that can serve as examples for future interventions.

The objective is to communicate a sense of urgency to inspire the government, civil society, and the international community to accelerate their actions toward addressing WASH deprivation in Tajikistan. By visualizing poor WASH service conditions, particularly among the bottom 40 percent and those living in rural areas and secondary towns that appear "invisible" to service providers, the report aims to facilitate the development of new strategies for improving WASH access for these population groups. It also aims to show service and tariff levels that are affordable, and inform policy measures that would make sector reform acceptable. The report highlights the perspectives of service users, especially women and the rural poor who are typically absent from such discussions. It also documents the monetary and nonmonetary costs that these groups incur in exchange for poor services and their willingness to pay for service improvements. Building on this diagnostic, the report identifies institutional gaps and examples of existing service delivery models that can help identify priorities for future policies and investments in the sector.

Key Questions, Data and Methodology

Core Questions

The report is structured around four main questions, based on documenting conditions on the ground, assessing their impacts, and identifying opportunities and constraints for improved service delivery. These core questions (CQs) are:

1. CQ1: Who and where are the poor in the country? (Chapter 2)

2. CQ2: What are the WASH conditions across different population groups, particularly among the bottom 40 percent of the income distribution? (Chapters 3–6)

3. CQ3: What are the synergies between WASH and other well-being outcomes, particularly health and chronic illnesses? (Chapter 7)

4. CQ4: What are the WASH service delivery constraints and potential solutions for improving service delivery to the bottom 40 percent of the population? (Chapter 8)

The core questions go beyond issues of "access" and include a range of other factors that have a bearing on WASH outcomes. The approach of this report is guided by the Country WASH Poverty Diagnostics initiative and particularly the "Access Plus" framework put forward by the World Bank's Water and Sanitation Program (WSP). This framework goes beyond the binary concept of "access" to incorporate a wider range of contextual factors that collectively determine WASH conditions on the ground (such as affordability, service quality, accountability of service providers; see Appendix B).[5] In addition, the core questions are compatible with the recently established WASH targets under the Sustainable Development Goals (SDGs) that also go beyond issues of "access": namely, SDG 6.1 and 6.2, which deal with "safely managed drinking water" and "safely managed sanitation services," respectively. As such, the report not only addresses country-level issues, but also the data collected therein will contribute to the monitoring of the global SDG targets (box 1.1).[6]

Box 1.1: The Shift from the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs) on Water Supply, Sanitation, and Hygiene

In 2015, the world shifted from the Millennium Development Goals (MDGs) (1990–2015) to the Sustainable Development Goals (SDGs) (2015–30). SDG 6 aims to "ensure availability and sustainable management of water and sanitation for all." It consists of six targets related to water supply, sanitation, and hygiene (WASH), as well as wastewater management, water efficiency, integrated water resource management, and protection of aquatic ecosystems. With respect to WASH, two specific targets have been selected:

Target 6.1: *By 2030, achieve universal and equitable access to safe and affordable drinking water for all.*

Target 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.*

The monitoring framework builds on the MDG framework, integrating more comprehensive and strict component indicators. There are three core indicators:

- *The percentage of population using safely managed drinking water service*s is defined as an MDG improved drinking water source that is located on premises, available when needed, and compliant with the fecal and priority chemical standard. The protocol for compliance is to verify that there is zero *E. coli* in 100 mL sample of the household's source of drinking water.
- *The percentage of population using safely managed sanitation service*s is defined as use of an MDG improved sanitation facility not shared with other households, where excreta

box continues next page

Box 1.1: Continued

are safely disposed in situ or transported and treated offsite. Thus sanitation monitoring is now extended to monitor whether the human waste is effectively kept from human contact after it goes into the latrine. This could be by remaining sealed or being transported and treated safely elsewhere.

- *The percentage of population with handwashing facilities with soap and water at home*.

During the 1990–2015 timeframe, the focus was on halving the proportion on those without "improved" drinking water (that is, the threshold for having at least "limited" drinking water in SDG terms) and those without "improved" sanitation (that is, the threshold for having at least "basic" sanitation in SDG terms). There was no core international hygiene MDG indicator. The changes under the SDG framework are designed to better represent the full water cycle and fecal-oral chain, help quantify important issues that were less visible through MDG-lenses, and aid efforts to set a thorough SDG baseline and inform action. Not only do the SDGs refine the definition of access, but countries commit to monitoring in new domains beyond the household level—namely, in health care centers and schools. In these institutional settings, the monitoring will also include whether elements are in place allowing menstrual hygiene management. Monitoring must also verify whether there is progressive reduction of inequity across subpopulations with traditionally lower access (such as the rural population) vis-à-vis the general population.

The household- and school-level survey data collected for this study will be used by WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation to establish a baseline for SDG 6.1.1 and 6.2.1 in Tajikistan. The JMP has been tracking global, regional and national progress on WASH since 1990, and it is tasked with the responsibility of global monitoring of the SDG targets 6.1 and 6.2. Where possible, data will be disaggregated by several strata, including service type, place of residence, household wealth, and public facilities such as health care centers and schools.

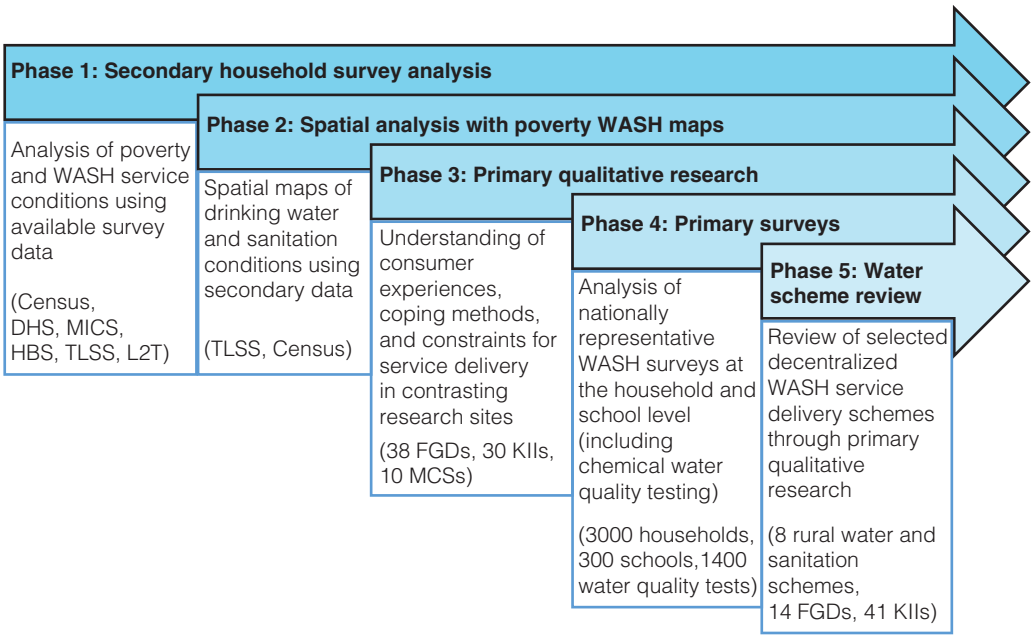
Source: WHO/UNICEF Joint Monitoring Programme (JMP), "JMP-WASH-in-the-2030-Agenda-factsheet," https://www.wssinfo.org.

Data Sources

The report uses a combination of qualitative and quantitative data sources and methods. The data sources include both primary and secondary data from surveys, case studies, and qualitative interviews. In addition, qualitative and quantitative data sources and methods were interacted throughout the five-phase research process (figure 1.1) in order to inform instrument design, to revise and deepen research questions, and to triangulate information from one source with information from another source.[7] A detailed description of the study's methodology, including data collection and sampling methods used in each of the five research phases, is presented in Appendix A.[8]

The primary survey data comes from two nationally representative surveys that were carried out for this study. The Household WASH Survey and the School WASH Survey

Figure 1.1: Summary of Research Phases



Source: World Bank team.
Note: DHS = Demographic and Health Survey; FGDs = focus group discussions; HBS = Household Budget Survey; KIIs = key informant interviews; L2T = Listening to Tajikistan (L2T); MCSs = mini case studies; MICS = Multiple Indicator Cluster Survey; TLSS = Tajikistan Living Standards Survey (2009); WASH = water supply, sanitation, and hygiene.

covered about 3,000 households and 300 primary/secondary schools, respectively, and were conducted in the same primary sampling units following a household listing exercise (see Appendix A). The school survey covers basic WASH conditions in schools, whereas the household survey contains information on the availability and quality of WASH services, costs incurred for meeting WASH needs, the health and other impacts on household wellbeing, and willingness to pay for improved services. In addition, it includes bacterial infection and chemical pollution tests of household water sources at consumption point (for a subsample of 1,000 households) and at the water source (for a subsample of 500 households). The household survey also includes anthropometric indicators (for a subsample of approximately 500 children under the age of 2, and approximately 1,200 children under the age of 5) collected by the UNICEF Nutrition Survey, which was administered around the same time as the Household WASH Survey and shared an integrated subsample with it.

The report also draws on previous survey data for Tajikistan. The Household Budget Survey (HBS 2015) is used for poverty analysis. The Population and Housing Census (2010) is used for spatial mapping of WASH conditions in combination with imputations based on estimation models derived from Tajikistan Living Standards Survey (TLSS 2009). Other secondary sources for analyzing WASH trends over time include the Multiple Indicator Cluster Survey (MICS 2000, 2005) and the Demographic and Health Survey (DHS 2012). In addition, a monthly phone survey on living conditions, Listening to Tajikistan (L2T), is used to assess seasonal trends in service availability and other issues not captured by one-off household surveys. Together, these data comprise all preexisting data sources that include information on WASH conditions in Tajikistan (box 1.2).

Box 1.2: Available WASH Data in Tajikistan

Several existing datasets measure drinking water and sanitation conditions in Tajikistan. These are based on nine household surveys carried out since 1999, and include various rounds of the Demographic Health Survey (DHS), Tajikistan Living Standard Survey (TLSS), Multiple Indicator Cluster Survey (MICS), and the Population Census. These data are useful for tracking trends, but also have several limitations.

Only the MIC surveys of 2000 and 2005, the TLSS 2005 and 2007, and the DHS 2012 have unambiguous data to measure access to MDG "improved drinking water"/SDG "limited drinking water" or SDG "basic water." The remaining surveys and the census have inconclusive answer categories that are unable to track the internationally agreed standards of measurement for WASH indicators. None of them permits the measurement of "safely managed water," the highest rung indicator on the new SDG ladder (see box 3.1 for water SDG definitions).

The existing data for measuring sanitation conditions are also limited. Three household surveys conducted over the period 2000–12 support the measurement of the MDG "improved sanitation" indicator /SDG "basic sanitation." However, there is only one survey available that measures "limited sanitation" and none that offer all elements of "safely managed sanitation" or "basic handwashing" that can be collected in a household survey (see box 4.1 for sanitation SDG definitions).

Aside from WASH indicators for households, there are no existing data sources for measuring the SDG multipurpose indicators for health care facilities and schools in Tajikistan. This underscores the importance of the stand-alone surveys conducted as part of this study. The Household WASH Survey and the School WASH Survey will enable the WHO/UNICEF Joint Monitoring Program (JMP) to fill key elements to the baseline for SDG 6.1.1 and 6.1.2 and the multipurpose indicator on basic WASH services in schools in Tajikistan.

Source: World Bank team.

The primary qualitative data were collected through participatory methods and key informant interviews. The qualitative data were collected in 15 purposively sampled research sites covering regional (oblast) centers, district (raion) centers, and rural villages. Data include transcripts of 38 focus group discussions (FGDs) with low-income and middle-income individuals from 287 households, as well as 30 key informant interviews (KIIs) and 10 mini case studies (MCS) with local government representatives, local leaders, service suppliers, and managers of health facilities and schools. Though not statistically representative, the qualitative data illustrate consumer experiences across contrasting research sites; capture hard-to-measure impacts, particularly on population groups that may be left out of other data sources; and provide information on institutional constraints for service delivery. In addition to helping the interpretation of statistical findings, the qualitative data also informed the design of the WASH survey questionnaires.

The report also draws on information from case studies of selected decentralized WASH schemes, supplemented with a desk review of broader institutional issues in WASH service delivery in Tajikistan. The case studies collected in-depth data on eight water and sanitation schemes that experimented with various WASH service delivery models across Tajikistan. They examined how these schemes cope with the existing institutional and legal gaps for the functioning of standalone WASH schemes in Tajikistan. They also explored the quality and affordability of services; financial sustainability and cost recovery issues; and level of consumer engagement (community participation in decision making, accountability, and transparency of service providers), particularly regarding the construction, operation, and maintenance of the schemes. These case studies were used for drawing lessons and understanding regulatory and other service delivery constraints that need to be tackled to make better service delivery possible, especially in rural areas.

Report Structure

The first part of the report provides a diagnostic of poverty, drinking water, and sanitation conditions in Tajikistan. Chapter 2 discusses the characteristics and geographic distribution of the poor and bottom 40 percent of the population, the main population group of interest in this report. Chapter 3 and Chapter 4 use information from previous surveys and the census, together with primary data collected for this study, to present drinking water conditions and sanitation and hygiene conditions across different population groups. These two chapters also discuss WASH conditions in a nationally representative sample of schools.

The second part of the report builds on this diagnostic to discuss the impacts of WASH conditions on household well-being, along with consumer experiences and institutional constraints to better service delivery. Chapter 5 explores the linkages between WASH conditions and health outcomes based on the poverty risk model, along with some additional evidence based on the UNICEF Nutrition Survey. Chapter 6 focuses on the broader consumer experiences in meeting drinking water and sanitation needs by presenting households' monetary and nonmonetary costs, and their interactions with service providers and local organizations, and willingness to pay for service improvements. Finally, Chapter 7 analyzes broader institutional gaps in service delivery and presents lessons learned from selected standalone water schemes in Tajikistan. The report concludes with a summary and discussion of implications.

Notes

1. Due to changes in the methodology used for poverty measurement in 2012, poverty statistics from previous periods are not strictly comparable with statistics after 2012.
2. Based on primary household survey data collected for this study. "Improved" water sources include "piped to dwelling," "piped to compound," "piped to neighbor," "public tap," "tubewell" or "borehole," "protected well," "protected spring," and "rainwater collection." See Chapter 3 for more details.
3. Other estimates of child mortality, such as those by UNICEF (2015), suggest that diarrhea cases account for 8 percent of deaths among children under the age of five, slightly below the world average of 9 percent and the same rate as in Nicaragua, South Sudan, and Uganda.
4. Khatlon and Districts of Republican Subordination (DRS) have the highest under-five mortality, while Dushanbe have the lowest rate.
5. Traditional analyses on WASH focused on "access" or "use" measures capturing the percentage of people using improved drinking water and sanitation services. It is increasingly recognized that this is insufficient for capturing all crucial WASH-related preconditions for the desired poverty and prosperity outcomes. The "Access Plus" framework, which builds on the JPM's "sustainable WASH services concept," includes considerations of physical accessibility, quality, availability, continuity, quantity, accountability, affordability, and sustainability of WASH. See Appendix B for more details.

6. Data constraints mean that only limited insights are possible on how the shift to the SDG framework will play out in Tajikistan. Due to this and several other factors, the findings in this report largely continues to focus on the "improved" measure: that is, "at least limited drinking water" and "at least "basic sanitation" in SDG terminology. These other factors include the need to ensure relatability between the new analyses and those that countries were accustomed to during the MDG period. Nevertheless, where data were available at the time of analysis, findings on the new elements are highlighted as possible.
7. Qualitative research in the third phase used information from the previous two phases (analysis of preexisting data sources in phase one, followed by spatial analysis in phase two) to purposively select contrasting research sites and to develop research questions. The fourth phase, primary survey data collection, used qualitative findings to develop survey instruments at the household and school level.
8. All research instruments and fieldwork guidelines used in data collection are available to researchers as a toolkit.

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Chapter 2
Poverty Profile of Tajikistan

This chapter provides an overview of poverty and poor population groups in Tajikistan. It discusses where the poor and the bottom 40 percent are located, along with their main characteristics. This information helps in identifying and describing the population group of interest in this study. The data comes from the official source of poverty statistics in Tajikistan, the Household Budget Survey (HBS), as reported in the latest poverty profile (World Bank 2017, forthcoming).[1] The Population and Housing Census (2010) and the Tajikistan Living Standards Survey (TLSS 2009) are also used for poverty maps and for discussing trends.

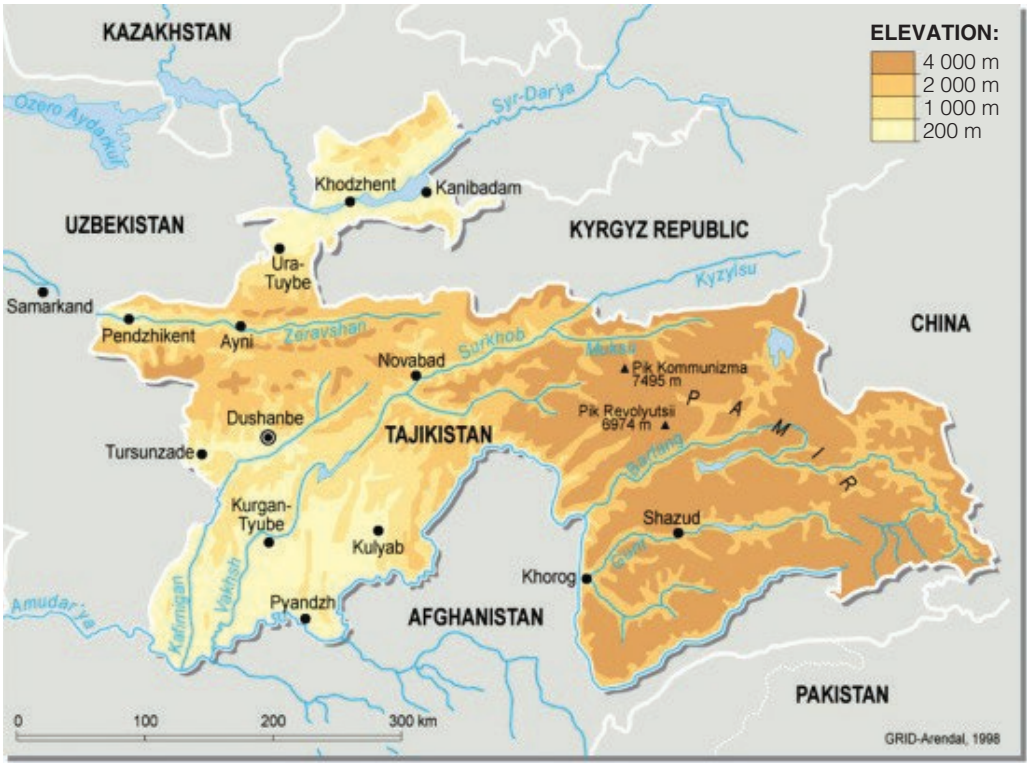
Poverty and Geography in Tajikistan

Tajikistan is a landlocked yet geographically and climatologically diverse country. Even though 93 percent of the territory is occupied by mountains, altitudes vary between 100 meters and 7400 meters above sea level (map 2.1). These differences correspond to diverse climatic conditions observed across the country. The average temperature in the valleys, for instance, ranges between below 0°C in winter to 35°C in summer. While annual precipitation rate is high in mountainous areas (over 1,000 mm), rainfall is very low in the valleys (100 mm per year). Tajikistan is also endowed with fresh water resources from the large glaciers located in the eastern parts of the country, and is home to several fresh water lakes and two rivers that are among the largest in the world, the Amudarya and Syrdarya. Several irrigation schemes divert water from the various contributory rivers to farmlands across Tajikistan, especially in the low-lying and dry lands in the south and north. However, because of the mountainous terrain, only about 6 percent of the land is arable.

Population density largely overlaps with the country's topography. While the mountainous areas are sparsely populated, approximately 8 million of Tajikistan's 8.8 million residents, or about 1.6 million households, are concentrated in the valleys. These include the Vaksh and Kafimigan valleys in the center and south; the Syrdarya valley in the north; and the Zerevshan valley in the center-east (map 2.2). These densely populated areas fall across administrative lines that divide Tajikistan into four regions (oblasts) and 58 districts (raions). After the capital Dushanbe, the most populated regions are Khatlon, followed by Sughd and the Districts of Republican Subordination (DRS). The highest altitudes located in the easternmost parts of Tajikistan, which host the Pamir mountain range, are the most sparsely populated parts of the country. In Gorno-Badakhshan Autonomous Oblast (GBAO), and to a lesser extent in DRS and Sughd, settlements that depend on connectivity over mountainous areas are isolated and served by fewer services, particularly in winter.

Despite geographical impediments, Tajikistan has done a remarkable job in reducing monetary poverty. Poverty declined impressively between 2003 and 2009, when the national poverty rate fell from 72 percent to 49 percent of the population.[2] The main sources of this performance were labor earnings and remittances (figure 2.1). When compared to other countries, Tajikistan's achievement in poverty reduction positions it in the top decile of the world performers (Azevedo et al. 2014).[3] More recently, the HBS (which is not directly comparable to previous poverty statistics) shows that the official national poverty headcount rate declined from 36.4 percent to 31.3 percent of the population between 2012 and 2015, and extreme poverty declined from 19.4 percent to 15.1 percent.[4] During this period, the poor and the bottom 40 percent of the distribution benefited more from consumption growth than people at the top. The increase was greatest for the bottom 10 percent (6 percent), while consumption

Map 2.1: Altitudes across Tajikistan



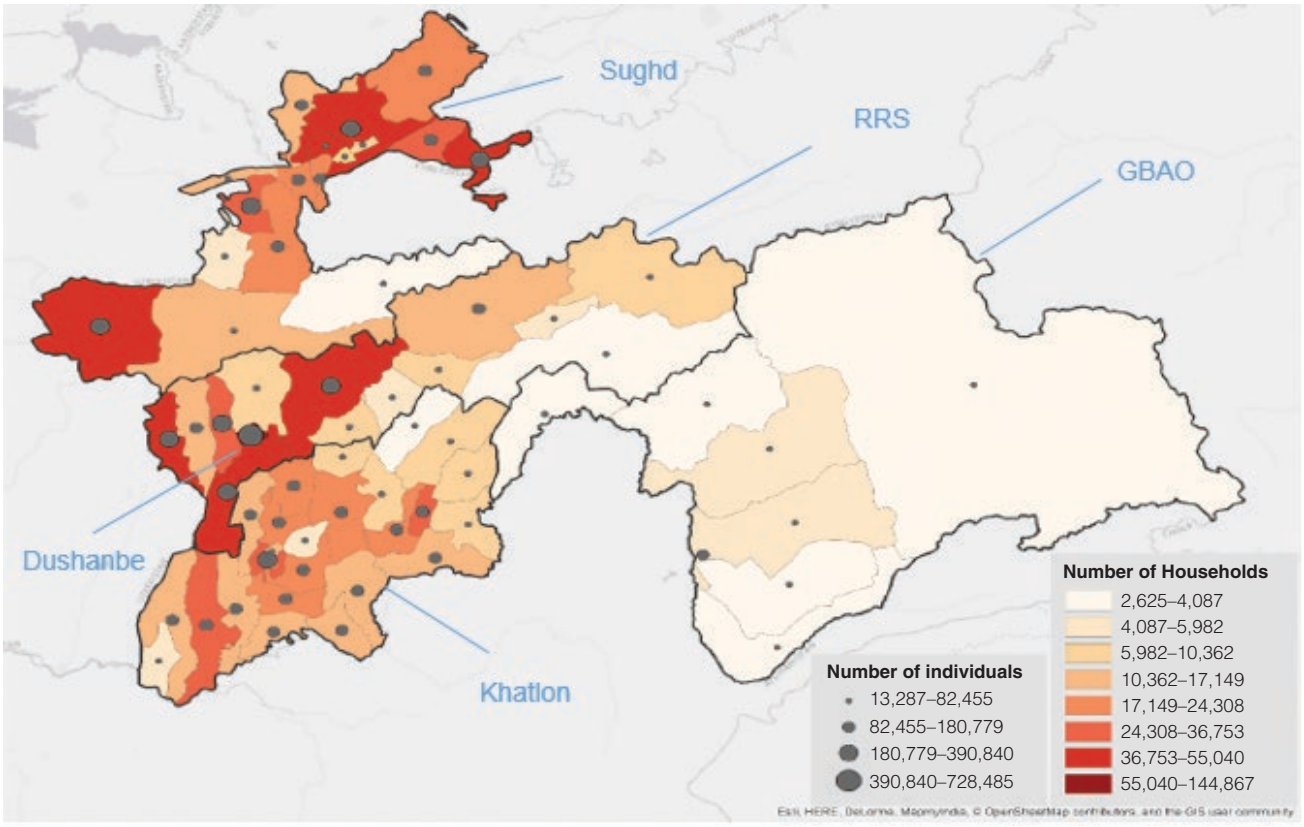
Source: Philippe Rekacewicz, Emmanuelle Bournay, UNEP/GRID-Arendal. https://www.grida.no/resources/5373.

growth declined for the top 10 percent (4 percent). Consistent with this trend, the poverty gap, which measures the average consumption shortfall of the poor, fell from 9.7 percent to 7.3 percent of the national poverty line, suggesting that it became easier for the poor to escape poverty.

While monetary poverty has declined, Tajikistan remains as one of the poorest countries in the region, with a large share of its population dependent on remittances and low-productivity sectors. Tajikistan has maintained positive real GDP growth since 1998 and became a lower-middle income country in 2015. However, with a per capita income level of $2,780 in 2015 (measured in 2011 PPP), it is poorer than most Central Asian and South Asian countries, with the exception of Afghanistan and Nepal. The primary drivers of recent poverty reduction were employment and wage growth, particularly in the construction, mining, health, and human services sectors. Yet, two-thirds of the working population is still employed in the agricultural sector, which has very low productivity levels, and over 62 percent of the 580,000 jobs created between 2010 and 2014 were in agriculture (World Bank 2016). Importantly, Tajikistan is also heavily reliant on remittances from migrant workers, many of whom are based in the Russian Federation. This makes the population extremely vulnerable. In 2015, for example, the estimated value of remittances was 29 percent of the GDP; two years earlier, before the economic slowdown in Russia, remittances had accounted for roughly 50 percent of the GDP.

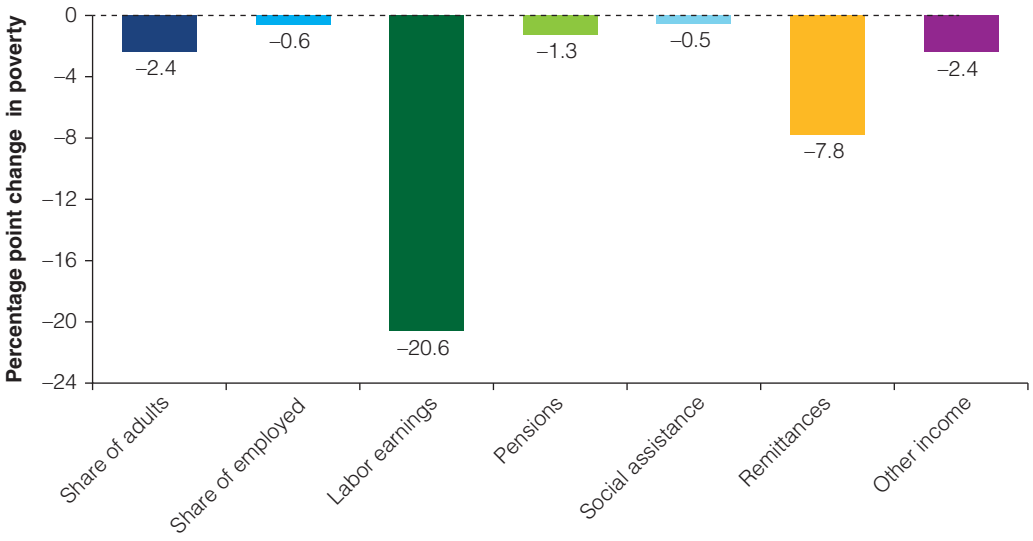
Given the country's difficult terrain, poverty varies considerably across regions and across rural-urban settlements. An important characteristic of poverty in Tajikistan pertains to the sharp rural-urban divide. Not only does a greater share of rural the population live in poverty

Map 2.2: Distribution of the Population (Households and Individuals), by District



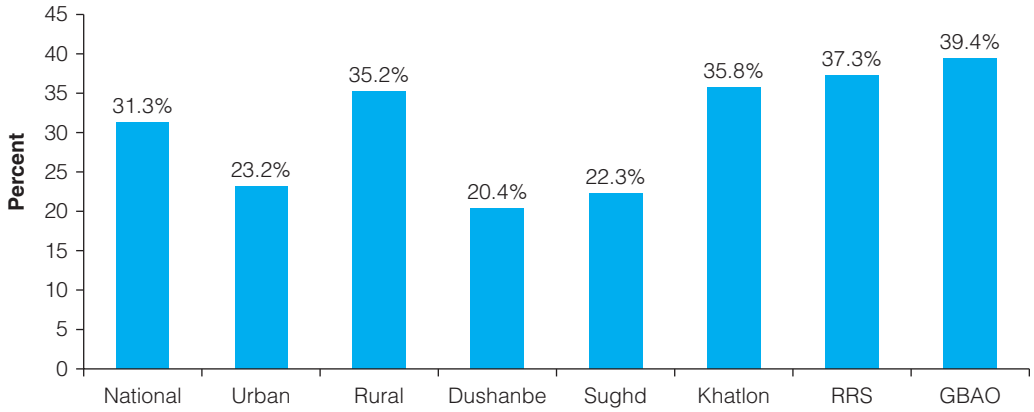
Source: Census 2010.
Note: GBAO = Gorno-Badakshan Autonomous Oblast; DRS = Districts of Republican Subordination.

Figure 2.1: Sources of Poverty Reduction, 2003–09



Source: Azevedo, Atamanov, and Rajabov 2014.
Notes: Poverty line is $2.50/PPP per day. Welfare aggregate is income per capita.

Figure 2.2: Poverty Rates in Tajikistan, by Location (Poor as a Percentage of the Population)



Source: World Bank (2017, forthcoming) estimates based on HBS 2015.
Note: GBAO = Gorno-Badakhshan Autonomous Oblast; HBS = Household Budget Survey; DRS = Districts of Republican Subordination.

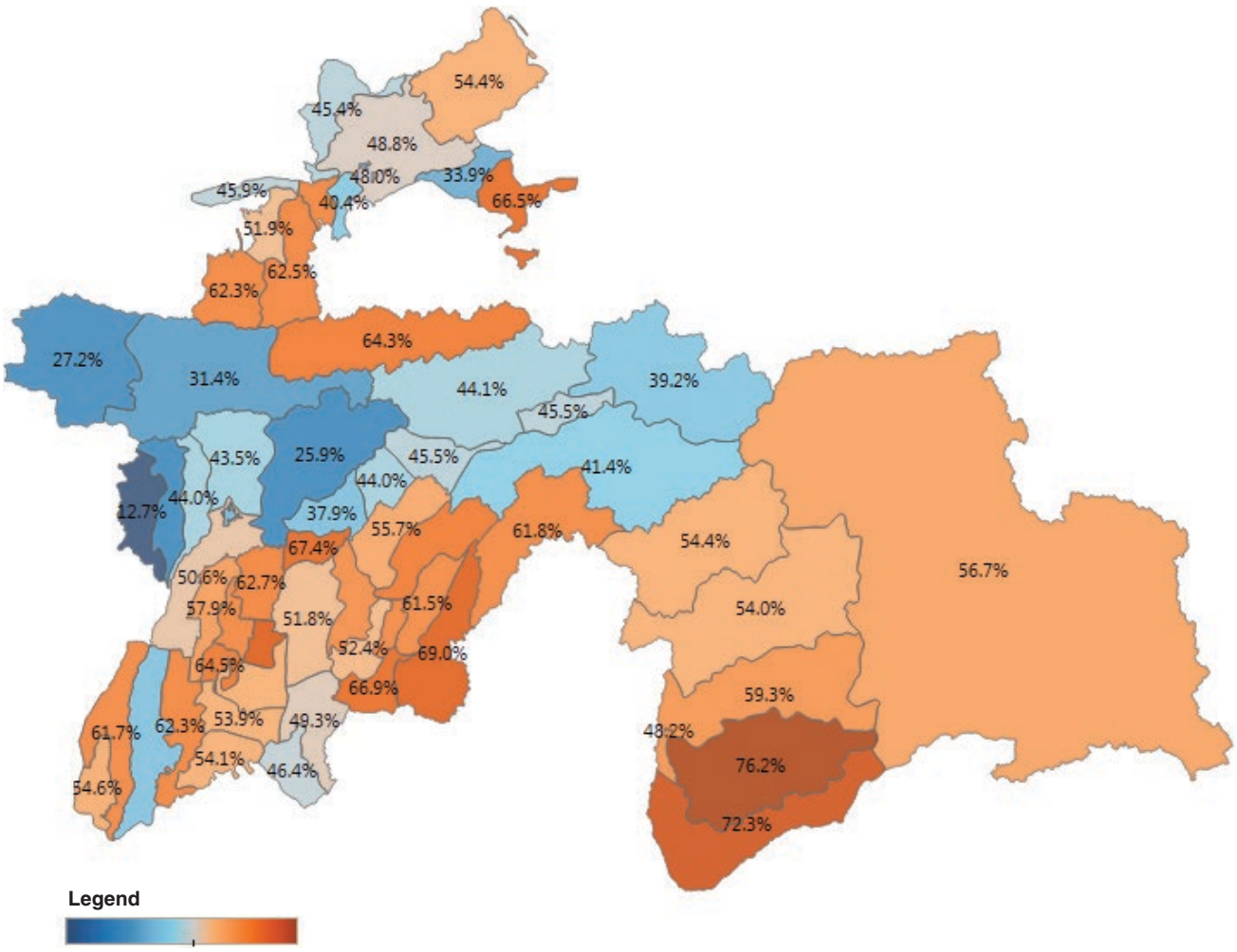
(35.2 percent) as compared to the share of urban population who are poor (23.2 percent) (figure 2.2), but the poverty reduction rate since 2012 has been slower in rural areas than in urban areas. In terms of absolute numbers as well, the poor population is disproportionately concentrated in rural areas, with about 76 percent of Tajikistan's poor population living in rural settlements. Churning in and out of poverty over the course of the year is also significant in rural areas, as they are more affected by seasonality.[5] Aside from the rural-urban divide, there are other regional disparities in poverty rates. According to the official poverty estimates for 2015, Dushanbe has the lowest poverty rate in Tajikistan, at 20.4 percent, followed by Sughd at 22.3 percent. In other regions, the share of the poor population is much higher—35.8 percent in Khatlon, 37.3 percent in DRS, and 39.4 percent in GBAO (figure 2.2).

Poverty rates are also heterogeneous within each administrative region, indicating the presence of deep pockets of poverty. The district poverty rates in Tajikistan, which are based on information from the 2010 census and the TLSS 2009 (rather than the HBS), range between 13 percent and 76 percent of the population (map 2.3).[6] This indicates high concentration of poverty in certain districts, even those that are located in regions with low poverty rates. For example, while the regional poverty estimate for Sughd is 47 percent, poverty rates within this region vary from 27 percent in Panjakent to 67 percent in Isfara. Some districts are also densely populated and host large numbers of the poor. The poor population are primarily concentrated in the capital, Dushanbe, as well as in the Bokhtar, Kulob and Yovon districts in Khatlon; in the Rudaki and Hisor districts in DRS; and in the Bobojon Ghafurov, Isfara and Istaravshan districts in Sughd. In contrast, some districts host relatively fewer numbers of the poor, despite having high poverty rates. The most mountainous districts in GBAO, for example, have some of the highest district-level poverty rates in Tajikistan (map 2.3), yet they host considerably fewer numbers of the poor because the population is sparse (map 2.4).

Characteristics of the Poor and the Bottom 40

The poor and the bottom 40 percent in Tajikistan have certain characteristics that distinguish them from others. Based on the TLSS 2007 and 2009, these include: high dependency ratios (that is, a large proportion of nonworking household members); employment in the low-paying agriculture sector; a low level of education, particularly at the tertiary level; high exposure to exogenous risks; and poor access to infrastructure and basic services.

Map 2.3: District Poverty Rates in Tajikistan (Poor Population as a Share of District Population)

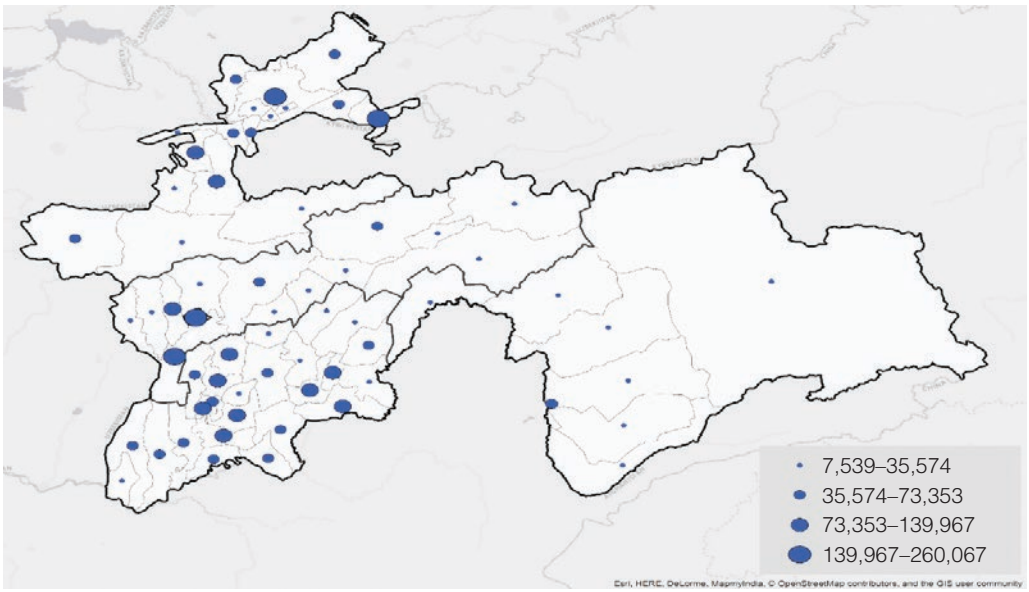


Source: World Bank estimates based on TLSS 2009 and Census 2010.
Note: Poverty rates show the share of poor in the district. Districts with poverty rates lower than the national average are in blue. Those with a higher poverty rate than the national average are in orange.

Poor households tend to have higher dependency ratios, a trend driven by high fertility and large numbers of children in families. Tajikistan's average household size and dependency ratio are 6.43 members and 56 percent, respectively. With a high birth rate (3.82 births per woman) and a relatively low life expectancy (69.7 years at birth), the high dependency ratio is mostly driven by large numbers of children. Only 3 percent of the population is over the age of 65 in Tajikistan, well below the average for developing countries in Europe and Central Asia (ECA) (15 percent). There is a relationship between poverty status and household size. Poor households have, on average, 7.95 members and a dependency ratio of 62 percent, while nonpoor households have an average of 5.9 members and a dependency ratio of 53 percent. The link between poverty and household size is even more pronounced for extremely poor households, which have an average of 8.6 members and a dependency ratio of 65 percent. Together, these statistics suggest that a significant proportion of children in Tajikistan tend to live in poor households.

Another notable demographic pattern is the prevalence of female-headed households, but unlike in many other countries, this does not necessarily convey poverty status in Tajikistan.[7]

Map 2.4: Poor Population Living in Each District (Number of Individuals)



Source: World Bank based on Census 2010.
Note: Blue dots refer to the population of the poor in each district. Larger dots indicate larger numbers of the poor living in that district.

About 23 percent of the population in Tajikistan live in households headed by women. However, female-headed households are slightly more common among the nonpoor than among the poor (21 versus 24 percent of households), and among urban households as opposed to rural households (38 percent versus 16 percent of households). In 2014, a higher share of female-headed households received either some pension income (41 percent versus 37 percent), some employment income (80 percent versus 76 percent), or both, as compared with male-headed households. Also, the average amount of income received from each source, as well as income from remittances, was higher for female-headed households. Given that a significant portion of female-headship is driven by male migration to Russia (Hoffman 2017), households headed by women were about equally likely to receive remittances as male-headed households.[8]

Although educational attainment is generally high, girls are less likely to attend school at the secondary level and above, while members of poor households are less likely to complete tertiary education. As a legacy of the Soviet period, over 70 percent of adults in Tajikistan completed secondary school, with 5 percent of poor and nonpoor households having completed only primary school or less. However, there are gender-based disparities that begin in low grades and widen at the secondary level, especially when girls hit puberty. For example, between 2008 and 2012, the net school enrollment ratio in public educational institutions was 3 percent lower for girls in primary school, but nearly 10 percent lower for girls in secondary school. During the same period, the average net secondary school attendance ratio for girls was 13 percent lower than it was for boys. At the tertiary level, there are important disparities between poor and nonpoor households. While only about 15 percent of adults living in poor households have a tertiary education, about 25 percent of adults living in non-poor households, and 26 percent of adults living in households in the top 60 percent of the income distribution, have completed tertiary education.

Poor households, particularly in rural areas, are more exposed to risks associated with external shocks and seasonal shifts. Poverty rates in Tajikistan fluctuate substantially from one quarter to the next, with many poor exiting poverty and many nonpoor entering it. This is

especially the case in rural areas. In 2015, for example, the quarterly poverty rate from the trough period to the peak period varied by 16 percentage points in rural areas, but by only 8 percentage points in urban areas. Between 2013 and 2015, about 56 percent of people living in urban areas were never poor in a given year; this was the case for only 40 percent of the rural population (World Bank 2017, forthcoming). These variations have several causes, including harvests and agricultural income leading to seasonal variations in consumption; seasonality of migration and related remittance flows; electricity and food shortages in winter time; and religious and cultural holidays that lead to variations in food intake. Regardless of the cause, seasonality can have serious impacts, particularly on nutrition and food security, since food expenditures account for more than 70 percent of consumption among the poor and vulnerable households. As reported in World Bank (2017, forthcoming), the share of people living in households that report that they consume less than 2250 calories per capita per day fluctuates substantially by season.[9] In winter and spring, the share of people reporting less than 2250 calories per person increases by 4 percent. Since a significant share of the food consumed in Tajikistan is imported from abroad, other exogenous fluctuations, such as exchange rate volatility and food prices, as well as limited connectivity of remote areas in winter, also pose significant risks.

If the definition of poverty is extended to nonmonetary forms of deprivation, access to infrastructure and services also become key dimensions of poverty. This is true even in regions with low monetary poverty rates. While monetary poverty has declined steadily over the past two decades, Tajikistan has done less well in reducing multidimensional poverty indicators (box 2.1). For example, at 64 percent, the multidimensional poverty index (MPI), which includes three sets of indicators (demographic and labor, education, and services and infrastructure), is much higher than monetary poverty at the national level.[10] The MPI is also higher among the bottom 40 percent, yet this correlation is not very strong.[11] Decomposition of the MPI indicates that having no connection to sewerage and poor heating conditions at home are the largest contributors to multidimensional poverty at the national level, along with low education. Outside of Dushanbe, which has the lowest MPI in Tajikistan, the importance of infrastructure and services is even more pronounced. For example, GBAO, DRS, and Khatlon score the worst in access to a toilet inside the house, access to piped water, and access to sewage, with at least three-fourths of their populations being deprived along these indicators (table 2.1).

Box 2.1: Multidimensional Poverty and Subjective Well-Being

Nonmonetary forms of deprivation are associated with low levels of subjective well-being in Tajikistan. As a result, a large portion of the population perceives themselves as poor. According to the Listening to Tajikistan Survey (L2T), a national phone survey administered by the World Bank every month, about 70 percent of Tajikistan's population perceive themselves as "poor." This is a much higher proportion than the official poverty rate, and it is much closer to the multidimensional poverty rate. Further, despite seasonal fluctuations in monetary poverty, the majority of households in Tajikistan do not report substantial fluctuations in their life satisfaction. In monthly rounds of L2T in 2015 and 2016, for example, about half the population reported being "neutral," "somewhat unsatisfied," or "not at all satisfied with life." This suggests that life satisfaction, like infrastructure and service conditions, is less likely to fluctuate over time. Indeed, analysis indicates that subjective well-being in Tajikistan is strongly associated with electricity outages, as well as factors such as migration and illness.

Source: Azevedo and Seitz (2017).

Table 2.1: Multidimensional Poverty Rates, by Region (Percent of Households)

	National	Dushanbe	Sogd	Khatlon	DRS	GBAO
Multidimensional Poverty Index	64	22	63	72	75	61
Severe Multidimensional Poverty Index	33	5	31	38	44	29
Deprivation indicators						
Education						
Households with adult individual members (18+) cannot read or write	1	1	1	1	1	1
Household member (+20) does not have complete secondary education	41	32	37	41	53	29
No household member (+25) has tertiary education	79	58	81	84	83	65
Demographic and labor						
Age dependency ratio >1	22	17	19	27	26	16
Both household heads are unemployed	13	16	12	13	16	16
Services and infrastructure						
No access to sewage	73	19	76	80	85	88
No access to piped water	67	8	70	80	72	89
Heating from oven, or heating is absent	70	9	77	78	80	73
No garbage disposable system	63	4	64	73	76	76
No toilet inside the house	78	21	82	88	89	90

Source: World Bank (2017, forthcoming) based on Census 2010.
Note: A household is defined as "multidimensionally poor" when the household is deprived on 33 percent or more of the weighted indicators in the MPI index, and as "severely multidimensionally poor" when the household is deprived on 50 percent or more of the weighted indicators in the index. GBAO = Gorno-Badakhshan Autonomous Oblast; DRS = Districts of Republican Subordination.

In conclusion, despite Tajikistan's progress in reducing monetary poverty, there are substantial disparities in poverty and living conditions across the country, which largely overlap with local conditions. The poverty that remains in Tajikistan, whether defined in monetary terms or multidimensional terms, largely overlaps with rural location and mountainous terrain, plus a limited range of household characteristics. Many of the household characteristics associated with poverty status, moreover, are either related to or get reinforced by poor infrastructure and service conditions at the local level. For example, evidence shows that gender- and wealth-based inequalities in educational attainment, a key aspect of both monetary poverty and multidimensional poverty in Tajikistan, tend to correlate with local service conditions (Baschieri and Falkingham 2009), including poor sanitation and hygiene conditions at home and in public spaces. Such poor conditions disproportionately affect girls and children from poor households, and can partly explain the large drop in educational attainment of girls at secondary level. Such links are explored in the remainder of this report.

Notes

1. The HBS is conducted quarterly with a panel of 3000 households. It became the official source of poverty data in 2014 and includes information on household consumption, expenditure, and income. It is not directly comparable with poverty statistics from 1999–2009 because of methodological differences vis-à-vis the previous poverty data sources in Tajikistan.
2. Between 1999 and 2009, monetary poverty in Tajikistan was measured using the Tajikistan Living Standard Measurement Survey (TLSS). Due to differences in the methodology used

by the TLSS and the current data source, HBS, the poverty statistics for 2012–15 are not directly comparable with those reported before 2009.

3. The global comparison is based on the international $2.5 PPP 2005 poverty line and refers to the period 2007–09.
4. The poverty rate is based on the official national poverty line drawn at 146.77 somoni (TJS) in 2012/13 (in current terms, calculated using the cost-of-basic-needs approach). It is measured on the basis of a quarterly moving average. The poverty line is updated quarterly using the official consumer price index (CPI).
5. Seasonal fluctuations can result from seasonality of agricultural production, seasonal labor migration, particularly to Russia, and the seasonality in many other domestic economic activities, such as construction (World Bank 2017, forthcoming).
6. The poverty maps are based on the 2009 LSMS and the 2010 Population and Housing Census, and therefore are not directly comparable to the current national poverty estimates. Official national poverty estimates using the HBS survey began in 2012/13, and comparable HBS data for 2009–10 could not be used for the purposes of poverty mapping. Poverty mapping usually requires that survey data be collected during a relatively short period around the time of the census.
7. This does not necessarily mean that women do not live in poor households. The male-headed versus female-headed household categorization does not necessarily reflect the well-being of men and women in a country. For example, female headship variables do not capture anything about the status or well-being of males and females within households. It is possible for household headship to reflect a transitory status related to the life cycle or temporary circumstances such as migration. Female headship concept has also been criticized for not being gender neutral because it assumes a patriarchal system of governance within families, where every household is indiscriminately assumed to be headed by a male member unless stated otherwise.
8. This is consistent with previous literature suggesting that the net impact of male migration is ambiguous for their families left behind (World Bank 2013). For instance, studies suggest that while migrants send back remittances, it is also common for migrants' wives to be abandoned, resulting in economic and social precariousness among females (see IOM 2009; OSCE 2012).
9. This figure is based on converting reported food consumption in the HBS into calorie equivalents.
10. The variables used to create the MPI are grouped according to three dimensions: demographic and labor; education; and services and infrastructure. The deprivations are identified in the 2010 Census and summarized in the form of an index. Each dimension is equally weighted. Within each dimension, each indicator is also equally weighted. A household is defined as multidimensionally poor when the household is deprived on 33 percent or more of the weighted indicators in the index. A household is considered "severely poor" when it is a household which is deprived on 50 percent or more of the weighted indicators in the index.
11. For example, DRS has the highest proportion of people living in multidimensional poverty, despite having the second lowest monetary poverty rate in Tajikistan.

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Chapter 3
Drinking Water Conditions

This chapter discusses the drinking water conditions and highlights group-based and spatial disparities in Tajikistan. It documents the differences in service levels across regions, rural-urban location, and bottom 40 percent versus top 60 percent of the income distribution. It also shows how the conditions have changed over time. In addition to mapping the types of drinking water sources in households and schools, the chapter examines the four main tenets of SDG "safely managed drinking water"—improved, accessible, available when needed, and of sufficient quality. The analysis is based on two primary surveys and qualitative field research conducted for this study, supplemented with various secondary data sources. The findings show that improvements in water supply since 2000 have occurred in the lowest tiers of service and have varied by rural-urban location. Even when households have access to water, significant challenges remain in the availability, continuity, and quality of water supplies. Similar findings hold for schools across the country. While most schools have access to piped water sources in their yard, others, particularly in rural areas, rely on open drinking water sources that may pose a health risk for children.

Drinking Water Conditions of Households

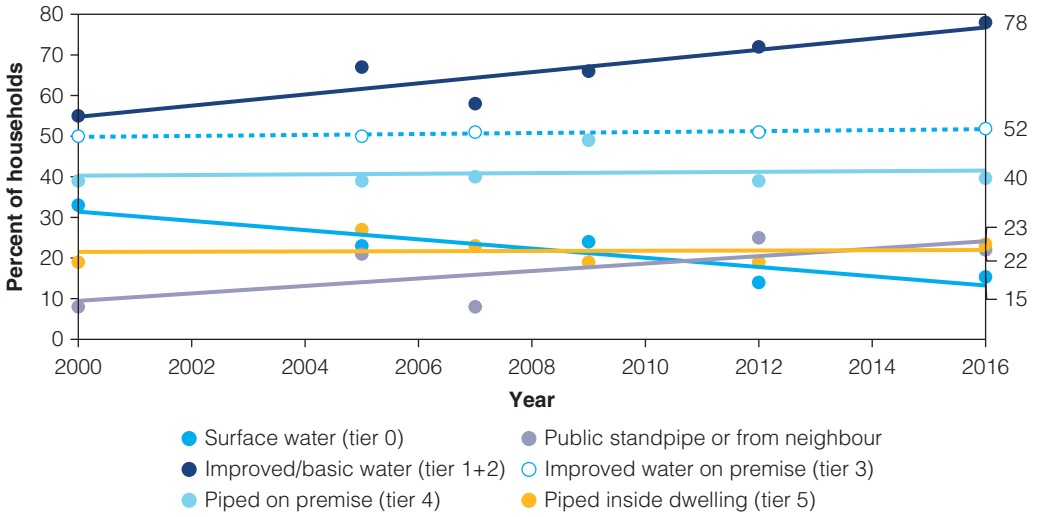
Access to Drinking Water

Tajikistan has made significant progress in access to improved drinking water sources since the turn of the century, although it failed to reach the Millennium Development Goal (MDG) on drinking water. In addition to the Household WASH Survey data collected for this study in 2016, five previous data points are available on drinking water sources in Tajikistan, covering the period 2000–12.[1] Plotted against the "multi-tier ladders" of drinking water (Appendix B), these data show that the proportion of households using "MDG improved" sources (tiers 1 and 2) increased from 55 percent to 74 percent from 2000 to 2016 (figure 3.1). While this is a significant increase, it was not enough for Tajikistan to meet the MDG on drinking water (see box 3.1 and Appendix C for definitions of "improved" and "unimproved").[2]

Improvements since 2000 have occurred in the lowest tiers of service; therefore, access to improved water sources remains limited across the country. According to the Household WASH Survey data collected for this study in 2016, and other household surveys available for previous years, Tajikistan has made progress in reducing the proportion of people with no drinking water supply. The share of those relying on "surface water" for their main drinking water source declined from 33 percent to 15 percent from 2000 to 2016. While this was accompanied by an increase in access to improved water sources, the latter was driven by the lowest tiers of service (tiers 1, 2). There was almost no change in the higher tiers (tier 3, 4, 5). Over this period, the proportion of people whose main water source were "improved on premises," "piped on premises," and "piped inside dwelling" remained at about 52 percent, 40 percent, and 23 percent, respectively. The only type of piped improved water source that had an upward trend, as shown in figure 3.1, was public standpipes or shared connections, which increased from 8 to 22 percent.

The progress in access to improved water has been geographically uneven, with rural areas recording some improvements over time, but remaining far behind urban areas. Access to improved water and piped service did not change much from 2000 to 2016. Over 80 percent

Figure 3.1: Trends in Multi-Tier Levels for Household Access to Main Water Source, 2000–12 (Percent of Households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Tajikistan Living Standard Survey (TLSS) 2007, 2009; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: For the 2016 data point, tier 1+2 shows improved water. WASH = water supply, sanitation, and hygiene.

Box 3.1: Definitions of MDG "Improved" Drinking Water

During the MDG time frame of 1990 to 2015, the Joint Monitoring Programme (JMP) used a simple improved/unimproved source type classification. "Improved drinking water" included:

- *Piped drinking water on premises:* Piped household water connection inside the user's dwelling, plot or yard
- *Other improved drinking water sources:* Public pipes or stand pipes, tube wells or boreholes, protected dug wells, protected springs, rainwater collection, bottled water (when the secondary source was improved).

As explained in box 1.1, this is now a component indicator of the SDG "safely managed" classification. Sources that did not meet the criteria for improved in the MDG framework are generally grouped into two classifications:

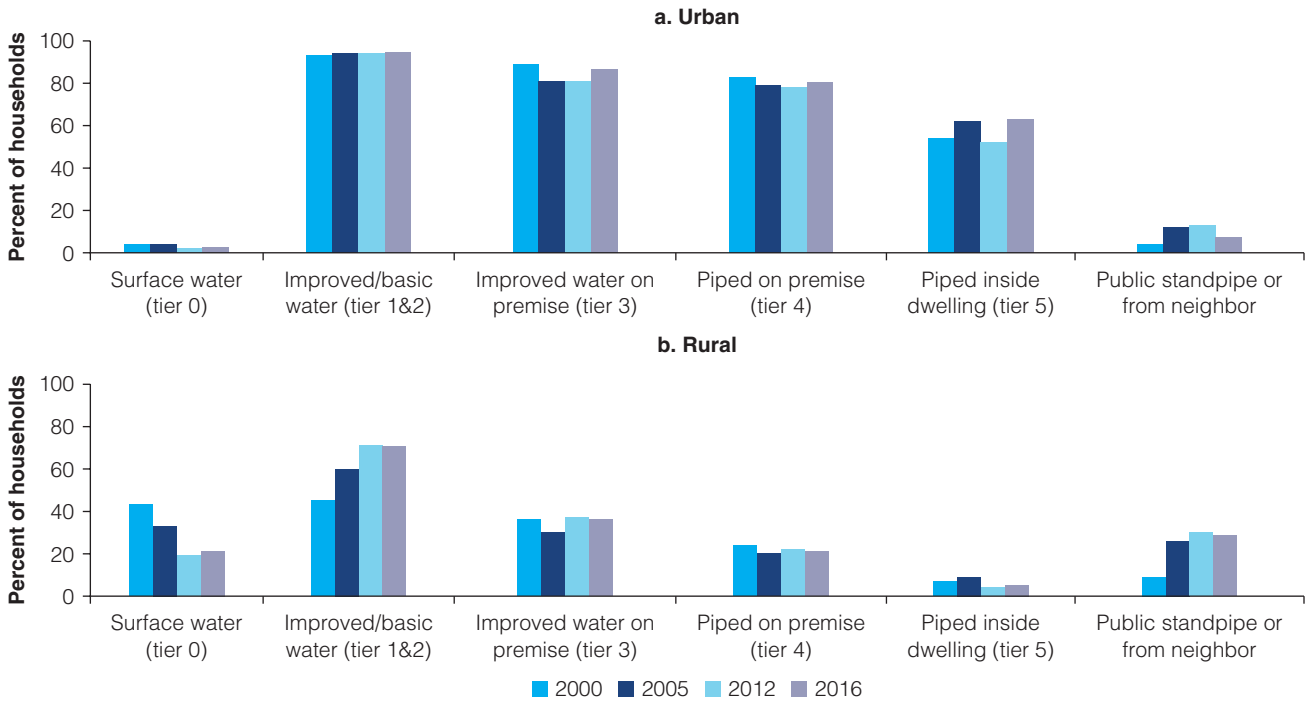
- *Unimproved drinking water sources:* Drinking water from unprotected dug wells, unprotected springs, carts with a small drum, tanker truck.
- *Surface water:* River, dam, lake, pond, stream, canal, or irrigation channel.

Source: WHO/UNICEF Joint Monitoring Programme (JMP), "JMP-WASH-in-the-2030-Agenda-factsheet"; https://www.wssinfo.org/definitions-methods/watsan-ladder.

of the urban population continue to have piped water connections either on their premises or in their dwellings. In fact, the proportion of urban households using "improved water on premise," "piped water on premise," and "piped water inside dwelling" declined slightly from 2000 to 2012, though these trends seem to have picked up in 2016 (figure 3.2). In contrast, the proportion of rural households with access to "improved water on premises" has remained unchanged, at about 36 percent during 2000–16, while the share of those with access to "piped water on premises" and "piped water in dwelling" has declined, from 24 to 21 percent and from 7 to 5 percent, respectively. Access to "improved/basic water" increased greatly in rural areas from 2000 to2016, from 45 to 71 percent, but this was mainly driven by replacement of "surface water" with water from "public standpipes and neighbors." Private piped connections, on the other hand, reach small segments of the rural population.

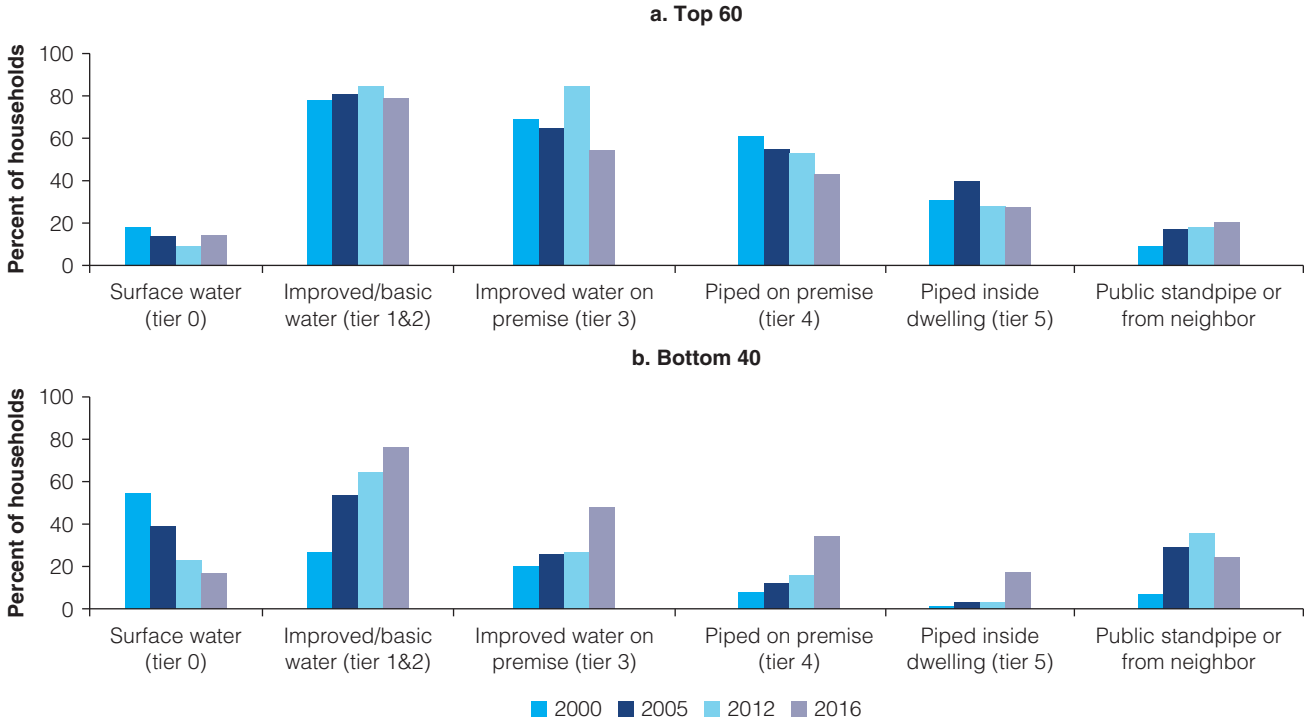
Access to improved water has increased for the less well-off, particularly in lower tiers of service, but the gap between them and the well-off has not closed. For the bottom 40, the proportion of households relying on "surface water" as their main drinking source has declined markedly, from 55 percent to 17 percent. This was accompanied by a large increase in improved water sources, consisting mainly of "piped on premise" (20 to 48 percent) and "piped inside dwelling" (8 to 34 percent) (figure 3.3).[3] In contrast, the proportion of households in the top 60 using improved water sources declined, resulting in some degree of convergence in access to improved water sources across wealth groups. For example, access by the top 60 to "improved water source on premises" declined from 69 to 54 percent and "piped water on premises" dropped from 61 to 43 percent. This was accompanied by an increase in

Figure 3.2: Trends in Main Household Water Supply Source, by Rural-Urban Location (Percent of Households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Tajikistan Living Standard Survey (TLSS) 2007, 2009; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: TLSS data are omitted for comparability reasons. WASH = water supply, sanitation, and hygiene.

Figure 3.3: Trends in Main Household Water Supply Source, by Bottom 40 and Top 60 percent of the Income Distribution (Percent of Households)



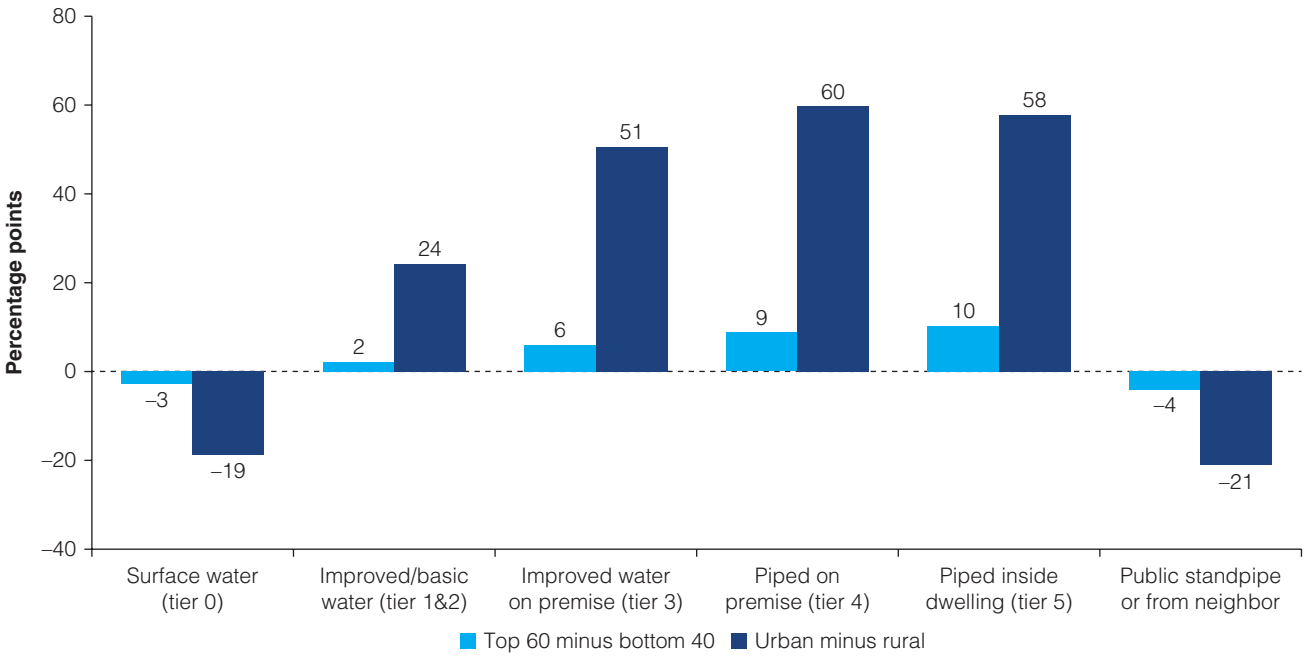
Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Tajikistan Living Standard Survey (TLSS) 2007, 2009; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: TLSS data are omitted for comparability reasons. WASH = water supply, sanitation, and hygiene.

"public standpipe or water from neighbor" from 9 percent to 20 percent, suggesting substitution from private connections to shared ones. This finding is also confirmed by regressions based on the methodology used by the JMP (see Appendix D).

Overall, the remaining group-based inequalities in access to improved water sources overlap with location, and to a lesser extent, with wealth. As discussed, the opposite trends in water access for each wealth group, particularly in tier 1–4 indicators, may indicate that wealth-based disparities in access to improved water sources are on the decline. Even if this is true, a considerably larger proportion of the less well-off households have access to lower tiers of service than the well-off households. For example, in 2016, the share of the top 60 households that have a "piped connection inside dwelling" was 10 percentage points higher than the share of the bottom 40 (figure 3.4). The gaps are considerably greater between rural and urban areas. The difference between the shares of urban residents who have access to "surface water" vis-à-vis rural residents using this water source is 19 percentage points. For improved water sources (tiers 3, 4, and 5), the disadvantages of rural residents are far greater, ranging from 51 percentage points for "improved water on premise" to 58 percentage points for "piped water on premise" to 60 percentage points for "piped water inside dwelling" (figure 3.4).

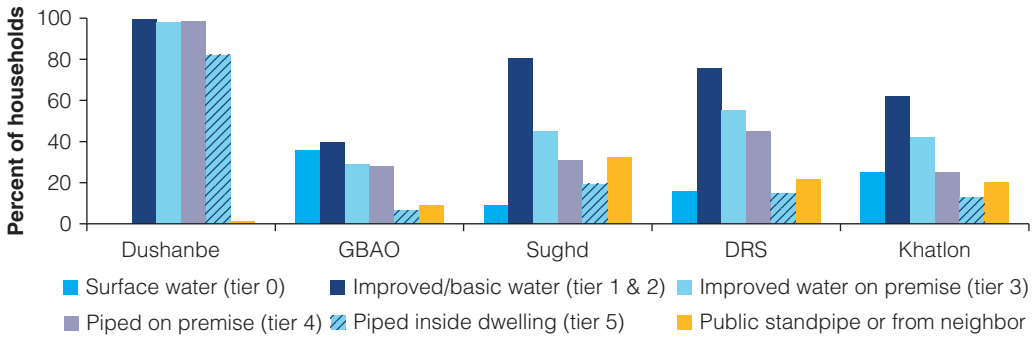
There are also large service gaps across administrative regions, with GBAO and Khatlon having the lowest service levels. As expected, Dushanbe, the largest urban settlement with the most developed infrastructure, has the greatest proportion of households that use improved sources as their main drinking water (figure 3.5). While access to "improved," "improved on premise," and "piped on premise" are nearly universal in Dushanbe, access to "piped water inside dwelling"

Figure 3.4: Gaps in Access to Water Sources, by Location and Wealth, 2016 (Percentage Points)



Source: Household WASH Survey 2016.
Note: Figures show percentage point difference in proportion of households that have access to each water source, computed as urban—rural, top 60 minus bottom 40. N = 3018 households. WASH = water supply, sanitation, and hygiene.

Figure 3.5: Regional Differences in Main Household Water Supply Source, 2016 (Percent of Households)



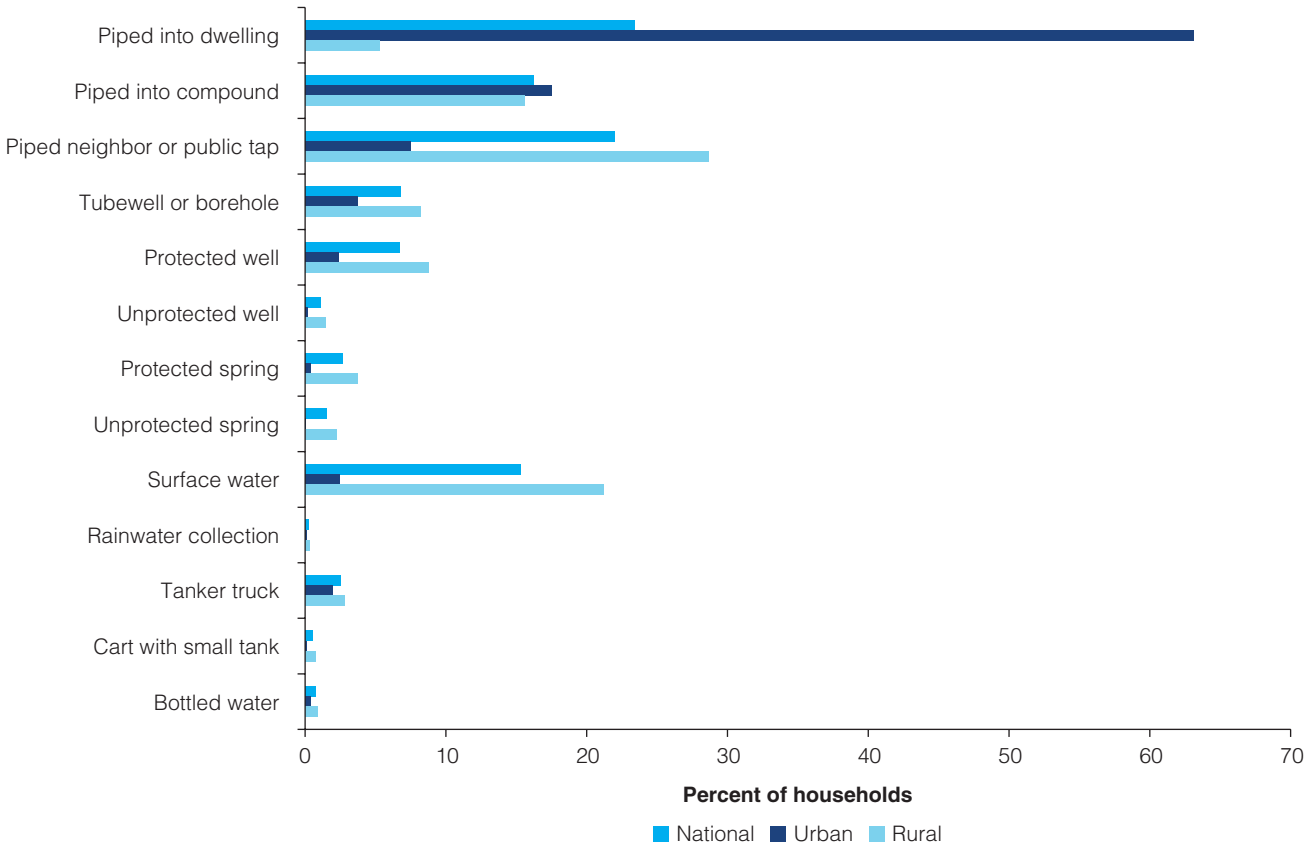
Source: Household WASH Survey 2016.
Note: N=3018 households. DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

is also quite high, at 82 percent. These figures drop dramatically for other regions. In GBAO, a sparsely populated and mountainous region, the share of residents who rely on "surface water" is the highest, at 36 percent, and those who use any improved and piped source is the lowest. GBAO is closely followed by Khatlon. On the other hand, DRS and Sughd have the greatest share of households using "improved" water sources (75–80 percent) and "improved water

on premises" (41–55 percent) outside the capital area. DRS also has the highest share of households outside Dushanbe that use "piped water on premise" as their main source (45 percent), whereas Sughd has the highest proportion using "public standpipe or water from neighbor" (32 percent).

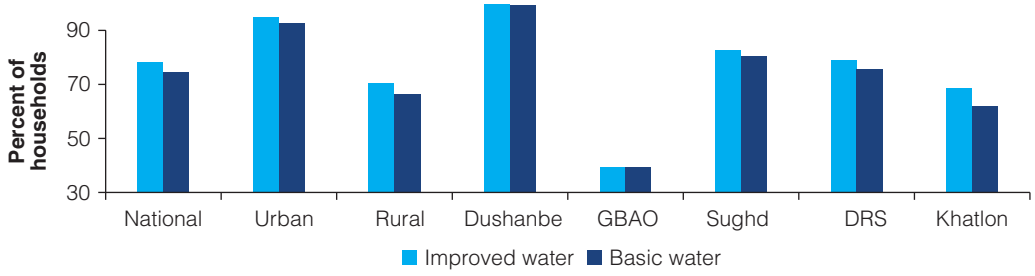
Although the majority of the population in Tajikistan is connected to some type of piped water supply network, piped connections in rural areas tend to be shared, and many rural households continue to rely on surface water. At the national level, 62 percent of households have access to piped water sources, including "piped into dwelling" (23 percent), "piped into neighbor or public tap" (22 percent) and "piped into compound" (16 percent). Yet, the majority of these piped connections (especially, private connections) are located in urban areas (figure 3.6). For 63 percent of urban households, the main drinking water source is "piped into dwelling," and for 18 percent of them, it is "piped into compound." Shared connections are the third most common water source in urban areas, but less than 8 percent of urban households report having a connection piped into their neighbor or public tap. In contrast, shared connections are the most common water source in rural areas, with 29 percent of rural households having access to a public tap or a connection piped to their neighbor's house. This is followed by a large share of households relying on surface water sources (21 percent) and on water "piped into compound" (16 percent). Not surprisingly, the main drinking sources used by rural households are more diverse than urban households,

Figure 3.6: Distribution of Main Drinking Water Sources Used by Households in Tajikistan, 2016 (Percent of Households)



Source: Household WASH Survey 2016.
Note: N = 3,018. WASH = water supply, sanitation, and hygiene.

Figure 3.7: Access to Improved Water and Basic Water, by Location, 2016 (Percent of Households)



Source: Household WASH Survey 2016.
Note: N = 1291 households that report collecting water outside their homes. DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

with a greater share of rural households using water from shared piped connections, boreholes, wells, springs, surface water, and tanker trucks. Urban households, on the other hand, mostly have access to piped water into dwelling or compound (figure 3.6).

Households spend considerable time collecting water; once this time is taken into consideration for purposes of monitoring the SDGs, access to improved water sources declines almost everywhere. At the national level, 41 percent of households in Tajikistan report collecting water from sources located outside of their home. As expected, the share of such households is much higher in rural areas (52 percent) than urban areas (16 percent). In rural areas, off-site water sources are located, on average, 142 meters away from home, though some households report traveling much farther (0.5–1.5 kilometers) and making multiple trips per day (see Chapter 5). These differences are reflected in the access rates for "improved water" versus "basic water." At the national level, accounting for improved water sources that take less than 30 minutes to access (the definition of "basic water") reduces the share of households with access to improved water sources from 78.1 to 74.4 percent (figure 3.7). The gap between improved water and basic water is the largest in Khatlon region (about 7 percentage points), where households spend an average of 23 minutes collecting water, and is also sizable in rural areas (4.3 percentage points). Had the definition of "basic water" used a lower threshold than 30 minutes, these differences would have been much larger, since households in Tajikistan report an average water collection time of 17.4 minutes (see Chapter 5).

Access indicators can hide disparities within households; some household members may have poorer access to drinking water sources than others. Even when households report having access to a water source, often certain household members may face additional barriers in accessing it without assistance. These difficulties may stem from the characteristics of the water source, such as distance, or from individual characteristics, such as age or disability. A group that faces significant barriers in accessing water sources are persons with disabilities. In Tajikistan, out of 3019 households interviewed for the WASH survey, 1673 households (or about 54 percent) reported having at least one household member with one or more functional disability, at various levels of severity. These include household members who have problems with seeing, hearing, walking or climbing, remembering, self-care, and communicating, at any level of severity (being unable to, having a lot of difficulty, having some difficulty). Among these households, 24 percent report that persons with disabilities in their households are unable to access the main drinking water without any assistance. Another 14 percent report that persons with disabilities in their household have some or a lot of difficulty in accessing the main water source. There is some variation in the types of barriers faced (box 3.2).

Box 3.2: Access to Drinking Water by Persons with Disabilities

The Household WASH Survey included specific questions to identify households with members with disabilities. This effort built on the short module developed by the Washington Group on Disability Statistics to assess the prevalence of persons with varying degrees of functional difficulties. The questions focused on identifying the degree of difficulty faced across six functional domains: seeing, hearing, walking or climbing, remembering, self-care, and communicating. These were followed by specific questions on access to drinking water by individuals with at least one of these disabilities. To emulate local terminology, follow-up questions used the wording "household member with disability or other special needs."

At the national level, 9 percent of the sampled households indicate that they have at least one household member who has one or more of the six functional disabilities at the highest severity level (e.g. unable to see, hear, etc.). The most common type of disability is being unable to care for oneself (7 percent), followed by being unable to walk or climb (5 percent). Because the survey asks about the severity of each of the six functional disabilities (such as the level of difficulty in seeing) as opposed to making a binary categorization (such as blindness), taking these varieties into consideration increases the share of households reporting that they have a household member with a disability to 54 percent of the sample. Within this group, the most common disability is self-care; 13 percent report having one of more household members who are unable to care for themselves at all, and 39 percent report having one or more household members who have some or a lot of difficulty in self-care. About 9 percent report that they have at least one household member who is unable to walk or climb, and 9 percent report at least one household member who is unable to communicate. In these two cases, an additional 60 percent report that they have at least one household member who has some or a lot of difficulty in walking or climbing, and another 29 percent report that they have at least one household member who has some or a lot of difficulty in communicating.

Access to drinking water sources can be highly constrained for persons with disabilities, even those who have less severe levels of disabilities. In particular, about 24 percent of households report that persons with disabilities in their household cannot access the main water source without assistance from others. This figure is higher in rural areas (29 percent) than in urban areas (12 percent). Another 14 percent report that persons with disabilities in their household have some or a lot of difficulty in accessing the main water source. The most commonly cited barrier to accessing drinking water is distance to the water source (17 percent of responses). This is followed by physical difficulty in carrying or transporting water (11 percent of responses), lack of accessibility features such as ramps (12 percent of responses), and difficulty of terrain (9 percent of responses). These findings illustrate that access to water can be severely constrained for persons with disabilities, especially once disability is recognized as a spectrum instead of a binary status. This is an important finding with implications for future disability-inclusive drinking water investments in Tajikistan.

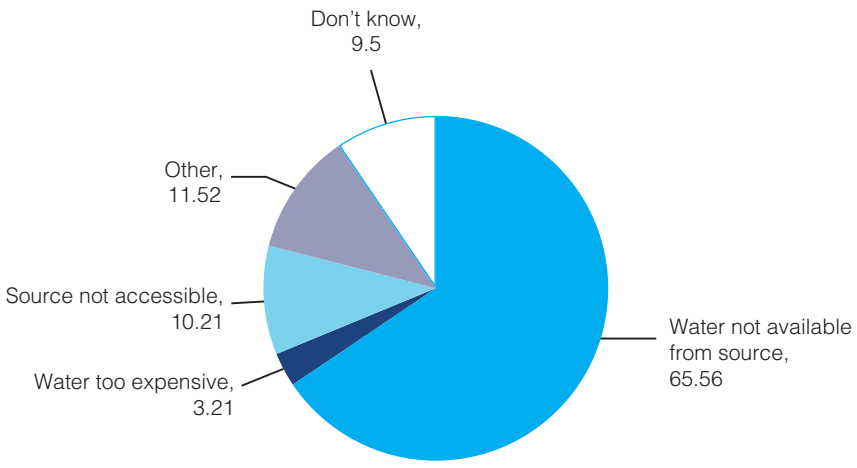
Source: World Bank team; Washington Group on Disability Statistics (http://www.washingtongroup-disability.com).

Availability of Drinking Water

Even when households have access to an improved water source, they face significant challenges in the availability and continuity of their water supply; one out of four households in Tajikistan does not have access to sufficient quantities of water when needed. According to the Household WASH Survey conducted for this study, in the month preceding the interview date, over 25 percent of households reported being unable to access water from the main drinking water source in sufficient quantities when needed, disqualifying them from classification as SDG "safely managed." In two-thirds of these cases, households cited the "unavailability of water in the source" as the reason for not having a sufficient amount of water when needed. In addition, 10 percent of households cited inaccessibility of the water source and another 10 percent cited factors related to poor infrastructure, such as broken pipes, broken pumps, and electricity outages (figure 3.8). The share of households that reported being unable to access water from the main drinking water source was greater in urban areas (34 percent) than in rural areas (21 percent). This pattern can be explained by the fact that more urban households than rural households rely on centralized piped water supply. Rural households, on the other hand, typically rely on alternative sources to cope with insufficient water from their main source.

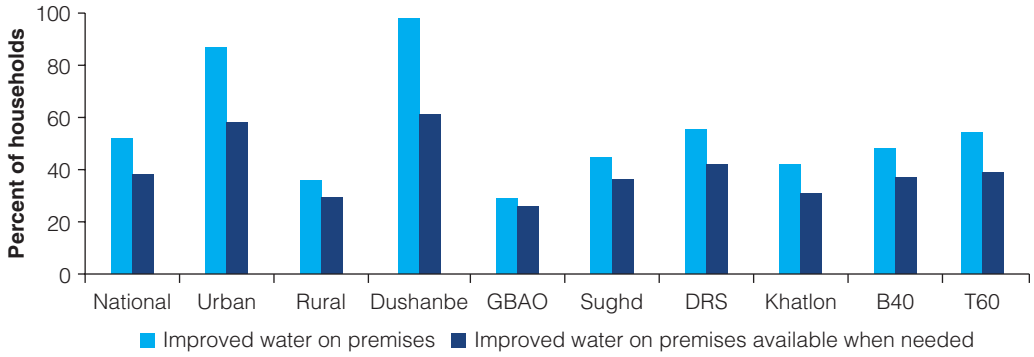
The gap between availability and access is illustrated by the subgroup of urban households whose main drinking water source is "improved water on premises." Since urban areas have better access to improved water sources on premises than rural areas, the gap between access and availability is quite large for this subgroup. The difference between the share of households that have access to improved water sources on premises, and the share of households that have access to improved water sources on premises that are *available when needed* is nearly 30 percentage points in urban areas (figure 3.9). On the other hand,

Figure 3.8: Reasons for Inability to Access Water from the Main Drinking Water Source in Sufficient Quantities When Needed, 2016 (Percent of Households)



Source: Household WASH Survey 2016.
Note: N = 762 households that reported they were unable to access the main drinking water source in sufficient quantities when needed in the previous month.

Figure 3.9: Availability of and Access to Improved Water on Premises (Percent of Households)



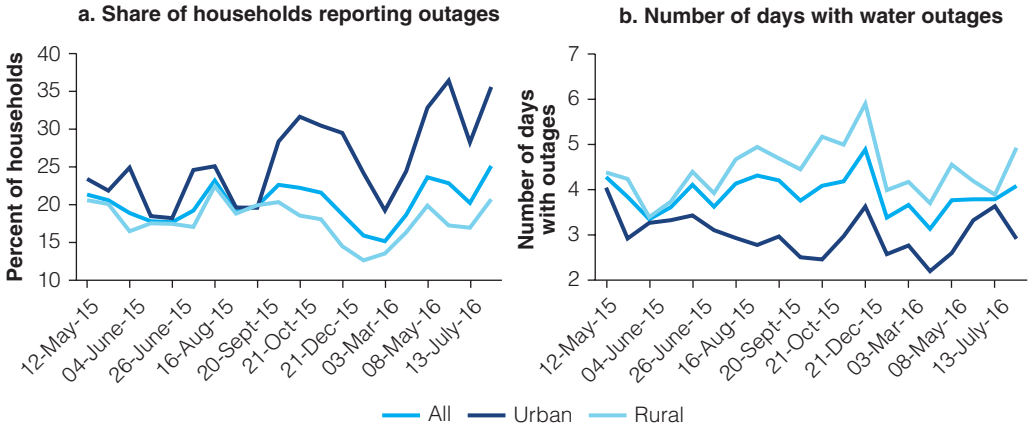
Source: Household WASH Survey 2016.
Note: B40 = bottom 40; T60 = top 60. DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

it is less than 7 percentage points in rural areas (though levels of access and availability are lower there). The gap is the largest in Dushanbe, where 98 percent of households have access to improved water on premises, but only 61 percent report that water from this source is available when needed—a 37 percentage point difference.

Households in Tajikistan experience long periods of service interruptions because of water supply infrastructure breakdowns. Although urban residents report more instances of water being unavailable in sufficient quantities when needed, rural residents experience more instances of major service interruptions that last a week or more. In the Household WASH Survey of 2016, 18 percent of households reported that there have been major interruptions in the previous year where water was not available for a week or more (ranging from 12 percent in urban areas to 20 percent in rural areas). On average, 4 such major outages were reported in urban areas in the previous year, whereas 5 outages were reported in rural areas. In both locations, outages lasted about 23 days at a time. Broken pipes and broken pumps were the most commonly cited reason for outages (42 percent of responses), followed by unavailability of water at the source (27 percent), and other service disruptions (9 percent). Many households also reported that service breakdowns have not become any less common over time. About 38 percent of rural households and 44 percent of urban households reported that breakdowns lasting more than a week were about as common in 2016 as they were five years before; about 27 percent of rural and 22 percent of urban households reported that outages have become more common over time.

Water outages increase in frequency and length during winter months, mainly because of frozen water sources, frozen pipes, or electricity outages. The Listening to Tajikistan (L2T) survey, a high-frequency phone survey, shows that about 15 to 20 percent of households experienced water outages over the 10 days preceding the interview. Although more outages were reported in urban areas, the outages lasted longer in rural areas. There was a clear seasonal pattern in the frequency and the length of water outages. In 2015–16, both the share of households reporting outages, as well as the reported number of days that the outages lasted, increased during winter months, in both rural and urban areas, especially in November, December, and January (figure 3.10). The same pattern was observed in the following winter season, 2016–17. The most common reasons for outages were unavailability

Figure 3.10: Percent of Households Reporting Water Outages and Number of Days with Water Outages in a 10-Day Period



Source: World Bank (2017, forthcoming) based on data from Listening to Tajikistan.

of water from the source (44 percent), broken pumps (12 percent), broken pipes (10 percent), and electricity outages (9 percent).

Service providers also associate water supply interruptions with poor infrastructure and electricity outages. As part of the qualitative research, interviews were conducted with representatives of water utility firms (Vodokanals) in selected parts of Tajikistan. All the regional Vodokanals visited for this study relied on electric pumps for pumping drinking water through the network. In some cases, such as in Khorugh, electricity supply to the water utility firm was rationed at the time of research, because it was in arrears with its payments to the electricity utility firm. Service providers mentioned electricity outages as the primary reason for service interruptions. Another reason cited was the outdated water supply network. Most Vodokanal equipment was installed during the Soviet period and has not been updated since the fall of the Soviet Union. The service providers claimed that most pipes, pumps, and filters need to be replaced because they break down frequently and take days to repair. Regional water utility firms do not have enough funds to update or maintain the infrastructure; in fact, service providers interviewed for this study suggested that this should be the responsibility of the consumers.

Because most water connections are unmetered, it is likely that households do not use water efficiently and underpay for the amount of water they consume. Most households in Tajikistan pay a fixed monthly fee for water, which is determined by household size, regardless of how much water is consumed. Water utility representatives believe that households use drinking water for watering kitchen gardens and trees near their premises, as well as for other domestic needs, such as washing carpets. This is particularly prevalent in spring and summer. In small towns and cities, overconsumption leads to drops in water pressure and situations whereby water does not reach higher floors of apartment buildings. The primary reason for overconsumption is believed to be lack of water meters. At the national level, only 15 percent of water connections were metered in 2016, ranging between 5 percent in rural areas to 38 percent in urban areas. Even in Dushanbe, 54 percent of households do not have a water meter. Service providers think that not all household members are registered officially, which leads to discrepancies between households' payment obligations and amounts paid. In Kurgan-Tube, a city of around 100,000 people, for example, water utility representatives estimated

that 40,000 residents were unregistered. The representatives argued this gap leads to insufficient cost recovery for the operation and maintenance of the water supply infrastructure.

Given the unreliability of drinking water supply, many households rely on multiple water sources throughout the year. In 2016, the average number of water sources used by households at any point in time was 1.1. Households living in rural areas and in Khatlon region, as well as the bottom 40 households, used more sources than the national average, and those living in Dushanbe and Sughd used fewer sources. In the qualitative research, the median number of drinking water sources reported by focus group respondents was higher (3 in rural villages and 2 in district and region centers) because many of the visited research sites had severe drinking water conditions. In urban and rural areas alike, continuous water supply is not guaranteed even for those with access to piped connections. Out of 16 focus group discussions (FGDs) conducted with households that had a connection to centralized piped systems, participants in 13 FGDs reported that they rely to a significant extent on other water sources. Only in Dushanbe and Khujand did focus group participants mention that the water supplied through the centralized piped system was sufficient. In other research sites, such as Gissar (DRS) and Istaravshan (Sughd), households diversified their drinking water sources:

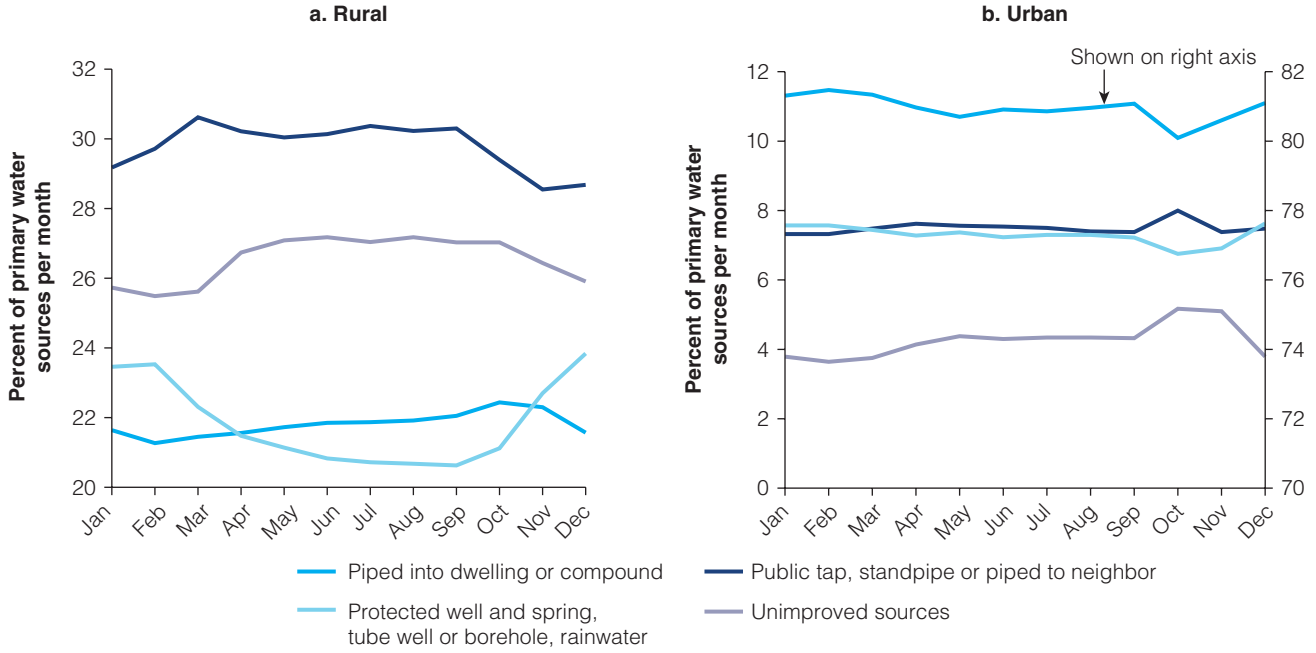
> *Water in a public tap is available only 3 to 4 hours per day. But sometimes, for example, when there is no electricity, we are left without water. When there is no water in the tap, we bring water from the river, canals, and collect rainwater. We use the water for cleaning the house, laundry as well as drinking and cooking.* —Focus group discussion with low income female participants living in houses, Gissar, DRS

> *Water from a piped network is available only on Tuesday, one day per week from the morning until 10 pm. Other days we go around the neighborhood with buckets, searching for water. Sometimes we get water from those who live in private houses and have wells. Some of us buy water in trucks, others try to store enough water on Tuesday for the whole week. In winter, the water freezes in pipes and we do not have any water, even on Tuesdays.* —Focus group discussion with low income female participants living in apartments, Istaravshan, Sughd

The composition of households' primary drinking water sources changes throughout the year, depending on the availability of water from each source; in rural areas, the pattern of water source diversification by season is especially strong. In wintertime, rural households use nonpiped improved water sources to compensate for service interruptions in piped water supply, but in summertime, households rely on unimproved water sources because water is more scarce. The share of rural households using private and shared piped water sources as their primary source (piped to dwelling, compound, neighbor, or public standpipes and taps) declines dramatically during the winter (figure 3.11, panel a) due to the infrastructure problems previously discussed. During these months, the use of other improved water sources, protected wells and springs, tube wells, boreholes and rainwater collection increases markedly. In the summer, on the other hand, when water from alternative improved sources is no longer available, households start using unimproved water sources as their primary water source (see box 3.1 for definitions). This finding is supported by the qualitative research, which found that during summer months, rural households use water from irrigation and drainage canals and surface water delivered by private water trucks. When there is no water in irrigation canals in autumn and winter, they switch back to using water from rivers as well as rain water.

In urban areas, the majority of households rely on improved water sources throughout the year, but their use of unimproved sources increases in the summer and the fall. In urban areas, most households rely on piped water connections as their primary water source (piped to dwelling or compound). The share of households with access to water from piped water connections declines in the early spring and stays low through the summer, before declining further in the fall. The same holds for other improved water sources (protected wells, springs, tube wells, rainwater collection). During these months, the share of households using public taps, standpipes, and piped connection from their neighbors' house shows an increase (figure 3.11, panel b). This is also true for the share of households using unimproved

Figure 3.11: Distribution of Primary Drinking Water Sources Used throughout the Year (Percent of Primary Water Sources Per Month)



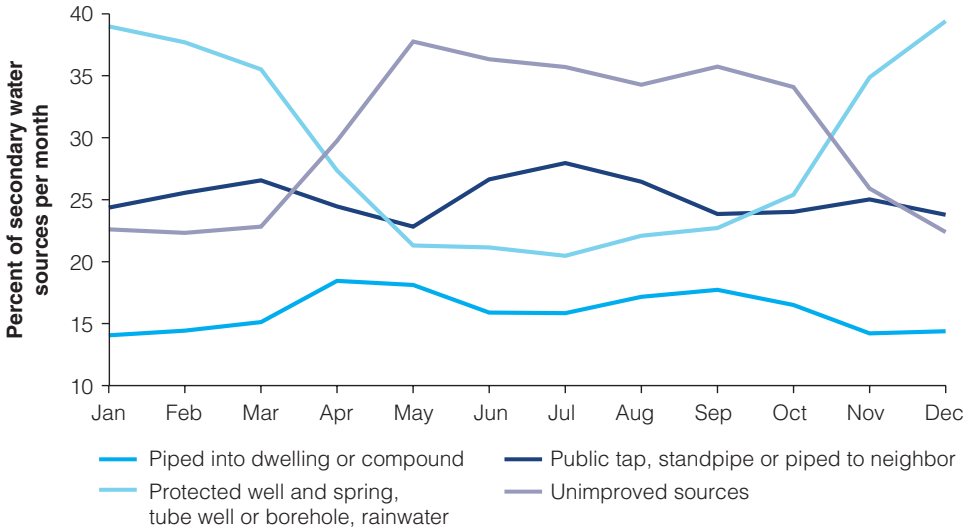
Source: Household WASH Survey 2016.
Note: The range of the *y-axis* differs for rural and urban areas. Piped water sources are shown in reference to a secondary axis for urban areas. The shares of the four water categories sum up to 100 in each month. WASH = water supply, sanitation, and hygiene.

water sources. This pattern is likely driven by increases in the demand and overconsumption of water accessed from piped sources, as well as declines in water pressure and overall scarcity of water resources during the summer.

That said, in both rural and urban areas, unimproved water sources are used as a last resort, when other primary and secondary sources are unavailable. That households increase their reliance on unimproved water as a secondary source, and only during those months when other water sources are unavailable, suggests some degree of understanding of the poor quality of water obtained from unimproved sources. As water from private piped connections fluctuate throughout the year, households supplement their primary water source with secondary water sources. These include shared connections and public standpipes, and other improved sources such as protected wells and springs, tube wells, boreholes and rainwater, which are available only in winter. In the summer, the share of households using these secondary sources falls dramatically, and is accompanied with a large increase in the share of households reporting unimproved water sources as their secondary water source. During this time, the relative share of surface water used in each month increases from about 22 percent to about 27 percent (figure 3.12). In the qualitative research, the focus group participants as well as the key informants raised a concern that the quality of the water obtained from irrigation and drainage canals, and the water delivered by private trucks and carts, is poor. The respondents associated this water with illnesses, as they are believed it to contain pesticides, chemicals, and other pollutants:

> *Women do laundry in the canal. People throw garbage directly into the canal. I arrange meetings with people all the time, and at the beginning and at the end of each meeting, I always would discuss the issue. Health depends on the quality of water. There are many cases of inflamed appendix and hepatitis because of the water.*—Local leader, rural area, Khatlon

Figure 3.12: Distribution of Secondary Drinking Water Sources Throughout the Year (Percent of Secondary Water Sources Per Month)



Source: Household WASH Survey 2016.
Note: Figure shows drinking water sources that are reported as sometimes secondary or always secondary sources in each month. WASH = water supply, sanitation, and hygiene.

There are some differences across wealth groups in terms of how they cope with limited water availability throughout the year. Mahalla (neighborhood) leaders and representatives of local government stated that in areas where functioning piped drinking water networks are no longer present, there are important differences in coping methods across wealth groups. Well-off households can afford to install pumps to deliver water from the canal/river to their house directly and construct water storage tanks (usually 2–10 tons). They can also afford to pay for water delivery by trucks, although the quality of that water is always questionable (photo 3.1). In contrast, low-income households typically do not have the means to install large underground or above-ground water storage (photo 3.2), and are able to store only 20–50 liters of drinking water. This makes them more vulnerable to changes in water availability, as they have to spend more time and effort to meet their needs through alternative methods (box 3.3).

Quality of Drinking Water

The third pillar of "safely managed drinking water" concerns the quality of water, which can be characterized by several parameters. Both pathogenic and nonpathogenic microorganisms can be found in drinking water. While nonpathogenic microorganisms typically do not pose major health risks, they can impair the taste, odor, and palatability of drinking water. They can also affect how water reacts with other chemicals and with physical conditions. The main concern, however, lies with the presence of disease-causing organisms in drinking water, which are derivatives of fecal contamination. In this study, the presence of such pathogens is detected through tests of an indicator organism, *E. coli*. In addition, tests are conducted for pH (acidity or alkalinity), total dissolved solids (TDS) concentrations, free and total chlorine levels, and nitrate levels (box 3.4). For all tests, water quality is assessed based on samples from the point of consumption for about 1,000 households and from the drinking water source for about 500 households. The results are assessed against acceptable parameter ranges defined by the World Health Organization (WHO) and the national guidelines used by the government of Tajikistan (see Appendix E for details).

Photo 3.1: Water Trucks (Rudaki Raion, DRS)

Source: World Bank.

Photo 3.2: A Container for Collecting Rain Water (Rudaki Raion, DRS)

Source: World Bank.

Water quality tests indicate the presence of relatively high levels of coliform bacteria in drinking water in Tajikistan. Coliform bacteria are present in the environment and in feces of animals and humans. Its presence in drinking water can indicate the possibility, but not the certainty, of disease-causing pathogens. In Tajikistan, 57 percent of the water consumption point tests and 55 percent of the water source tests show presence of total coliforms in drinking water. A higher share of the bottom 40 households had coliforms in their drinking water, both at the

Box 3.3: Diversification of Water Sources by a Family in Istaravshan

Istaravshan is one of the oldest and largest cities located in the Sughd region in northern Tajikistan. The city has modest access to improved drinking water sources, including piped water on premise. However, water availability is not always reliable, particularly in apartments like the one occupied by Behnaz family. The family has six members, including four children, who all live in a two-room apartment. The family relies on the salary of the wife of the household head, who works as a janitor in a local school. Her income is TJS 350 ($ 40–50) per month. The household head is unemployed, and there are no other sources of income.

The apartment is located on the top floor of four-floor apartment building. Because water pressure is poor, the water does not reach that floor, meaning that household members need to bring and store enough water in their apartment from other sources. One such source is a public tap on the street. Usually, the wife undertakes this task. The household needs at least 60–80 liters of water per day, most of which goes to flush the toilet (40–50 liters per day). To store the amount of water, the wife needs to go to the tap three or four times per day and carry two heavy buckets back to the fourth floor on foot, as there is no elevator in the building. Doing laundry requires 160–180 liters and the woman makes 8–9 trips to the tap to be able to store the required amount of water. Sometimes water freezes in the pipes, or there is no water in the tap. Then she searches in the neighborhood for water.

Although water does not reach the apartment, the household receives a bill from the local water utility firm (Vodokanal). The bill is estimated based on the number of household members, and the household pays around TJS 20 per month (6 percent of household income) for the water supply. The wife experiences frequent kidney and joint pains because of carrying heavy buckets of water to the fourth floor. She does not allow her children to help her, to save their health. At the same time, she does not allow her husband to help her, thinking that neighbors will make fun of him.

Source: World Bank team's qualitative field research.

water source and at the consumption point. As expected, coliforms are also more commonly detected in water sources used by rural households (58 percent) than in urban households (49 percent). This is consistent with the fact that open and unprotected water sources are more common in rural areas. At the water source, Sughd and Khatlon have the highest share of coliforms (79 percent and 62 percent, respectively). They are followed by GBAO.[4] At the consumption point, in addition to these regions, Dushanbe has a high proportion of tests indicating coliform presence (67 percent).

Despite high presence of bacteria, only a few incidences of *E. coli* are detected in drinking water, suggesting that fecal contamination is not a major concern in Tajikistan.[5] This means that the SDG criterion of zero *E. coli* in 100 mL sample of the household's drinking water has less of a downward bearing than the other component criteria. At the national level, only 1.9 percent of the tested water sources and 1.2 percent of the water samples taken from consumption points have *E. coli* presence above the maximum threshold of

Box 3.4: Water Quality Testing in Tajikistan

For water quality testing, a module was added to the Household WASH Survey, which built on the Multiple Indicator Cluster Survey (MICS) water quality modules, and a manual was developed by the World Bank team to guide the fieldwork. An advantage of implementing water quality tests as part of the household survey is the ability to link water quality information to household characteristics, ranging from those directly related to drinking water, such as the type of water source and household water treatment, to socioeconomic characteristics, such as wealth.

In this study, pH, total dissolved solids concentrations, free and total chlorine levels, nitrate levels, and the presence of *E. coli* are tested. Two sampling locations of interest were used when collecting drinking water samples: point of consumption and water source. The point of consumption represented the quality of water just before ingestion, explained to households as the water given to a child to drink. The source water test was performed on households' main source of drinking water, which was obtained directly from the source by the research team. The water samples were preserved in local laboratories in each region and water quality was tested through a water testing kit. The results are compared against the World Health Organization (WHO) Guidelines for Drinking Water Quality, as well as against the national water quality standards used by the government of Tajikistan. While each of these microbiological, physical, and chemical parameters provide insights into the quality of drinking water, it is important to note that contamination can be highly variable in time and can escape detection.

Source: World Bank team based on JMP (2017), WHO (2017), State Sanitary and Epidemiological Service (2007), and State Standard of the Union of USSR (1982).

0/100 mL (table 3.1). As expected, water sources in rural areas (2.2 percent) and water sources used by the bottom 40 households (2.7 percent) have higher proportions of samples with *E. coli* than those used by households in Khatlon region (3.7 percent). At the point of consumption, the bottom 40 percent and households in Sughd region have contamination rates (1.6 percent) above the national average. Interestingly, water samples from improved and unimproved water sources have almost the same proportion of *E. coli* contamination at the source, and negligible differences at the point of consumption. Overall, low *E. coli* contamination can partly be explained by the fact that slightly less than 1 percent of the population practices open defecation in Tajikistan (see Chapter 4). Given low levels of fecal contamination in drinking water, there is no correlation between *E. coli* presence and its most commonly associated manifestation in households, reported incidences of diarrhea.

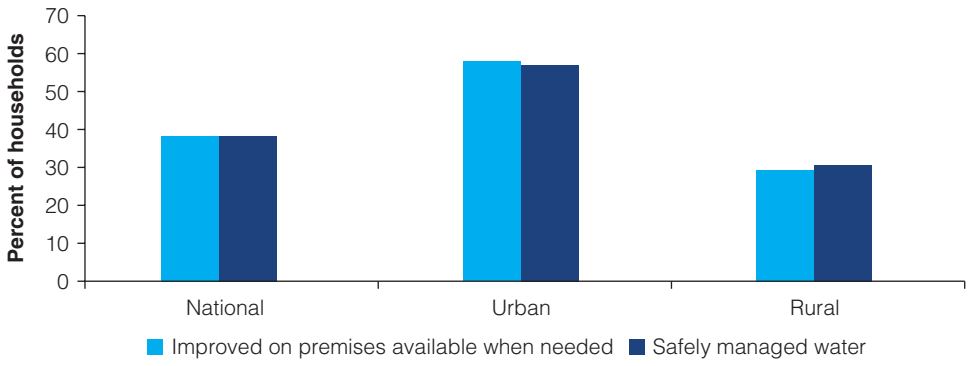
Since fecal contamination is low, the share of households with access to safely managed water is similar to the share with access to improved water sources on premises that is available when needed at the national level. There is, however, a difference between rural and urban areas. While 57 percent of urban households have access to safely managed water, this figure is only 31 percent in rural areas (figure 3.13). This finding is consistent with the higher rate of *E. coli* contamination found in rural water sources, as well as with the fact that open defecation in Tajikistan is practiced almost exclusively in rural areas.

Table 3.1: Proportion of Water Samples Containing *E. coli*

	Point of consumption	Water source
National	0.9	1.9
Urban	0.8	1.3
Rural	0.9	2.2
Region		
Dushanbe	0.7	0
GBAO	0	0
Sughd	1.6	0.7
DRS	0	2.3
Khatlon	0.8	3.7
Wealth		
B40	1.1	2.7
T60	0.8	1.5
Type of water source		
Improved	0.4	1.9
Unimproved	0.8	1.9
Number of samples	966	494

Source: World Bank team calculations based on Household WASH Survey 2016.
Note: The presence of *E. coli* is detected against a maximum threshold of 0/100 mL, which is the limit set by both national and World Health Organization (WHO) guidelines. WASH = water supply, sanitation, and hygiene.

Figure 3.13: Access to Safely Managed Water, 2016 (Percent of Households)



Source: Household WASH Survey 2016.
Note: Access to "safely managed drinking water" is calculated based on the subsample of households for which water quality data is available. Access to "improved water that is on premises and available when needed" is based on the full household sample. WASH = water supply, sanitation, and hygiene.

The chemical characteristics of the drinking water in Tajikistan largely comply with the national and WHO guidelines (except for chlorine concentration), although this does not necessarily mean that the water quality is good. The comparison of the water test results with national guidelines show that the levels of pH, total dissolved solids, and nitrate found in drinking water comply with the parameters set out by the State Sanitary and Epidemiological Service.

However, the compliance rates per the WHO guidelines are approximately 20–35 percentage points lower for pH and TDS (table 3.2). Because these two tests have a direct impact on the acidity and palatability of water, such differences imply that drinking water in Tajikistan has lower quality than globally accepted standards. For example, it is more likely to contain inorganic salts and other organic matter, as well as corrosive compounds and traces of heavy metal. In Tajikistan, water used by rural households has statistically significantly higher pH values, TDS values, and nitrate levels at the point of consumption. On the other hand, total and free chlorine levels in the tested water samples are far from being compliant with national and WHO guidelines, either at the point of consumption or at the water source, which may have significant impacts on public health (see Appendix E for the rural-urban division of compliance rates).

The pH levels of drinking water samples are higher for rural households, as well as for households that treat their water before drinking. While pH is an important parameter to consider, it poses minimal health risks to humans and is more commonly used as an evaluator of acidity or alkalinity. It may indicate pipe corrosion along the water distribution system, and can affect the effectiveness of water treatment and disinfection at the point of consumption. In Tajikistan, pH values at the point of consumption are statistically significantly higher in rural areas than in urban areas. This may be due to rural household's greater reliance on protected wells and springs, which may be naturally more alkaline in certain regions. However, pH values

Table 3.2: Compliance of Household Water Quality Samples with National and WHO Guidelines

Test	Number of samples	Mean parameter test value	Acceptable parameter range	Percentage of samples compliant with national guidelines	Percentage of samples compliant with WHO guidelines
pH					
Point of consumption	1000	8.1 pH	pH 6-9 (national), pH 6.5-8.5 (WHO)	100	82
Water source	495	8.2 pH		100	66
Total dissolved solids					
Point of consumption	1000	471 mg/L	<1000 mg/L (national), <600 mg/L (WHO)	95	68
Water source	495	477 mg/L		96	70
Nitrate					
Point of consumption	1000	13.9 mg/L	<45 mg/L (national), <50 mg/L (WHO)	100	100
Water source	497	14.2 mg/L		99	99
Total chlorine					
Point of consumption	1000	0 mg/L	1.1-1.7 mg/L (national), <5 mg/L (WHO)	0	n.a.
Water source	497	0 mg/L		0	n.a.
Free chlorine					
Point of consumption	1000	0 mg/L	0.3-0.5 mg/L (national), 0.2-0.5 mg/L (WHO)	1.0	1.2
Water source	497	0 mg/L		0.9	0.9

Source: World Bank team calculations based on water quality data in Household WASH Survey 2016.
Note: National guidelines: GOST 2874-82, State Standard of the Union of USSR, 1982; State Sanitary and Epidemiological Service (SSE) 2007. WHO guidelines: WHO 2017. mg/L = milligrams per liter; WASH = water supply, sanitation, and hygiene; WHO = World Health Organization. n.a. = not applicable.

do not vary significantly by water source. Values are not significantly lower for piped dwelling, piped compound, and piped neighbor sources, as would be expected in the case of corrosive pipes. The WHO compliance levels are lower at the point of consumption in households that boil or filter their water, which may suggest the use of unclean filters.

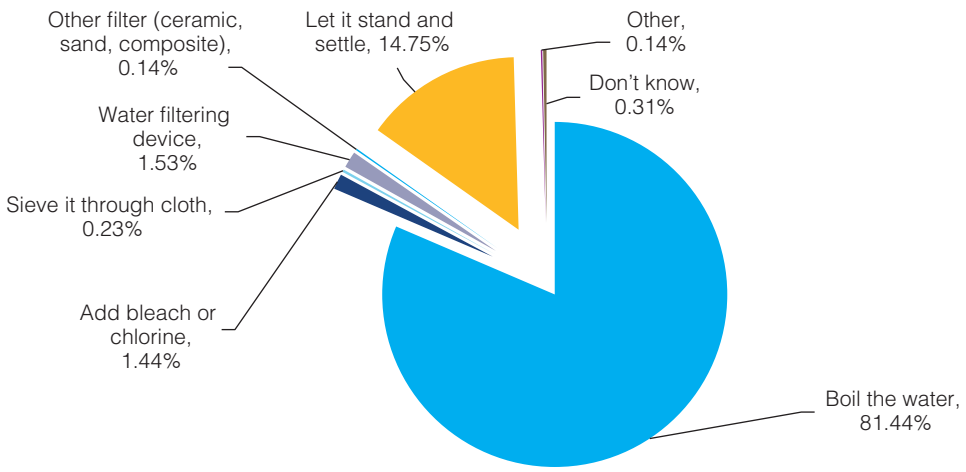
While total dissolved solids (TDS) concentrations largely comply with the national guidelines, the drinking water in Tajikistan tends to be less palatable than globally accepted standards. TDS is a measure of the amount of inorganic salts and organic matter present in drinking water, which directly affects its taste. When high concentrations of chlorides, sulfates, magnesium, calcium, and carbonates are present in the water, encrustation is likely to occur in water treatment and distribution systems. Pipe corrosion can also leach heavy metals into the water supply. In Tajikistan, while TDS levels of drinking water samples comply with national standards, the latter includes concentration levels that are considered "poor" and "fair" on the World Health Organization's palatability scale.[6] In addition, TDS levels for water source and for the point of consumption are significantly higher among rural households than urban households. The bottom 40 percent households also have higher TDS levels than the top 60 percent, but only at the point of consumption, which is likely driven by differences in the water sources used by these two groups. This is supported by the TDS values of different water sources. The sources more prevalent among rural and bottom 40 households—tube well, protected well, protected spring, and cart with small tank sources—have the highest average TDS concentrations.

Nitrate concentrations are within the national and WHO limits, but rural households are exposed to higher levels of nitrate that can be harmful to their health beyond a certain threshold. Nitrates are naturally present in the environment and are often found in fertilizers. They become integrated with drinking water supplies most commonly through agricultural activity, animal farming, wastewater treatment, and septic tanks. Exposure to high concentrations of nitrate can hinder the ability to transport oxygen, particularly for young infants, pregnant women, and the elderly. In Tajikistan, nitrate concentrations in drinking water are within the acceptable range. However, the sources more prevalent among rural households—piped compound, shared piped connection to neighbor, and public taps—have higher nitrate concentrations than other sources. Hence, rural households have statistically significantly higher nitrate concentrations, both at the water source and at consumption point. This conforms to expectations, as rural households are more likely to be exposed to contamination by agricultural runoff, septic wastes, and animal farming.

Finally, average chlorine concentrations in drinking water vary by the type of water source, but generally chlorine levels in the drinking water do not comply with any guidelines, with potentially significant implications on public health. Total chlorine refers to the total chlorine content in a sample of water. It is classified into combined chlorine and free (or residual) chlorine. The concentration of free chlorine represents the amount of unbound chlorine ions, which can disinfect pathogens that enter the water after the water has left the disinfection facilities. None of the tested water samples for Tajikistan comply with the national or WHO guidelines for total chlorine concentration in drinking water, while only about 1 percent complied with the guidelines for free chlorine concentration. This is concerning, given that the presence of free chlorine at the point of consumption is considered confirmation that the most dangerous organisms have been removed and the drinking water is safer for consumption. That said, average chlorine levels at the source depend on the type of water source, with piped compound connections having higher concentrations of total and free chlorine and surface water having lower concentrations. While this is expected, as piped water generally originates from treatment facilities where chlorine disinfection is likely to be practiced, it is curious that the same pattern does not hold for piped connections to dwelling or public taps. Overall, insufficient concentrations of chlorine increase the possibility of the contamination of drinking water after it leaves the treatment plant.

The low chlorine levels in the drinking water are consistent with the fact that chlorine is not a common water treatment method in Tajikistan. In the Household WASH Survey, 75 percent of households report that they treat their drinking water before consumption. However, only less

Figure 3.14: Water Treatment Methods Used by Households in 2016 (Percentage of Responses)



Source: Household WASH Survey 2016.
Note: The figure shows the share of responses for each category. N = 2600 multiple responses by 2,270 households that reported treating their drinking water from the main source. WASH = water supply, sanitation, and hygiene.

than 1.4 percent of these households list "adding bleach or chlorine to the water" among their treatment methods (figure 3.14). The most common treatment method is boiling before consumption (more than 81 percent of responses), followed by letting the water settle (about 15 percent of responses). Other treatment methods, such as using a water filtering device or other filters (ceramic, sand, or composite filters), are scarcer, together making up only 2 percent of the responses. Further, the data suggest that the common water treatment methods in Tajikistan may not contribute to chlorine retention in water. For example, free chlorine compliance percentages at the point of consumption are higher for households that let the water stand and settle, as compared to households that boil their water. This is because boiling water is an effective means of removing residual chlorine. Water storage practices can also result in dissipation of chlorine. High temperatures and the presence of light, for example, provide favorable conditions to support the reactions of chlorine compounds dissolved in water. Chlorine also evaporates faster when exposed to air—that is, when drinking water is stored in containers without lids. Indeed, in the Household WASH Survey, 13 percent of respondents had no lids over their water storage container and only 21 percent of the drinking water sources were identified by data enumerators as "not protected."

Spatial Distribution of Poverty and Drinking Water Conditions

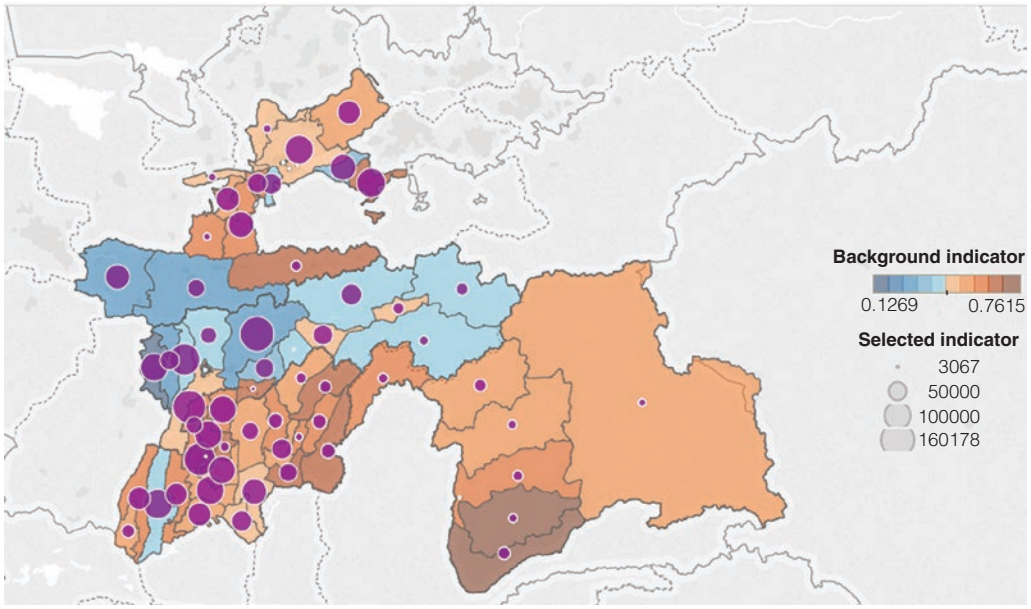
Available secondary data shows an overlap between poor drinking water conditions and poverty at the district level, providing a visual tool to help identify priority areas for intervention across Tajikistan. This section presents the results of the spatial mapping of poverty and drinking water conditions based on data from the 2010 Population and Housing Census. Two types of maps are presented: maps that present WASH conditions as directly taken from the census, and maps that present WASH conditions imputed to the census, using data from the TLSS 2009 survey. The TLSS 2009 survey is used for imputations instead of more recent data sources because it was administered near the time of the 2010 census. These data, while not as current as other data sources used in this report, adds an additional layer of analysis that can inform targeting decisions. The discussion that follows highlights selected snapshots

from the maps. Interactive census-based mapping and TLSS imputed mapping platforms allow users to select indicators for welfare, WASH conditions, and various subpopulations.[7]

The population with the poorest drinking water conditions are largely concentrated in districts with high poverty rates, particularly in Khatlon and Sughd. The poverty WASH maps show that large groups of people who rely on open water or an open well for their main drinking water source are concentrated in the river valleys in Khatlon region in the southwestern districts of Tajikistan, as well as in Sughd region in the northern part of the country. This is seen from the larger size of the purple circles representing population size using surface water or wells as their main source. Map 3.1 is based on the census and map 3.2 is based on the TLSS 2009. In Khatlon and Sughd, the proportion of the population living in poverty is also high, as is shown by the brown and dark brown colors representing district poverty rates. In addition, a considerable number of people indicated in the census that no water was available in their area, with the largest concentration of this group located in the poor district of Rudaki, just south of Dushanbe (map 3.3). There are some exceptions to this pattern. For example, DRS region, which is less poor as compared to other regions, also contains a number of districts with a large number of people relying on open water and wells. On the other hand, the poorest region of Tajikistan, GBAO, is thinly populated and therefore has a relatively lower density of people relying on open water or wells or having no water in their area, although this affects a large share of GBAO's poor population (box 3.5).

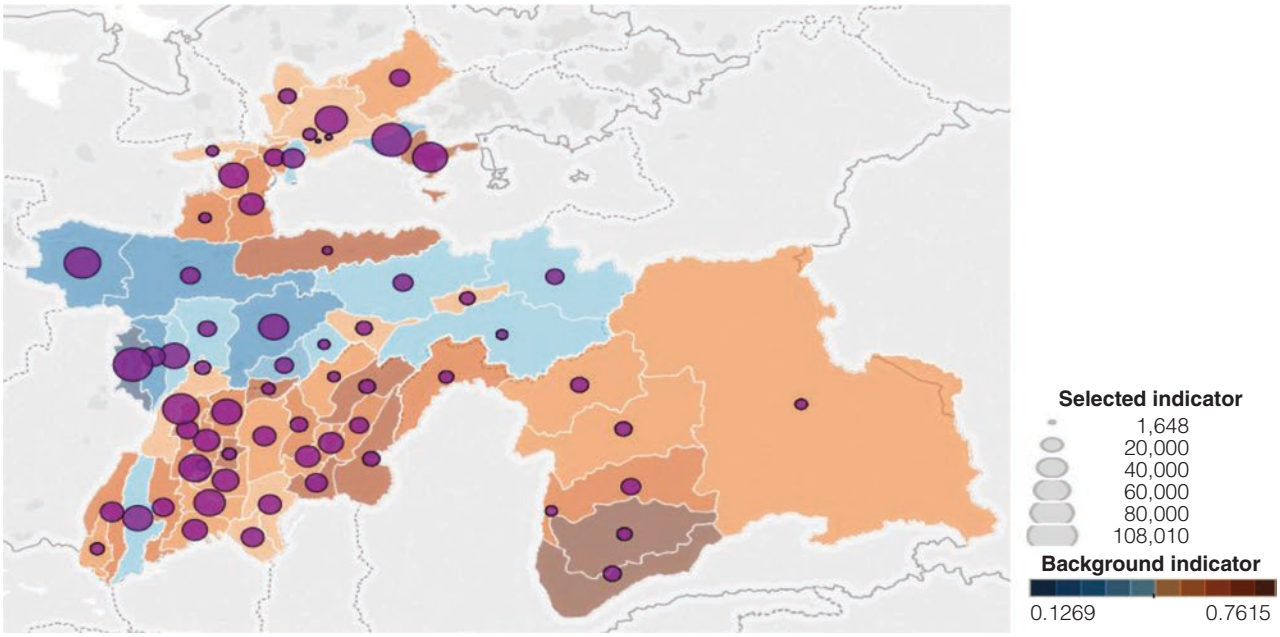
The distribution of the rural population who rely on surface water resembles that of the whole population, whereas urban residents with poor water access are concentrated in only

Map 3.1: Number of People Whose Main Source of Drinking Water Is Open Water or an Improved or Unimproved Well, as Reported in Census 2010



Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census. Estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this water condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Map 3.2: Number of People Whose Main Source of Drinking Water Is Open Water or an Unimproved Well, Data Imputed from TLSS, 2009



Source: TLSS 2009 and Census 2010.
Note: The reported water and sanitation variables and estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this water condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

a few districts. That there is virtually no difference between the maps showing the number of people who rely on open water or wells at the national level and in rural areas, reiterates that rural residents are disproportionally overrepresented in access to surface water among the Tajik population. Accordingly, it is not surprising that a considerably fewer number of people rely on open water or wills in urban areas across the country, as shown by smaller purple circles in map 3.4 and map 3.5. That said, the urban population with access to surface water is heavily concentrated in Dushanbe and a few districts of Sughd, DRS and GBAO. These include Khujand, the second largest city in Tajikistan in Sughd region; Khorugh, the capital of GBAO region; and Rudaki district in DRS region. These can be considered priority areas for urban investments.

Children with the worst poverty and WASH conditions live in Khatlon and Sughd, according to the "WASH deprivation index." The index shows the households that have children and fare worst in terms of poverty and WASH conditions. It thus captures this intersection for the children population. It has three dimensions: monetary poverty, presence of children age 0–6 in the household, no connection to a sewer system and no access to piped water. Each of the dimensions is given equal weight. A household is considered "deprived" if the index is greater than 0.5. As shown in map 3.6, the highest number of WASH deprived households are found in Khatlon region and in the northern districts of Sughd. When the background indicator is changed from the percentage of people living below the poverty line to the percentage of people who are WASH deprived, some districts in Sughd and DRS that are not among the poorest become the districts with the highest proportion of WASH-deprived population (map 3.7). These include Faizobod district in Sughd, as well as the Rasht, Tavildara, and Jirgatol districts in DRS.

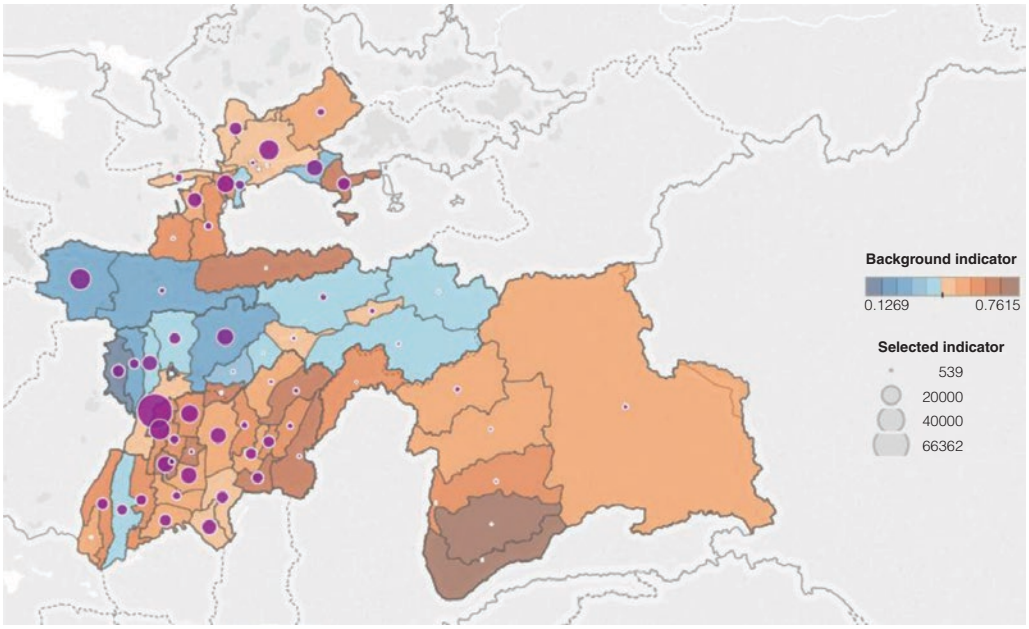
Box 3.5: Surface Water as the Default Water Source in GBAO

The GBAO region has the lowest access to improved water sources in Tajikistan, as well as the highest prevalence of households using surface water as their main drinking water source. For rural and poor households living in GBAO, surface water is the default water source option.

Gulnara, a 47-year-old widow living in rural GBAO, is the head of one such household. She has three children and works as a teacher at a local school. Gulnara's village used to have a functioning centralized water supply scheme during the Soviet period, but the equipment has been broken for years. The main source of water for the household, as well as other households from the area, is a river. The river, however, freezes in January and February. During these months, family members collect rainwater and melt snow to use as a source of drinking water. The household requires at least 10–20 liters of water per day for drinking and domestic needs. The river is located about 150–200 meters from the house. Household members think that the quality of the water is poor—it smells, contains some dirt, and has a strong taste—and therefore they usually boil the water before drinking. They think that the quality of this water source is not monitored or addressed by any organization, but have no other choice than consuming water from it throughout the year.

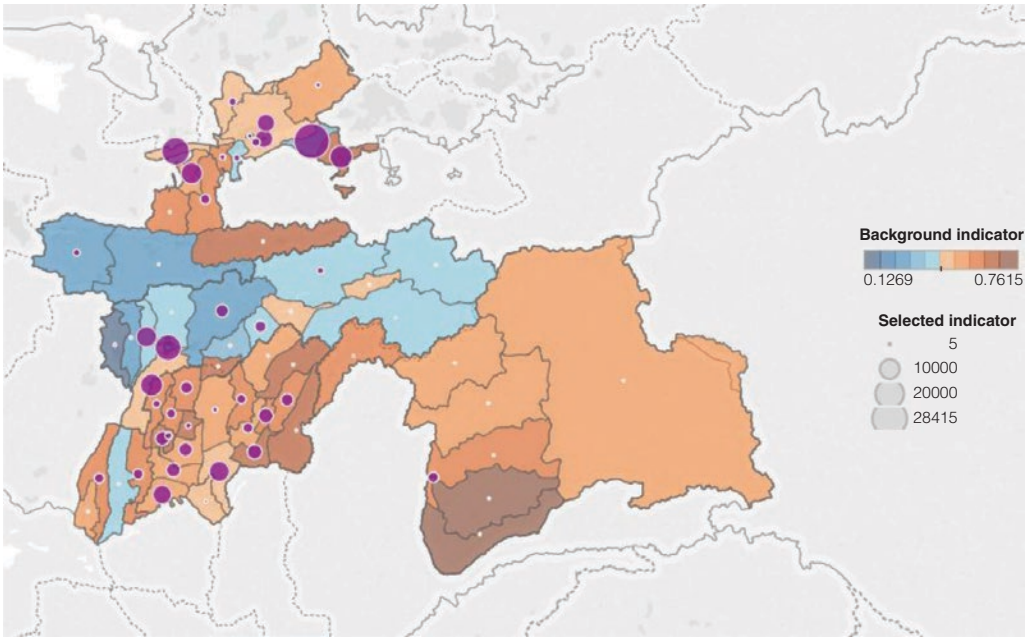
Source: World Bank team's qualitative field research.

Map 3.3: Number of People Who Indicated Water Is Absent in their Area, as Reported in Census 2010



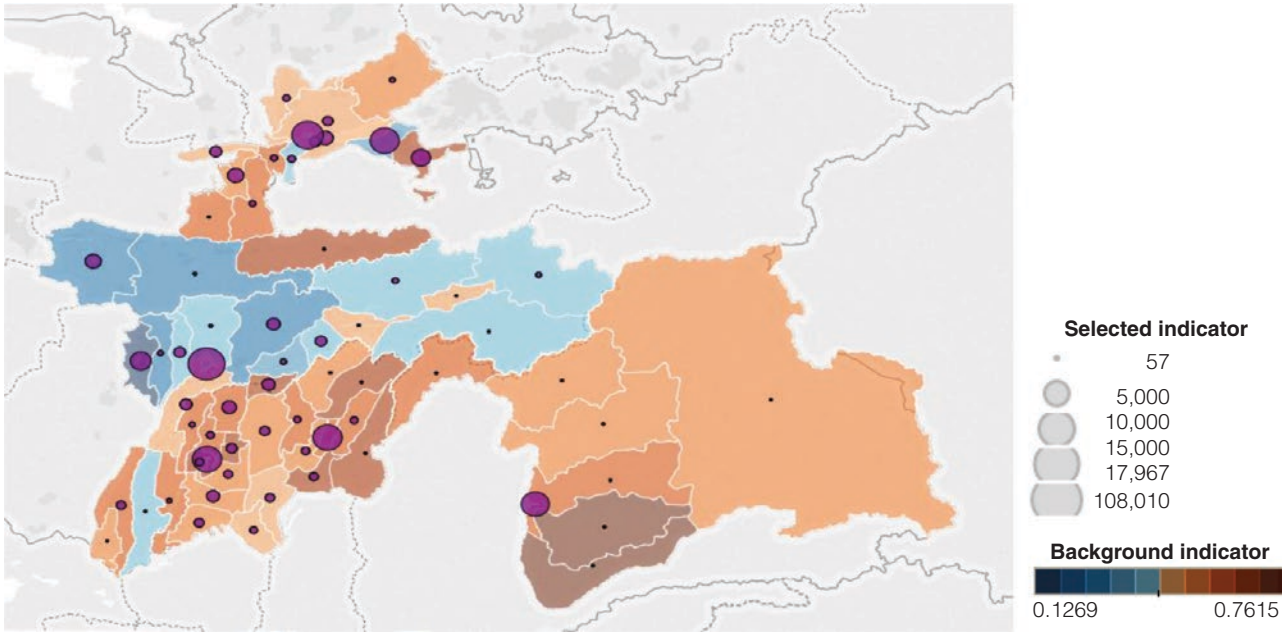
Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this water condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Map 3.4: Number of People in Urban Areas Whose Main Source of Drinking Water Is Open Water or an Improved or Unimproved Well, as Reported in Census 2010



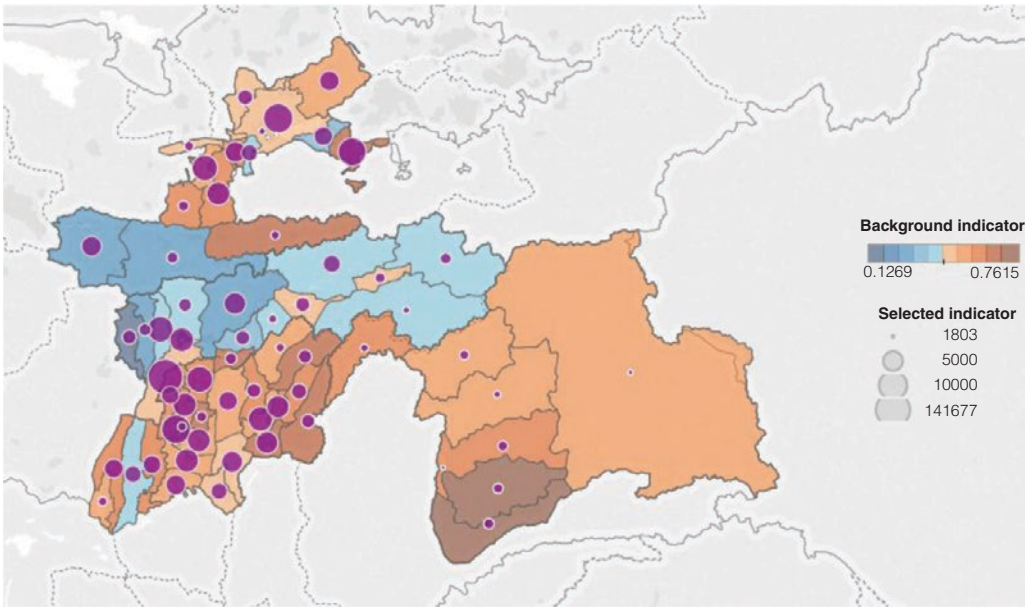
Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this water condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Map 3.5: Number of People in Urban Areas Whose Main Source of Drinking Water Is Open Water or an Unimproved Well, Data Imputed from TLSS, 2009



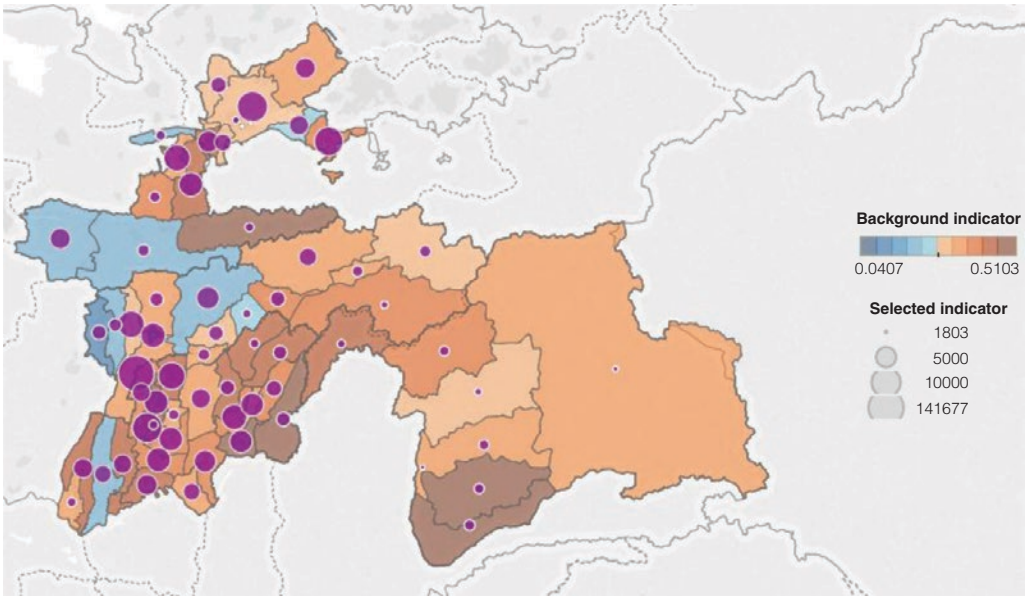
Source: TLSS 2009 and Census 2010.
Note: The reported water and sanitation variables and estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this water condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty.

Map 3.6: Number of People Who Are WASH Deprived, as Observed in Census 2010, with Poverty Rate as the Background Indicator



Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this water condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty.

Map 3.7: Number of People Who Are WASH deprived, as Observed in Census 2010, with WASH Deprivation Index as the Background Indicator



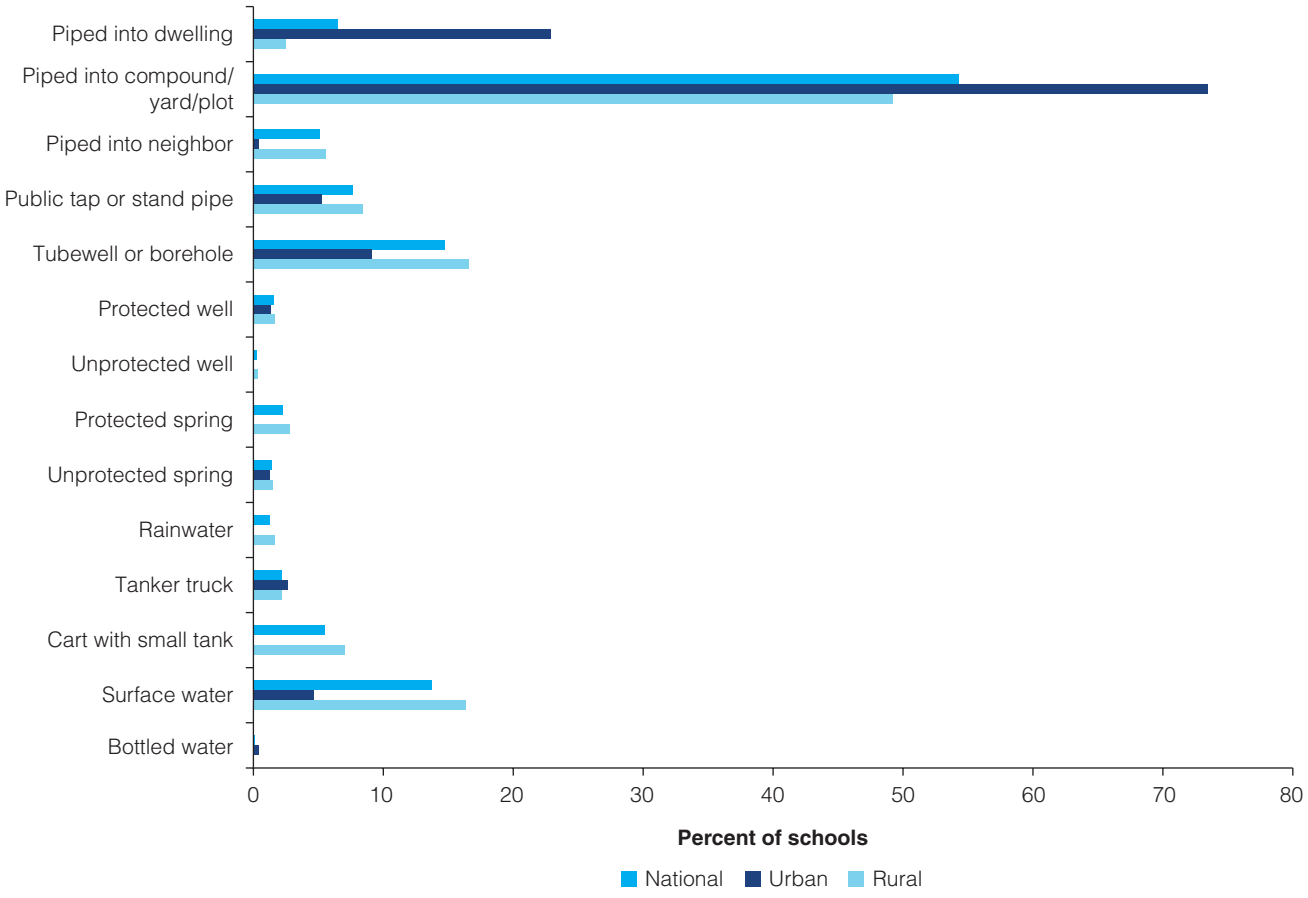
Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with high WASH deprivation in a district. Background color is the WASH deprivation rate, with the darker brown indicating high deprivation. WASH = water supply, sanitation, and hygiene.

Drinking Water Conditions in Schools

In Tajikistan, basic education covers nine years of compulsory schooling at the primary and lower secondary level for children ages 7–16. Together referred to as "basic education," primary education (grades 1–4) starts at age seven and spans four years of schooling, and is followed by five years of lower secondary schooling (grades 5–9). In many areas, primary and lower secondary schools are combined and referred to as "basic schools," which is the terminology adopted here. In the School WASH Survey, 302 basic schools (an overwhelming majority of which were combined primary and lower secondary schools) were selected on the basis of whether or not they served the primary sampling units (PSUs) that participated in the household survey. The survey gathered information on WASH services for a nationally representative sample of these schools, which represents the most comprehensive contribution to SDG monitoring in this domain to date to Tajikistan (see box 3.1). Drinking water was also tested in every case.

Most schools have access to piped water sources in their yard, but a significant proportion rely on open drinking water sources that may pose a health risk for children. The majority of schools (55 percent) report a piped water source in the yard, compound, or plot as the main source of drinking water. There is, however, a large disparity between schools located in rural areas versus those located in urban areas (figure 3.15). While 74 percent of urban schools have

Figure 3.15: Distribution of Main Drinking Water Sources in Schools, Tajikistan, 2016 (Percent of Schools)



Source: School WASH Survey.
Note: N = 298 schools. WASH = water supply, sanitation, and hygiene.

access to water piped into compound or yard, this is the case for only 50 percent of rural schools. Moreover, a large proportion of schools rely on open or unimproved water sources. For instance, 15 percent of schools use a tube well or borehole as the main water source nationally, while 13 percent reported surface water. These figures are even higher in rural areas, where 17 percent of schools rely on a tube well/borehole and 16 percent of schools rely on surface water as the main source of drinking water, as compared to only 9 percent and 5 percent of schools in urban areas.

Since schools rely on the same water sources and face the same service conditions as households living in the same area, the regional disparities observed at the household level also apply to the school level (box 3.6). The largest differences are observed in schools in Dushanbe compared to schools located elsewhere in Tajikistan (figure 3.16). Dushanbe has Tajikistan's highest share of schools (about 38 percent) that have a water source piped into the dwelling as the main source of drinking water. In addition, 92 percent of schools in Dushanbe use piped water in the compound, yard, or plot and 4 percent use piped water from neighbors. No schools use open sources as their main source of drinking water. The region closest to Dushanbe on using piped water are Sughd and DRS, where 63 and 64 percent of schools, respectively, use piped water in the compound, yard, or plot as the main source of drinking water. Sughd, however, also has a large proportion of schools that rely on surface water

Box 3.6: Local Water Sources and Conditions in Social Buildings

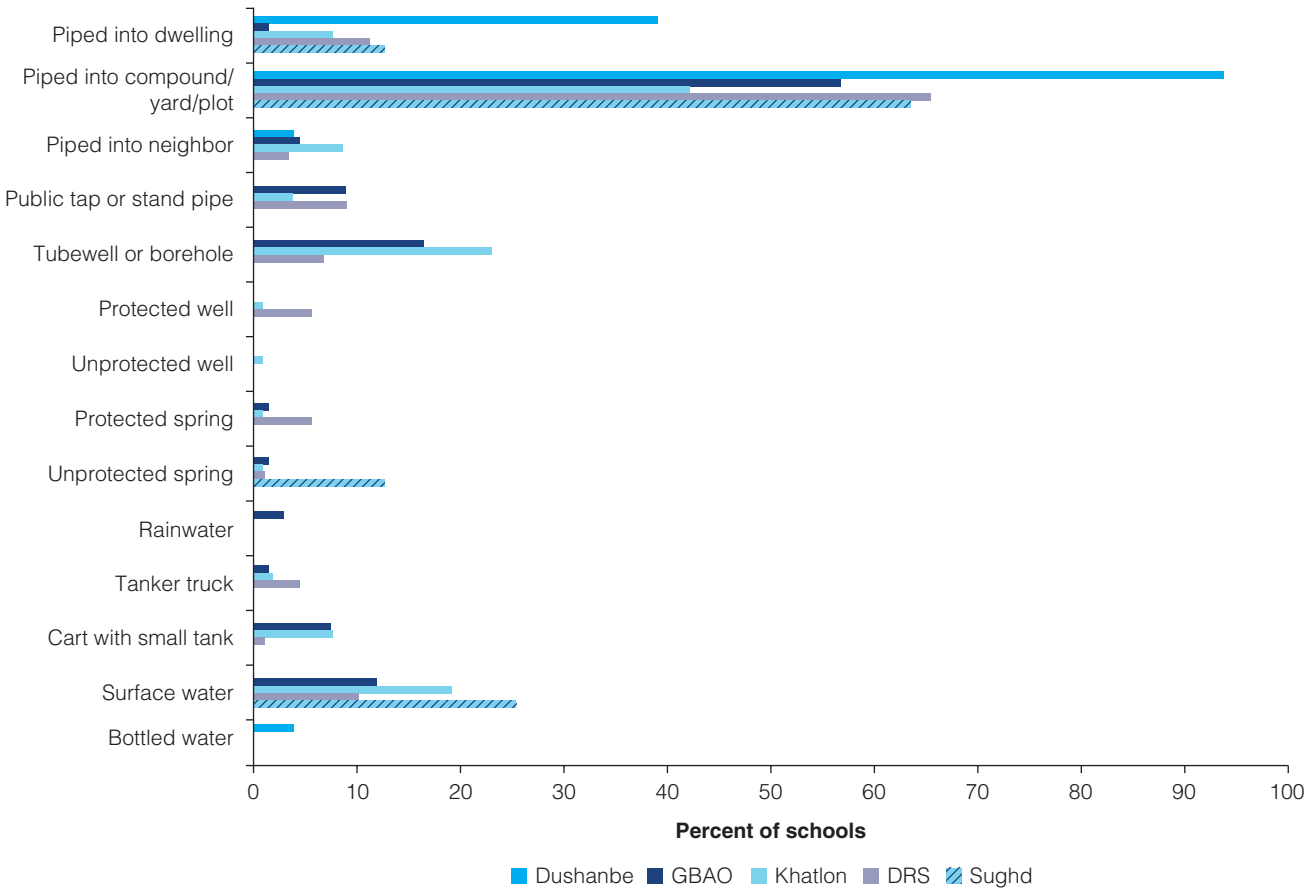
There are hardly any differences between the water sources used by households and schools across Tajikistan, according to representatives of schools (and health care facilities) interviewed for this study. In urban areas, frequent interruptions in water supply and low water pressure affect schools or clinics located at top floors of multistory buildings.

For example, a clinic in Gissar town that the research team visited is located in a three-floor building. The water does not reach the top floor. The clinic staff and patients have difficulties flushing toilets and washing hands. To store enough water on the top floor, building maintenance staff must carry water in buckets from the first two floors to the third floor several times a day. Similarly, the hospital in Dushanbe has a five-floor building. Water does not reach the fourth and fifth floors. The hospital had to install additional electric pumps to deliver water to the top floors.

The situation is even worse in rural areas. For example, Demnora village, in Sughd region, is located 46 km from the raion center and contains 935 people. The quality of water in the village is extremely poor. The only source of water is several pools and ponds (earthen pits filled with water). The water in the ponds/pits comes from a private well that is located in another village (8 km away) by earthen ditches and canals. It arrives only twice a month. The local school and health clinic receive water from the same source, with significant health impacts on the children and the ill. Local respondents said that nobody has checked the quality of water in the past two or three years. Village residents pay the owner of the well to deliver water, but the water is hardly drinkable. It has a strong smell and is filled with dirt, and is believed to cause frequent cases of different diseases in the village.

Source: World Bank team's qualitative field research.

Figure 3.16: Main Drinking Water Sources in Schools in Tajikistan, by Region, 2016 (Percent of Schools)



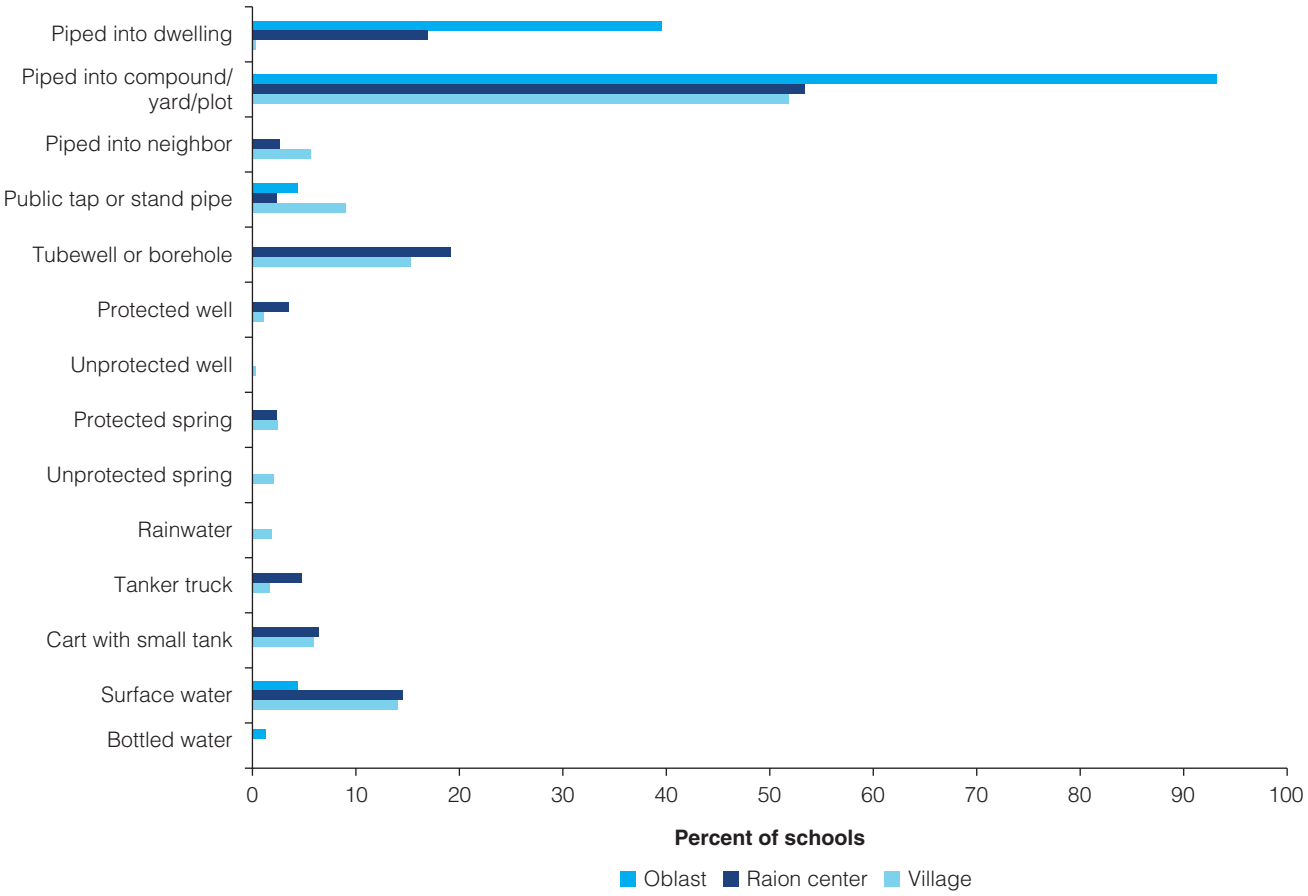
Source: School WASH Survey. N = 298 schools.
Note: N = 302 schools. DRS = Districts of Republic Subordination; GBAO = Gorno-Badakhstan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

(25 percent) and unprotected springs (13 percent). GBAO has the lowest proportion of schools have the water source piped into dwelling as the main source of drinking water (1 percent). This low figure indicates that in addition to facing poor drinking water conditions at home, children living in GBAO also have the worst conditions in their schools.

In addition to differences by region and rural-urban location, there are large disparities between schools located in oblast centers vis-à-vis schools in district centers and villages. A larger proportion of schools at the village and district (raion) levels use open sources of water for drinking purposes compared to schools in regional centers (oblasts) (figure 3.17). While 93 percent of schools in the oblast centers use a water source piped into the compound, yard, or plot, only half the schools in villages and districts do so. In addition, 19 percent of schools at the raion level use a tube well or a borehole, whereas 15 percent use surface water. However, 17 percent of schools at this level have a water source piped into the dwelling for drinking purposes compared to 40 percent of schools at the oblast level. At the village level, 15 percent of schools use a tube well or borehole, whereas 14 percent use surface water.

A larger proportion of primary schools that younger children attend use open water as their main source of drinking water. For example, 22 percent of primary schools use surface water compared to 13 percent of basic schools. Similarly, 18 percent and 10 percent of primary

Figure 3.17: Main Drinking Water Sources in Schools in Tajikistan, by Administrative Level, 2016 (Percent of Schools)



Source: School WASH Survey.
Note: N = 298 schools. WASH = water supply, sanitation, and hygiene.

schools use a cart with a small tank and rain water as the main source of drinking water, respectively, compared to 12 percent and 0 percent of basic schools for the same indicator. Many schools use water from open sources such as wells, springs, rain water, or melted snow, as well as use water delivered by trucks. School officials and the parents consider the quality of water in some of the schools very poor of children attending these schools. No funds were reported to be allocated to meet drinking water and sanitation needs in schools. Costs must be met by the community or parents.

> *There is only one school in our area. Children from two villages study there. People from the village collected money last year, purchased a pump and connected the school to the water from the river. But the pump has broken down; now there is no water in the school. Water is delivered by trucks from the river now.*—Local leader, rural area, DRS

> *There is only one water source for us, the river Kofarnikhon. The water cannot even be considered drinking water… Schools lack drinking water for children. And we have to take measures, ask parents for help. Every student brings to school a bottle with boiled water.*—School maintenance staff, rural area, DRS

Water quality results for schools are similar to those at the household level, suggesting that despite the prevalence of open sources, there is little evidence of presence of harmful

pathogens in drinking water in schools. For the schools included in the School WASH Survey, the same pH, TDS, nitrate, total chlorine, free chlorine, and *E. coli* samples were collected, using the same equipment and protocol applied at the household level. Only water from the consumption point was tested because many schools in Tajikistan do not treat drinking water obtained from the water source (less than half the schools reported treating water in the School WASH Survey, and more than half of these only boiled water). The findings indicate that the chemical characteristics of the drinking water in schools are largely compliant with national and WHO guidelines. However, as with the household-level findings, the main exception is the extremely low concentrations of chlorine. In addition, a higher percentage of samples were compliant with national guidelines than with WHO guidelines for pH and TDS concentrations. This discrepancy falls within a range of 13-22 percentage points, on average, similar to trends observed with water quality testing at the household level (table 3.3).

Only a few incidences of *E. coli are* detected in drinking water in schools, indicating that fecal contamination is not a major concern for children who consume water from the school's water source. At the national level, only 0.8 percent of the tested water sample taken from the points of consumption in schools have *E. coli* levels above the maximum threshold of 0/100 mL. As discussed, low *E. coli* contamination can be explained, in part, by the low incidences of open defecation in Tajikistan. The similarity of the school water testing results to the household survey confirm the field observation that households and schools typically rely on the same water sources available in their area. Similarly, all tested school water samples complied with

Table 3.3: Water Quality Testing Results for Primary and Basic Schools in Tajikistan

Test	Number of samples	Mean parameter test value	Acceptable parameter range	Percentage of samples compliant with national guidelines	Percentage of samples compliant with WHO guidelines
pH					
Point of consumption	292	8.0 pH	pH 6–9 (national), pH 6.5–8.5 (WHO)	100	87
Total dissolved solids					
Point of consumption	292	490 mg/L	<1000 mg/L (national), <600 mg/L (WHO)	93	71
Nitrate					
Point of consumption	292	11.9 mg/L	<45 mg/L (national), <50 mg/L (WHO)	99	99
Total chlorine					
Point of consumption	292	0 mg/L	1.1–1.7 mg/L (national), <5 mg/L (WHO)	0	n.a.
Free chlorine					
Point of consumption	292	0 mg/L	0.3–0.5 mg/L (national), 0.2–0.5 mg/L (WHO)	2.7	2.7

Source: World Bank team calculations based on water quality data in School WASH Survey 2016.
Note: National guidelines: GOST 2874-82, State Standard of the USSR, 1982; State Sanitary and Epidemiological Service (SSE) 2007. WHO guidelines: WHO 2017. WHO = World Health Organization. n.a. = not applicable.

national guidelines for pH values, although the percentage of samples compliant with WHO guidelines for drinking water pH is higher in primary schools than in basic schools. Since pH values can be indicative of treatment effectiveness and pipe corrosion, these findings suggest that water available in schools is generally safe to drink.

The chemical quality of the drinking water is lower in rural areas; therefore, rural students are more likely to consume water that has higher concentrations of inorganic salts, organic matter, and traces of heavy metals. Rural schools have a lower WHO compliance in TDS levels and a slightly higher WHO compliance in free chlorine concentrations than urban schools. While 80 percent of samples collected at urban schools comply with WHO guidelines for TDS levels, only 69 percent of samples collected at rural school fall within the WHO's recommended range. While no direct health impacts are necessarily associated with high levels of TDS, palatability can be significantly compromised with increasing concentrations. Similarly, primary schools in Tajikistan have the highest average TDS concentration and the lowest percentage of samples compliant with WHO and national drinking water guidelines, although the sample size for primary schools is quite small.

The average free and total chlorine concentrations, on the other hand, are alarmingly low and may pose a significant health risk for children. The total and free chlorine concentrations both average 0 mg/L. Only 2.7 percent of the tested water samples complied with national guidelines for free chlorine concentrations, while none of the tested samples complied with the guidelines for total chlorine levels. A zero free chlorine concentration at the point of consumption is an indicator of unsafe drinking water for children, since the absence of free chlorine ions and lack of a reliable disinfection mechanism make water vulnerable to risk of contamination. This finding further supports the conclusion that disinfection by chlorine is not a readily available or frequently used treatment method for drinking water supplies.

Schools typically lack the resources and facilities needed to filter and treat water before consumption, with potential health implications for children. The qualitative research indicates that because the electricity supply is unreliable (particularly in rural areas and during winter), water cannot be boiled. When the school runs out of drinking water, children drink water directly from canals. School officials and parents who participated in the qualitative study mentioned that children have become sick because of drinking unsafe water from open sources. The lack of water also affects the cleanliness of schools. Staff cannot always store a sufficient amount of water to clean floors, rooms, or toilets. When toilets are inside the building, they often cannot be flushed and used because there is no water available. In addition, the lack of water in schools prevents the staff from preparing food for children because they cannot clean the kitchen and utensils afterward meals.

Notes

1. In Tajikistan, the indicators used for trends are somewhat stylized, since previous surveys include only one data point for "distance to water source" (required for "basic water," tier 2) and no data points for water quality or for continuity of supply (tiers 3, 4, and 5). The Household WASH Survey conducted for this study in 2016 includes this detailed information.
2. MDG 7.8 aimed to "halve the proportion of the population without access to an improved water source."
3. These trends may have more to do with the large decline in monetary poverty over time, rather than with service conditions.
4. Coliform presence is also high in GBAO (both at the source and consumption point), but this finding is based on a total of 40 samples.
5. While the presence of *E. coli* in drinking water indicates that the water is contaminated and unsafe, the absence of *E. coli* does not guarantee safety. This is because the most

common measure of fecal contamination, *E. coli*, is more easily inactivated in treatment than some other pathogens. Moreover, contamination can be highly variable over time and can escape detection.

6. WHO rates drinking water quality as "fair" for TDS values 600–900 mg/L and as "poor" for TDS values 900–1200 mg/L. The national standards in Tajikistan consider water TDS-compatible for any value below 1000mg/L.
7. http://tab.worldbank.org/t/WBG/views/TajikistanPovertyandWASH/DshNewWASHDashboard?:embed=y&:showShareOptions=true&:display_count=no&:showVizHome=no; http://tab.worldbank.org/t/WBG/views/TajikistanPovertyandWASH/DshImputedWASHIndicatorsTLSS?:embed=y&:showShareOptions=true&:display_count=no&:showVizHome=no#1

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Chapter 4
Sanitation and Hygiene Conditions

This chapter provides an overview of sanitation and hygiene conditions in households and schools across Tajikistan. Like the previous chapter, it discusses trends over time and highlights the existing service gaps across different population groups. Because data was limited, the chapter assesses two of the main tenets of "safely managed sanitation services": access to an improved type of sanitation containment structure, and whether it is private or shared with other households.[1] This analysis is supplemented as far as data allow with assessments on the core SDG hygiene indicators on handwashing conditions and practices. The findings show that access to sanitation among households has improved, particularly over the last decade, but Tajikistan continues to have some of the poorest conditions in Central Asia. Spatial inequality in sanitation conditions is high and suggests a possible association with poverty. Sanitation facilities are generally available on site for schools, but the coverage and quality of improved facilities is alarmingly low in rural areas.

Sanitation and Hygiene Conditions of Households

Access to Sanitation Facilities

Access to improved sanitation has improved since 2000, but Tajikistan continues to have some of the poorest conditions in Central Asia. To assess the trends in access to sanitation, three data points are available from household surveys for the period 2000–12. These are complemented with primary data collected for this study in 2016. Because information on sharing was not covered in surveys before 2012 that were available for reanalysis for this diagnostic, analysis focuses on households using at least "basic" sanitation: that is, facilities meeting the MDG improved standard before data were adjusted to remove households sharing the facility (See box 4.1 for definitions). Moreover, data on safe management and safe disposal of human excreta, although covered by the 2016 survey, are not sufficient for a detailed analysis. (See Appendix B for the multi-tier sanitation indicators).

The share of the population that has no access to sanitation has declined steadily, and open defecation in Tajikistan has all but vanished. At 9.9 percent in 2000, the share of the population with no sanitation facilities—that is, those who practice open defecation or dispose human feces in open areas (fields, forest, bushes, open bodies of water or other open spaces)—was below global standards. Since 2000, open defecation has declined further, first to 6 percent in 2005, and then to just below 3 percent in 2012. In the Household WASH Survey, the share of the population with no sanitation facility is even lower (just below 1 percent in 2016) (figure 4.1). One potential driver of this steady decline could be improvements in rural sanitation facilities during a period of rapid poverty reduction. In rural areas, the share of the population with no access to sanitation declined from 12.6 percent in 2000 to 1.9 percent in 2016. Improvements have been smaller in urban households (declining from 2.4 percent in 2000 to 0.5 percent in 2016) because they started at a lower base.

Box 4.1: Definitions of "Improved" Sanitation

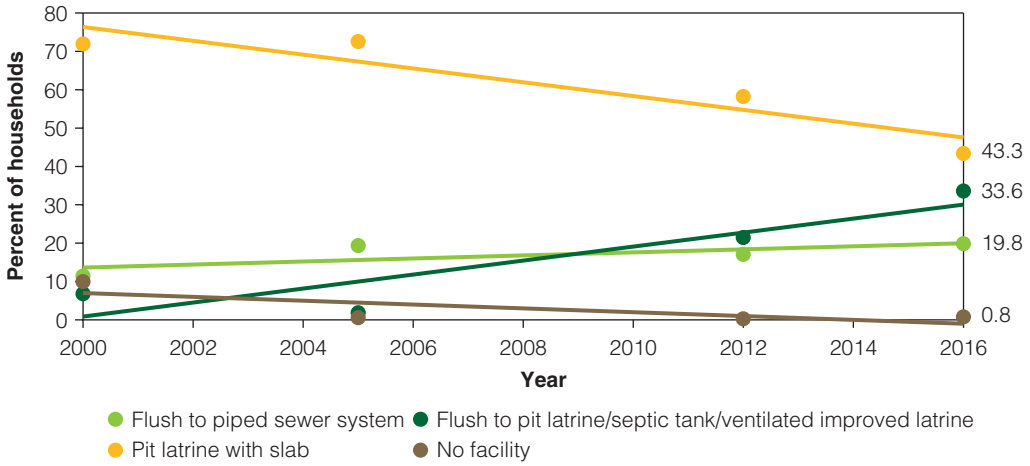
As with water (see box 3.1), sanitation was monitored during the MDG period according to an "improved" standard, including those types of facility that were understood to be more likely than others to separate human excreta from human contact. They included the following types if they were not shared people from other households: flush/pour flush to piped sewer system, septic tank, pit latrine, ventilated improved pit (VIP) latrine, pit latrine with slab, composting toilet.

As explained in box 1.1, this is now a component indicator of the "safely managed" classification under the SDGs. Facilities that did not meet the criteria are generally grouped into three classifications:

- *"Shared facilities"*: Sanitation facilities of an otherwise acceptable type, shared between two or more households. Only facilities that are not shared or not public are considered improved.
- *"Unimproved sanitation":* Including pit latrines without a slab or platform, hanging latrines or platform, hanging latrines, and bucket latrines.
- *"Open Defecation":* When human feces are disposed of in the fields, forest, bushes, open bodies of water, beaches, or other open spaces or disposed of with solid waste.

Source: WHO/UNICEF Joint Monitoring Programme (JMP), "JMP-WASH-in-the-2030-Agenda-factsheet"; https://www.wssinfo.org/definitions-methods/watsan-ladder/.

Figure 4.1: Trends in Household Sanitation Facilities in Tajikistan, 2000–16 (Percent of Households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016. Note: The response categories are slightly different for the 2000 data point, where flush to pipe sewer does not exclude flush to septic tank. Improved and unimproved latrine types that constitute less than 1 percent of responses are not shown. WASH = water supply, sanitation, and hygiene.

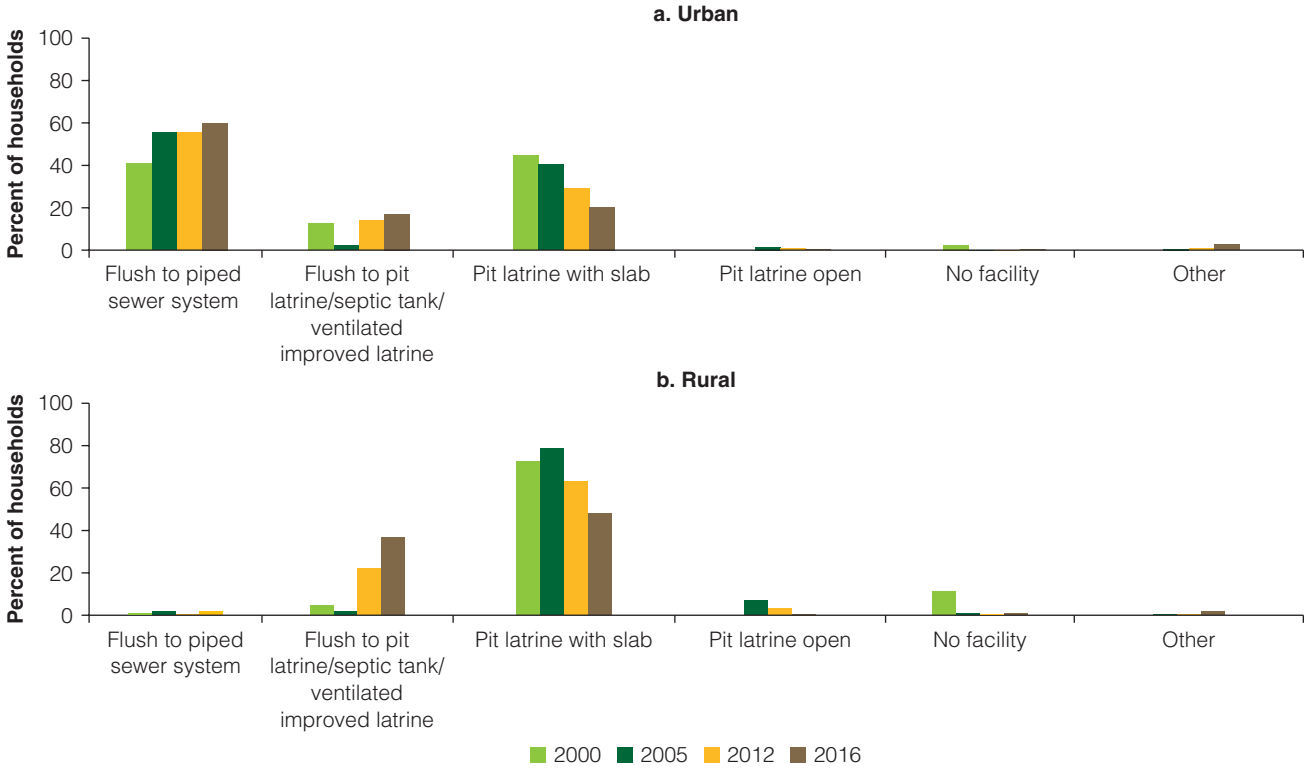
The decline in open defecation was accompanied by an increase in access to flush/pour toilets and in pit latrines with slab; these types are considered to be MDG "improved" and SDG "limited" sanitation facilities if they are not shared with members of other households. In the first decade of 2000s, "pit latrines with slabs" remained as the main type of sanitation facility for the bulk of the population. This category includes both improved and unimproved latrines, and both the facilities that are shared with other households and the facilities that are not shared. The proportion of the population with access to pit latrines with slabs hovered around 72–73 percent in 2000 and 2005, before declining to about 58 percent in 2012 (figure 4.1). In 2016, this figure declined even further to 43 percent. This coincided with a rather steep increase in safer types of "improved" latrines (flush/pour latrines, ventilated improved latrines, and latrines that are connected to septic tanks). Access to these facilities increased from less than 10 percent in 2000 to about 21.4 percent in 2012, and then to 33.6 percent in 2016. However, access to the safest form of sanitation facility (latrines flushed to a sewerage system) increased at a slower rate from 2000 to 2016. They were roughly as common as other improved latrines in 2000, but after a considerable jump to 19 percent in 2005, the share of population with flush toilets with sewer connections remained more or less constant, at around 17–20 percent, from 2012 to 2016.

Although the overall trend is toward greater access to improved sanitation (with some stagnation in the coverage of piped sewer connections), significant gaps persist between urban and rural parts. According to official government data, 79.8 percent of the population in cities and 18.2 percent of the population in small towns have access to sewage systems and improved sanitation facilities, while this is the case for only 0.2 percent of the rural population. The trends suggested by data sources used in this report are largely consistent with these statistics. In urban areas, the majority of the population has access to flush toilets connected to a sewage system. This proportion has been increasing over the years, to reach about 60 percent in 2016 (figure 4.2). The increase in piped connections occurred against a large decline in the share of the population using pit latrines with slabs, which nearly halved from 2000 to 2016 (falling from 44 percent to 20 percent). The use of other types of improved latrines in urban areas (flush to pit latrine, ventilated improved, and flush to septic tank) also increased to 17 percent in 2016, whereas the use of other unimproved and improved latrines remained negligible.

Rural areas have seen a transition out of unimproved latrines, but access to sewer connections and flush latrines remain considerably limited among rural households in Tajikistan. Since 2000, the share of rural households using unimproved open latrines and households practicing open defecation has steadily declined. In addition, there has been a decline in the lower tiers of improved sanitation (latrines with slab) particularly during the period 2005–16, from 88 percent to 54 percent. This, moreover, was accompanied by a sizable increase in safer improved sanitation facilities, including flush/pour to pit, flush to septic tank, and ventilated improved latrine, which increased from about 2 percent in 2005 to 41 percent in 2016. In other words, not only has there been a decline in unimproved sanitation facilities, but there has also been an upgrading of the type of improved sanitation services from latrines with slab to flush latrines. That said, access to flush toilets connected to a sewer system in rural areas is chronically low, with only 1.7 percent of the rural population having access to sewer connections in 2016 (figure 4.2).

Access to improved sanitation overlaps with wealth, with a lower share of the bottom 40 households having access to sewage connections and flush toilets relative to the top 60 households. Among the bottom 40 percent of the income distributions, by far the most common sanitation facility is pit latrines with slab—even though the share of the bottom 40 who have access to pit latrine with slab nearly halved in recent years, falling from about 85–90 percent in 2000–12 to 45 percent in 2016 (figure 4.3). This decline, moreover, went hand in hand with an increase in the share of bottom 40 households that have access to flush toilets (flush to pit, septic tank, or ventilated improved latrines). Flush toilets have become the second most common sanitation facility among this group. For the top 60 households, pit latrines with slab are similarly the most common sanitation facility, followed by flush latrines. Yet the proportion using these facilities is much lower among the top 60 households relative to the bottom 40 households.

Figure 4.2: Trends in Household Sanitation Facilities in Tajikistan, by Rural-Urban Location (Percent of Households)



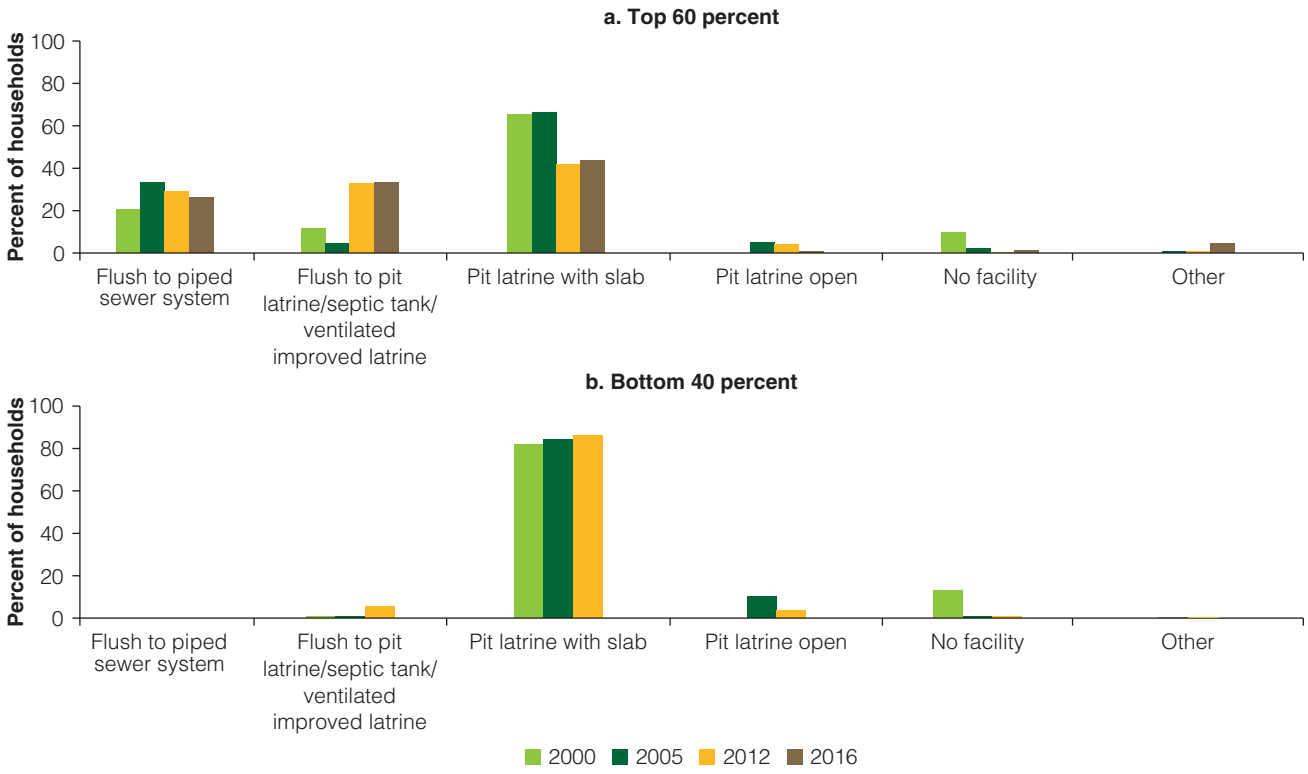
Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: The response categories are slightly different for the 2000 data point, where flush to pipe sewer does not exclude flush to septic tank. The other category includes improved and unimproved categories less than 1 percent. WASH = water supply, sanitation, and hygiene.

Further, virtually none of the bottom 40 household had access to a sewage connection until 2012. In 2016, while one-fourth of the top 60 households had sewage connections, access to flush latrine with a piped sewer system was about half that amount (13 percent) for the bottom 40.

Inequalities in access to improved sanitation are more pronounced across regions; Dushanbe accounts for more than four-fifths of all sewer connections, and GBAO and Khatlon regions have the worst conditions in the country. In Dushanbe, access to flush toilets that have piped sewer connection increased from 77 to 82 percent between 2012 and 2016, while other improved flush latrines remained unchanged, and the less desirable pit latrines with slab became less common (figure 4.4). In addition, Dushanbe remains the only region with some diversity in the types of sanitation facilities, where the "other latrine" category is larger than 5 percent. In contrast, Khatlon and GBAO have by far the highest proportion of households without access to improved sanitation facilities. Between these two regions, GBAO not only has worse conditions, but conditions in this region has also worsened over time. In Khatlon, pit latrines with slab have recently been replaced by flush latrines. In GBAO, by contrast, almost 90 percent of households use pit latrines with slab.

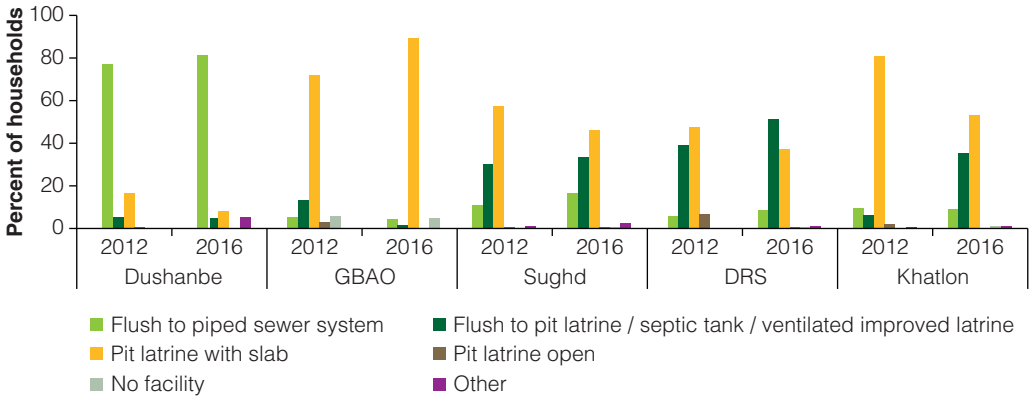
The regional gaps demonstrate high spatial inequality in sanitation conditions and suggests a possible association of this situation with poverty. During the qualitative field research, the majority of rural participants from low-income groups indicated that the most common facility is unimproved pit latrines (which lack a firm roof or walls, have no concrete lined pit,

Figure 4.3: Trends in Household Sanitation Facilities in Tajikistan, by Wealth (Proportion of Households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: The response categories are slightly different for the 2000 data point, where flush to pipe sewer does not exclude flush to septic tank. The other category includes improved and unimproved categories less than 1 percent. WASH = water supply, sanitation, and hygiene.

Figure 4.4: Trends in Household Sanitation Facilities in Tajikistan, by Region (Percent of Households)



Source: Multiple Indicator Cluster Survey (MICS) 2000, 2005; Demographic and Health Survey (DHS) 2012; Household WASH Survey 2016.
Note: The response categories are slightly different for the 2000 data point, where flush to pipe sewer does not exclude flush to septic tank. The "other" category includes improved and unimproved categories (less than 1 percent). DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

lack ventilation, or are shared with other households) (photo 4.1). Some also stated that their latrines have open pits and no slabs (photo 4.2). These were observed in research sites in Khatlon (Kurgan-tube, raion center, and all rural areas visited in this region), as well as in DRS and GBAO, which have the highest regional poverty rates in Tajikistan. Open defecation, on the other hand, was observed primarily in the rural parts of GBAO region. This observation is confirmed by the survey data, which indicate that 5 percent of the population does not have access to any sanitation facility (figure 4.5). The poor households in rural GBAO stated that they build latrines on riverbanks or dispose the feces in rivers. Local leaders and representatives of local government who were interviewed for the qualitative research said they identify such households and explain to them why such practices might be dangerous for the health of others. In the 2016 Household Survey, when asked to recall where a child member under 5 years of age of the household last defecated, only 49 percent of respondents cited a latrine; when asked about where children's stool was disposed, only 55 percent cited a latrine.

In rural areas, particularly in remote and mountainous settlements, the availability and affordability of the materials required to build improved latrines can be constrained. According to the interviews conducted for qualitative research, materials required for building improved latrines are often available in local markets, but few can afford them. This, in turn, reinforces wealth-based inequalities in sanitation conditions. Depending on the region and the type of toilet being built, constructing an unimproved latrine was reported to cost around TJS 300 ($25–35), while an improved pit latrine was reported to cost up to TJS 1000 ($125–140), and flush toilets up to TJS 6000–7000 ($750–1000). A representative of the local government from Khudjand mentioned that since latrine materials are typically imported, they have become more expensive after the drop in the value of the Tajik somoni, and less affordable after the large decline in remittance inflows in 2015. In mountainous areas, constructing latrines is especially difficult because of lower availability and high transport costs for materials, as these areas are located far from markets. In addition, it is difficult to dig pits in these areas because the soil is stony and household land area is usually too small to dig new pits every time an older pit gets full.

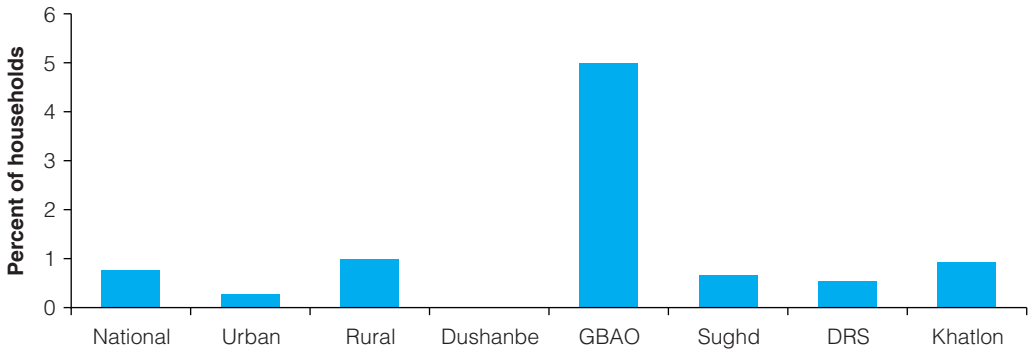
Photo 4.1: Unimproved Pit Latrine (Rudaki Raion, DRS)

Source: World Bank.

Photo 4.2: Unimproved Pit Latrine (Farkhor Raion, Khatlon)

Source: World Bank.

Figure 4.5: Open Defecation, by Region, 2016 (Percent of Households)



Source: Household WASH Survey 2016.
Note: N = 3,010 households. DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

Because the cost of building and maintaining permanent sanitation facilities is high, pit latrines in rural areas are usually replaced with new pits. Local leaders and government representatives stated that in rural areas, when a latrine pit is full, most households cover it with dirt and dig another pit in their yard. In the Household WASH Survey, over 70 percent of households that use latrines other than flush to sewer or septic tank reported that they build a new latrine each time an old latrine gets full. Only a few households can afford to build improved pit latrines with a cement pit. This type of facility is costly, but is common in regions where households have only a small amount of land. These households incur additional costs related to the maintenance

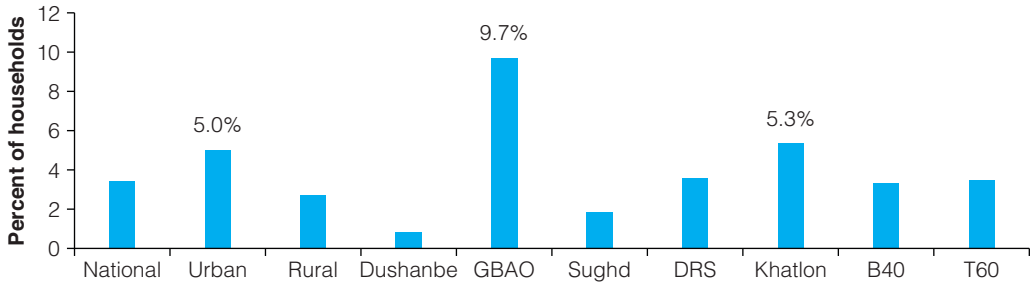
of their pits. For example, they often pay specialists to empty their pits using pumps. As expected, only middle-income and well-off households can afford such a service. Some key informants expressed their concern that the content of these toilet pits is often not safely disposed, but rather is emptied in open public spaces, posing a health risk for other households. The perceived injustice in access to sanitation by the poor and the nonpoor is exemplified by a focus group participant in GBAO:

> *The wealthier you are, the better your toilet is. Wealthy people can cement the pit, install a flushed toilet, use bricks and tiles for walls. Where will poor people or families with infants find money for all that? They cannot afford to build even a toilet made of clay.* —Focus group discussion with low-income male participants living in houses, Kishlok Zevordasht, GBAO

In urban areas, where sewage connections are more common, many households still rely on shared facilities because of the poor condition of the sewer system and interruptions in water supply. Discussions conducted as part of the qualitative research with urban households revealed that even if connected to a sewerage system, many apartment buildings cannot use their flush toilets because of lack of water. Poor water pressure is also a problem in apartment buildings, especially on top floors, where water does not reach. This problem was mentioned by urban participants from Dushanbe, Ganchi, Khorugh, and Khudjand. As a result, many urban households rely on public pit latrines on their street. These facilities often do not meet basic hygienic requirements. According to the study participants, nobody is responsible for cleaning and maintaining public toilets in the cities, and they are believed to be sources of infectious diseases and worms. The Household WASH Survey 2016 partly captures the pattern that urban households end up using public sanitation facilities despite being more likely to have improved sanitation facilities at home (figure 4.6). The proportion of households that share a sanitation facility with people other than their household members was almost twice as high in urban areas (5 percent) as in rural areas (2.7 percent).

In rural areas, on the other hand, many latrines are located outside the house, which can make it difficult for household members to access facilities. Certain household members, such as the elderly and people with disabilities, can be especially affected. Adverse impacts can be particularly severe during the cold winter if the latrines are located outside the house (box 4.2). In the WASH survey, only 25 percent of households indicated that their latrine was located inside the dwelling. For 73 percent of households, it was located in the yard, and for the remaining 2 percent, it was located elsewhere (figure 4.7). As expected, 92 percent of rural households had their latrines located in their yards, as opposed to only 32 percent of urban households. In Dushanbe, 81 percent had toilets in their dwelling.

Figure 4.6: Sanitation Facilities Shared with People Other than Household Members, 2016 (Percent of Households)



Source: Household WASH Survey 2016.
Note: N=2991 households. B40 = bottom 40 percent; DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; t60 = top 60 percent; WASH = water supply, sanitation, and hygiene.

Box 4.2: Access to Sanitation Facilities by Persons with Disabilities

As discussed in Chapter 3, 9 percent of households in Tajikistan indicate that they have at least one household member who has one or more functional disabilities, at the highest severity level. Because the survey captures the severity of six functional disabilities (for example, the level of difficulty in seeing, as opposed to only blindness), taking these varieties into consideration increases the share of households reporting that they have a household member with a disability to 54 percent.

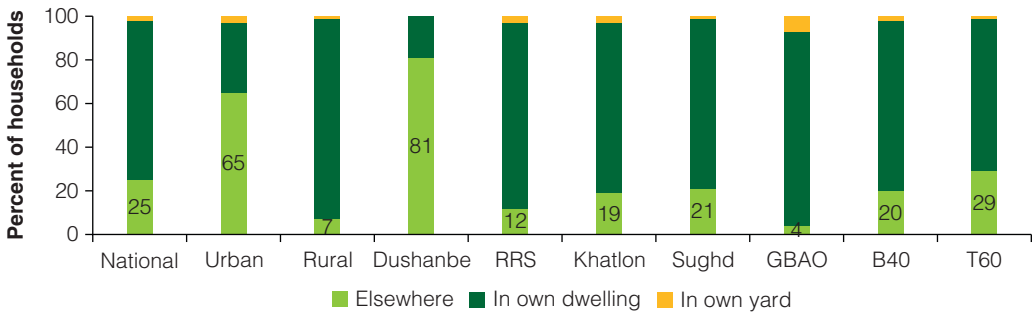
Access to improved sanitation can be highly constrained for the members of these households who have one or more disabilities. At the national level, about 20 percent of households report that persons with disabilities in their household cannot access the sanitation facility without assistance. This figure is largely driven by rural areas (24 percent) as opposed to urban areas (12 percent). As expected, GBAO and Khatlon, the regions that have the worst sanitation conditions in Tajikistan, also have the highest proportion of households reporting that their members with disabilities cannot access sanitation facilities (32 percent and 27 percent, respectively). Dushanbe, which has the best sanitation conditions, has the lowest proportion (only 3 percent). An additional 15 percent of households at the national level report that persons with disabilities in their household have some or a lot of difficulty in accessing sanitation facilities.

Although barriers to access to sanitation facilities by persons with disabilities is recognized and reported in the survey, over 60 percent of the households that have a household member with a disability have not made any adaptations to their sanitation facility to meet the needs of their household members. Only 40 percent reported making some adaptations. Among the changes that were made, the most common was widening the entrance, with 8 percent of households making this adaptation, followed by using a movable or adapted toilet seat, at 4 percent. GBAO had the highest share of households that widened the entrance (24 percent), followed by Sughd (13 percent). In response to the question about adaptations, the "other" category received 25 percent of the responses, suggesting that there are many forms of adaptations in Tajikistan that the survey was unable to capture.

Source: World Bank team.

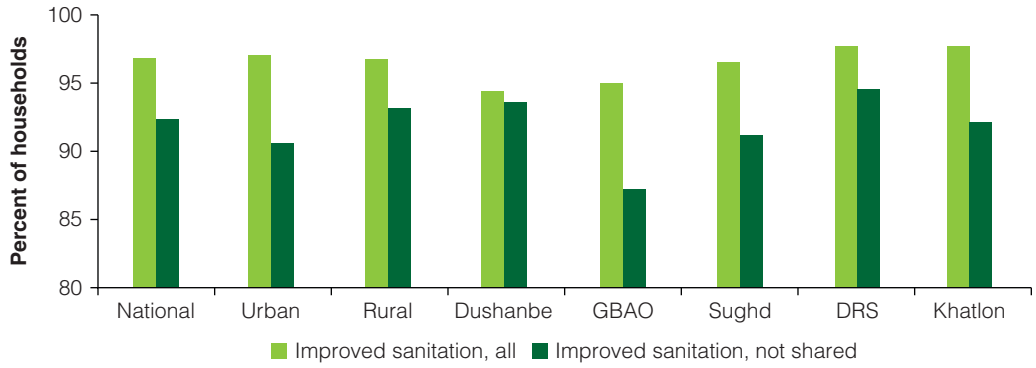
Even when households have access to improved sanitation facilities, these facilities are sometimes shared with other households or fail to meet basic hygiene standards. An important hygiene criterion for improved latrines is whether or not it is shared with members of other households. Evidence shows increased risk of adverse health outcomes associated with shared sanitation compared to individual household latrines, including increased incidences of diarrhea, helminth infections, and other fecal-oral diseases (Heijnen et al. 2014). Accordingly, the difference between the MDG improved sanitation ladder, which measures access to any improved sanitation facility, and the SDG improved sanitation ladder, which measures access to improved sanitation facilities that are not shared with other households, is the greatest in urban areas, as well as in GBAO and Khatlon regions (figure 4.8).

Figure 4.7: Location of Sanitation Facility (Percent of Households)



Source: Household WASH Survey 2016.
Note: N=2991 households. B40 = bottom 40 percent; DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; T60 = top 60 percent; WASH = water supply, sanitation, and hygiene.

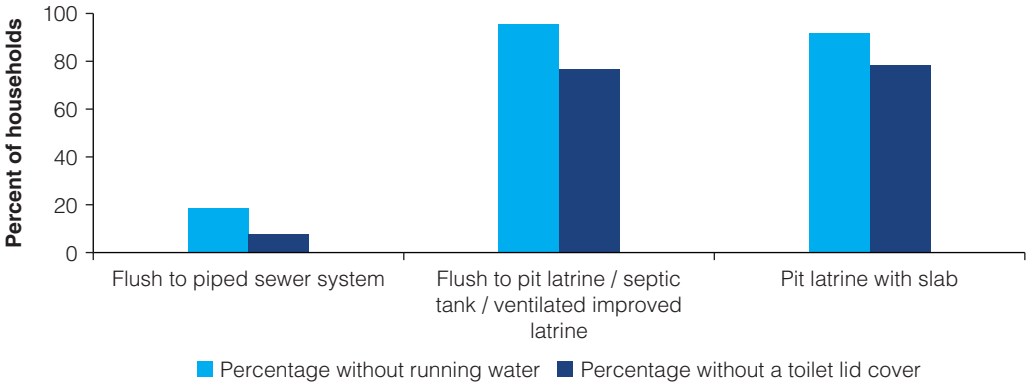
Figure 4.8: Access to Improved Sanitation, All versus Unshared (Percent of Households)



Source: Household WASH Survey 2016.
Note: N=2991 households. DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

One reason why latrines may fail to meet hygiene standards is because they are poorly constructed or have no running water supply. The location of the latrine is crucial for the separation of human excreta from water, food, and other household facilities. In the qualitative research, key informants expressed their concern that awareness about the risks of building toilets too close to water sources is low. Consistent with this, none of the focus group participants who participated in the study was able to name a particular standard for how far the latrines should be located from drinking water sources, pumps, springs, or canals. Further, across the household sample interviewed for the WASH survey in 2016, many sanitation facilities did not have protective lids to reduce the transmission of bacteria or running water to flush away excreta, including facilities that are considered "improved." For example, about 20 percent of flush latrines that were connected to a piped sewer system did not have a lid, and about 8 percent did not even have running water. The conditions of pour/flush latrines and pit latrines with slab were even worse. About 96 percent of flush latrines and 92 percent of pit latrines with slab did not have toilet lid covers, while about 77–78 percent of them did not have running water (figure 4.9).

Figure 4.9: Improved Toilets without a Lid/Cover and Running Water (Percent of Households)



Source: Household WASH Survey 2016.
Note: N = 2,604, households that have access to flush toilets or pit latrine with slab. N = 2,529, households where presence/absence of running water could be observed. Data as observed by enumerators. WASH = water supply, sanitation, and hygiene.

Hygiene Conditions

Only a few latrines are equipped with hygienic cleansing material or disinfectants, largely because these items are costly in local markets. The qualitative work found several obstacles to maintaining latrines, including water scarcity, water not reaching the top floors of apartment buildings (in urban areas), and the high cost of disinfectants. These observations are confirmed by the survey data. In 67 percent of the households covered by the Household WASH Survey, there was no place in or around the latrine to wash hands (photo 4.3). Further, in 62 percent of these cases, there was no running water (photo 4.4), and in 54 percent of the households there was no toilet paper or other cleansing material in the latrine. Focus group discussions conveyed that households are well informed about of benefits of washing hands and most of them claimed to use soap for hand washing. Participants said that they had obtained information on hygiene and health from schools, water and sanitation projects, and local awareness campaigns. However, discussants mentioned that limited water supply makes it difficult to practice hand washing regularly. Further, due to lack of sufficient quantities of clean water, people use poor quality "grey water" from ponds to wash their hands, or they recycle water used for domestic purposes, such as leftover water from washing the dishes.

Handwashing after defecation is not common because water and soap are scarce. Key informants interviewed for the qualitative study expressed concern that only a few households wash their hands frequently enough, even if they are aware of the importance of it. In the Household WASH Survey, 93 percent of households reported using soap a day before or on the day of the interview. Out of these households, only about 30 percent indicated that they washed their hands after defecation. Among the multiple responses about the context in which the respondent used a soap, washing clothes and washing body were the most common responses. In contrast, handwashing after defecation was mentioned by only 11 percent of households (figure 4.10). During the qualitative work, interviewees mentioned that women tend to wash their hands more often than men, since they work in the house and their hands get dirty more often. Observations during the qualitative research suggested that even when soap was available, households kept it in a backroom and brought it out only for guests. For example, when survey respondents were asked to show the soap they use to wash their hands, only 29 percent of them were able to bring it out in less than a minute. For 61 percent

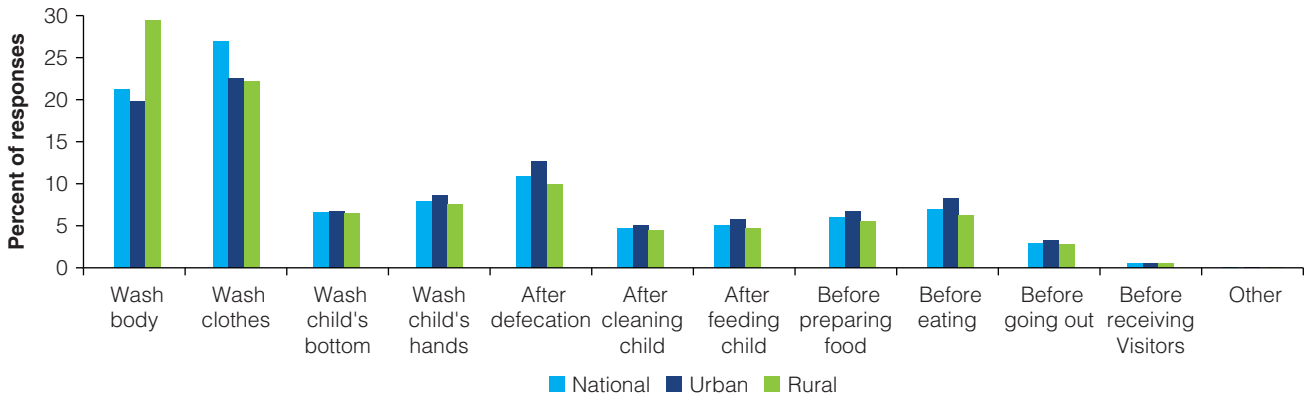
Photo 4.3: Handwashing Station in a Rural House (Rudaki Raion, DRS)

Source: World Bank.

Photo 4.4: Pitcher, Cloth, and Soap Used at a Handwashing Station in a Rural House (Rudaki Raion, DRS)

Source: World Bank.

Figure 4.10: Used Soap Today or Yesterday, 2016 (Percent of Responses)



Source: Household WASH Survey 2016.
Note: N = 8614 responses by 2991 households to a multiple response question. WASH = water supply, sanitation, and hygiene.

of households, it took 1–2 minutes to locate the soap, whereas for about 10 percent of households, it took 3–10 minutes.

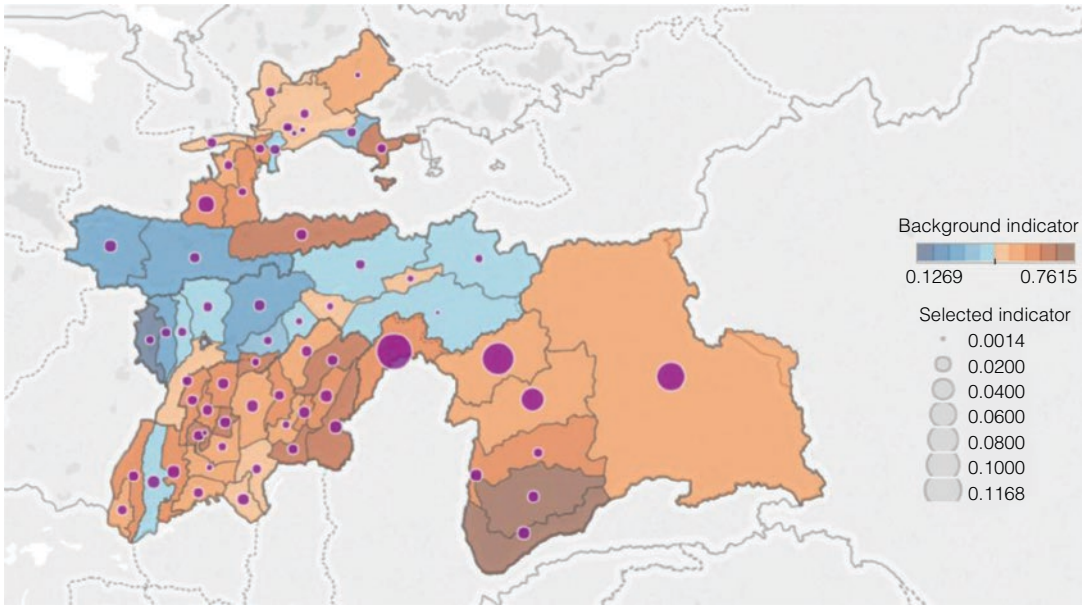
Spatial Distribution of Sanitation Facilities

The priority districts and target groups for future sanitation interventions are highlighted in WASH poverty maps, which overlay sanitation conditions in Tajikistan with poverty and population density. For the spatial distribution of sanitation facilities, the 2010 Population and Housing Census includes maps that show access to toilets and to a piped sewage system. While these data are somewhat dated, the maps are informative given that inequalities in access to sanitation have not improved much. An interactive census-based mapping platform that allows users to select various indicators and population subgroups is available online.[2]

The maps show that as a proportion, GBAO hosts the largest share of people without toilets, although in absolute terms the largest population without toilets live in selected districts of Khatlon, DRS, and Sughd. As noted, various data sources indicate that GBAO has traditionally had, and continues to have, the lowest access to sanitation in Tajikistan. The 2010 census concurs in this finding, adding that within GBAO, four districts have the greatest share of population without a sanitation facility (Darvoz, Vanj, Rushon, and Murghob districts in the northwest and in the east). In the southern districts of GBAO, the share of the population with no sanitation facility is much lower, even though these districts have higher poverty rates (map 4.1). While GBAO has the worst conditions, because it is sparsely populated, most people with no access to toilets are located elsewhere. These include Rudaki and Vahdat districts in DRS; Panjkend in Sughd; and Yovon, Kulob and Qabadiyon districts in Khatlon. Again, not all these districts have high poverty rates (map 4.2).

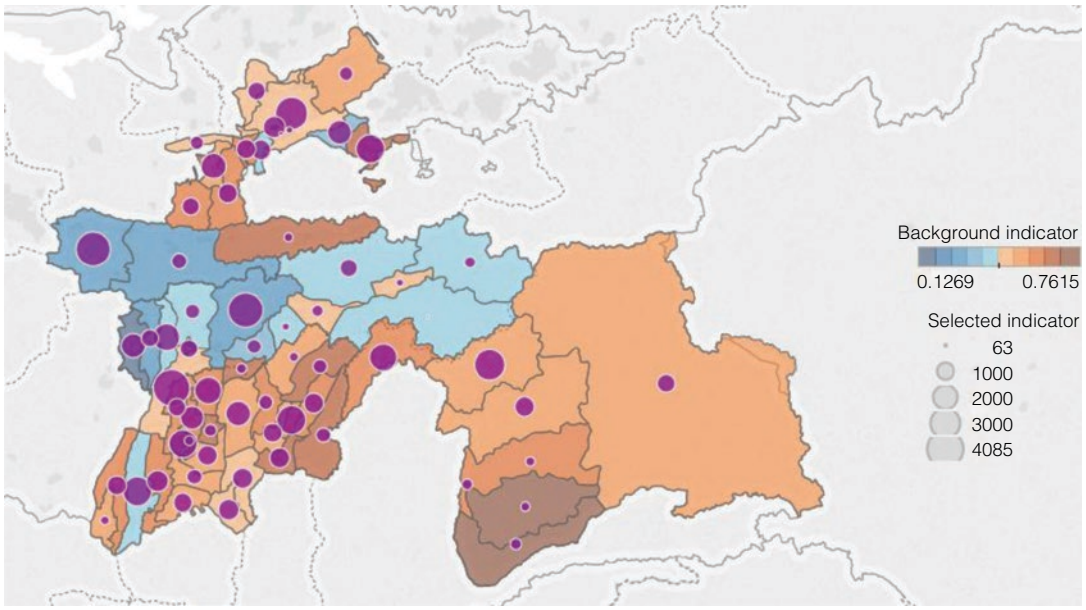
Urban settlements have poor access to sewage systems, but the largest number of people without a sewer connection live in Dushanbe, and the largest number of people without toilets live in Khatlon and Sughd. The census maps indicate that sewage connections across Tajikistan are equally poor across urban settlements, with over 80 percent of the urban population in each district not having access to a sewer (map 4.3). That said, because Dushanbe hosts the largest number of urban residents, the number of people without access to sewerage is the highest in Dushanbe, followed by Kulob in Khatlon (map 4.4). Further a large number of urban residents also do not have access to toilet facilities, particularly in the districts of Khatlon and Sughd, including in Kulob and Ghafurov, respectively (map 4.5). This finding points to a need to provide

Map 4.1: Share of Population with No Access to Toilets, as Reported in Census 2010



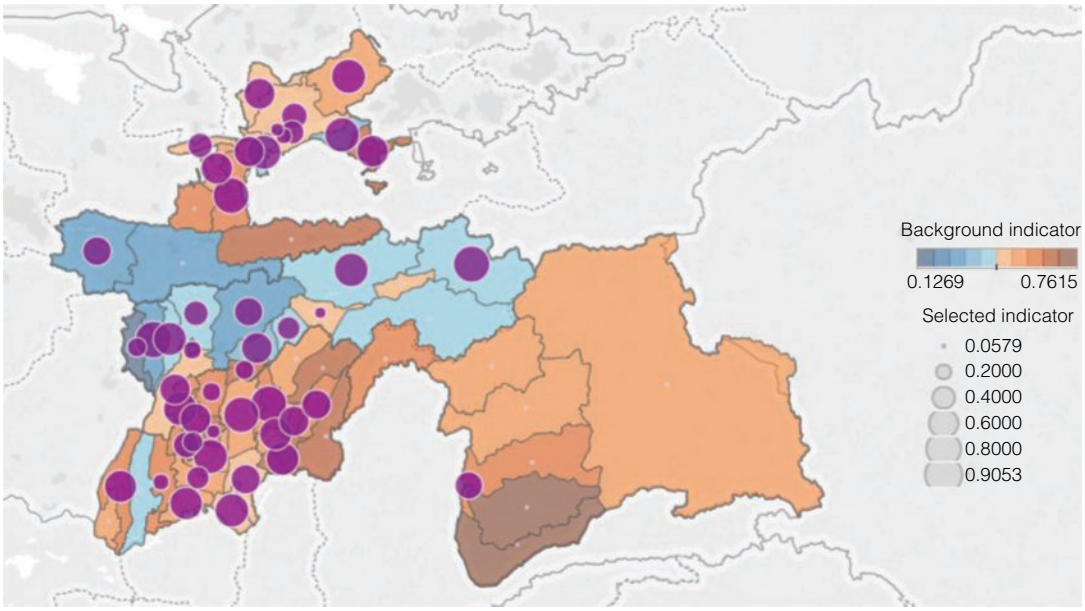
Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this sanitation condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Map 4.2: Number of People with No Access to Toilets, as Reported in Census 2010



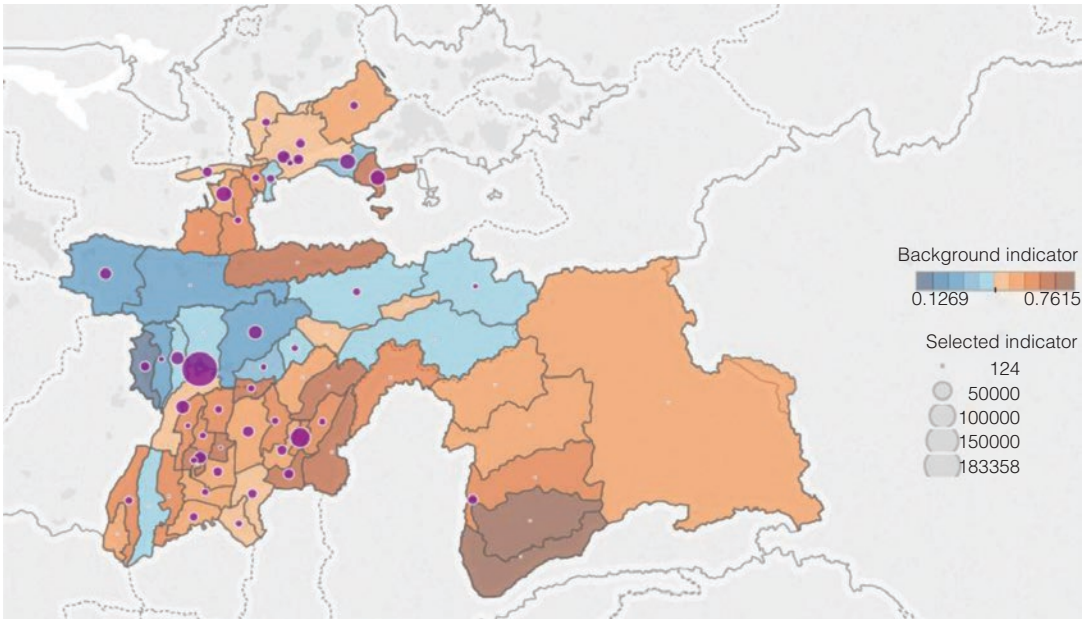
Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this sanitation condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Map 4.3: Share of Urban Population with No Access to Sewer Connection, as Reported in Census 2010



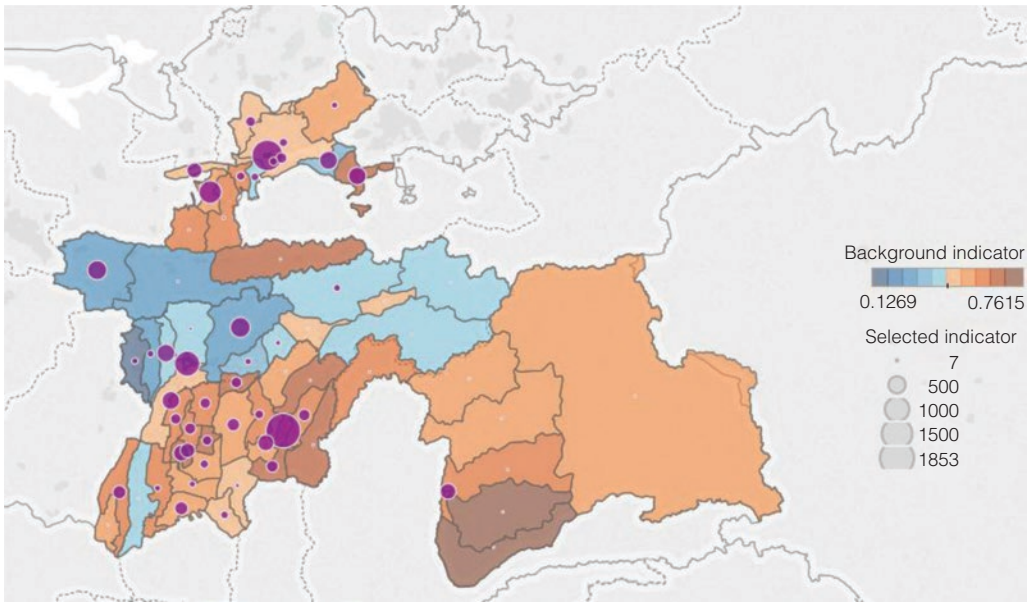
Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this sanitation condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Map 4.4: Number of People in Urban Areas without Sewerage Connection, as Reported in Census 2010



Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the Census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this sanitation condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

Map 4.5: Number of People in Urban Areas without a Toilet, as Reported in Census 2010



Source: Census 2010 with welfare estimates from TLSS 2009.
Note: The reported water and sanitation variables are directly observed in the Census; estimated monetary poverty are generated via multiple imputation. Purple circles indicate the number of people with this sanitation condition in a district. Background color is the poverty rate, with the darker brown indicating high poverty. TLSS = Tajikistan Living Standards Survey.

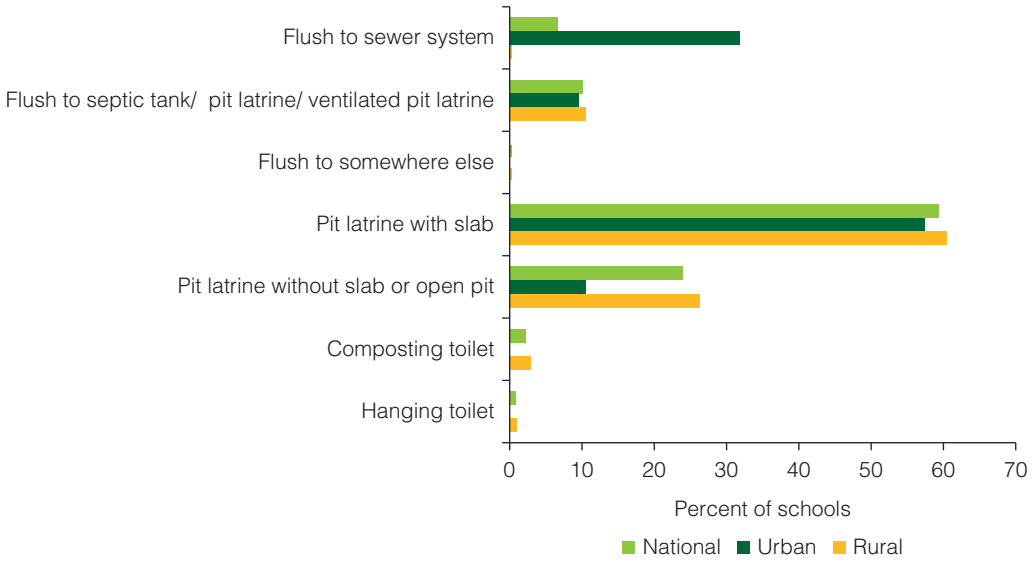
access to improved sanitation facilities before improving sewer connections for a large number of urban residents. The same conclusion holds for the rural residents, who have even poorer access to improved sanitation than urban residents.

Sanitation and Hygiene Conditions in Schools

Schools in Tajikistan generally have sanitation facilities available on site, though there are differences between rural and urban areas in the coverage of improved facilities. According to the School WASH Survey, all schools in the survey sample have toilet facilities, including separate toilets for teachers and students. About 95 percent of these facilities are located in the school building or on school premises, while the remaining 5 percent are located elsewhere. On average, students can access 9.8 toilets per school. At the national level, the majority of schools have an improved toilet facility, but most of these improved facilities (59 percent) consist of pit latrines with slabs (figure 4.11). Meanwhile, only 7 percent of schools have a flush to sewer system, and none of the rural schools have a flush toilet connected to the sewer system. In rural areas, unimproved latrines are more common. About 26 percent of rural schools have a pit latrine without slab or an open pit, as opposed to only 11 percent in urban areas.

In most schools, separate sanitation facilities exist for girls and boys, but only a few schools have special facilities for menstrual hygiene management, for younger students or for students with disabilities. At the national level, girls and boys share sanitation facilities in only 17 percent of the schools, ranging from 10 percent in urban areas to 19 percent in rural areas. Some schools also have separate toilets for youngest children.

Figure 4.11: Share of Schools with Various Types of Sanitation Facilities (Percent of Schools)



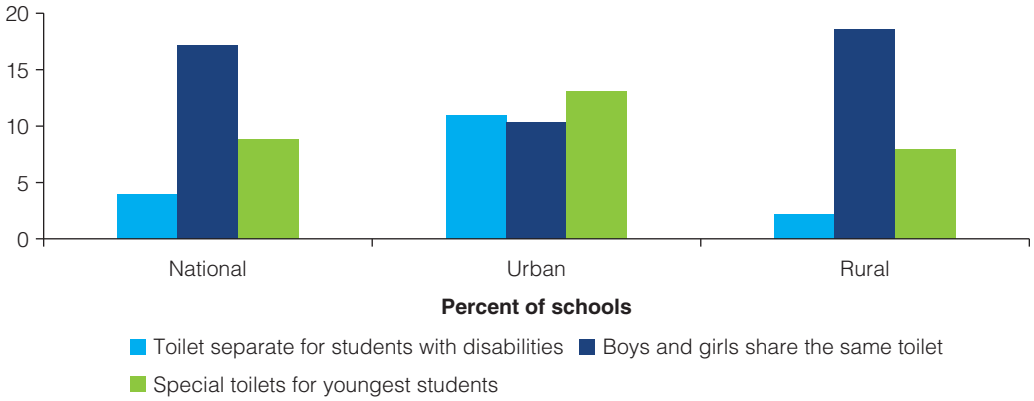
Source: Household WASH Survey 2016.
Note: N = 294 schools. WASH = water supply, sanitation, and hygiene.

This is the case for 9 percent of schools at the national level. The share is higher in urban areas (13 percent) and lower (8 percent) in rural areas. However, very few schools have facilities for menstrual hygiene management: only 1 percent of schools had covered bins for disposal of menstrual hygiene waste, while only 2 percent of schools had water available in girls' cubicles for menstrual hygiene management. Moreover, only 3 percent of schools have separate toilets for students with disabilities (11 percent in urban areas and 2 percent in rural areas) (figure 4.12). These trends are largely consistent with observations during the qualitative research, which found that sanitation facilities in schools in the raion centers and rural areas all consisted of pit latrines, had separate latrines for men and women, had no separate latrines for patients/students and staff, and lacked facilities for people with disabilities.

As with other outcomes, there are regional inequalities in the types of sanitation facilities available in schools across Tajikistan. Pit latrines with slabs are by far the most common sanitation facilities across all regions, except for Dushanbe. In the latter, about 92 percent of schools have a flush latrine with sewer connection. The region closes to this is DRS, where the share of flush to sewer sanitation facilities is just 6 percent. In Sughd, for instance, not only do none of the schools have a sewer connection, but 43 percent of schools have an open pit or a pit latrine without a slab (two main types of unimproved latrines in Tajikistan) (photo 4.5). Sughd is followed by GBAO, where the percentage of schools that use these two types of unimproved facilities is 37 percent (figure 4.13).

School administrators consider the sanitation facilities in schools to be safe for children, but there are a number of challenges with maintaining them. In the School WASH Survey, only 5 percent of school administrators reported that the sanitation facilities in their school are not safe for children. This number is the highest for Sughd (13 percent), followed by GBAO (7 percent) (figure 4.14). The majority of respondents that cite issues with toilets say that the problems are due to the poor local infrastructure for water and sanitation (photo 4.6). This is

Figure 4.12: Share of Schools with Separate Toilets for Different Groups of Children (Percent of Schools)

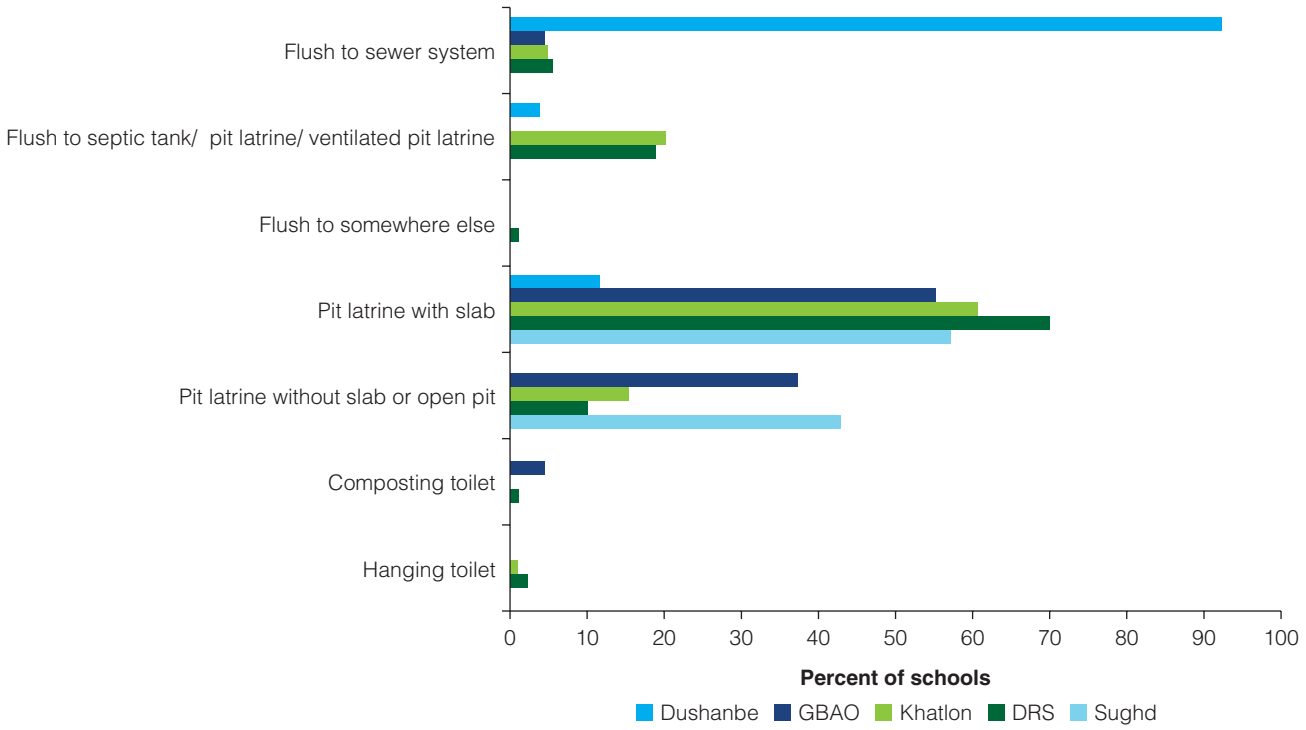


Source: Household WASH Survey 2016.
Note: N=294 schools. WASH = water supply, sanitation, and hygiene.

Photo 4.5: Pit Latrines in a Rural School (Ganchi Raion, Sughd)

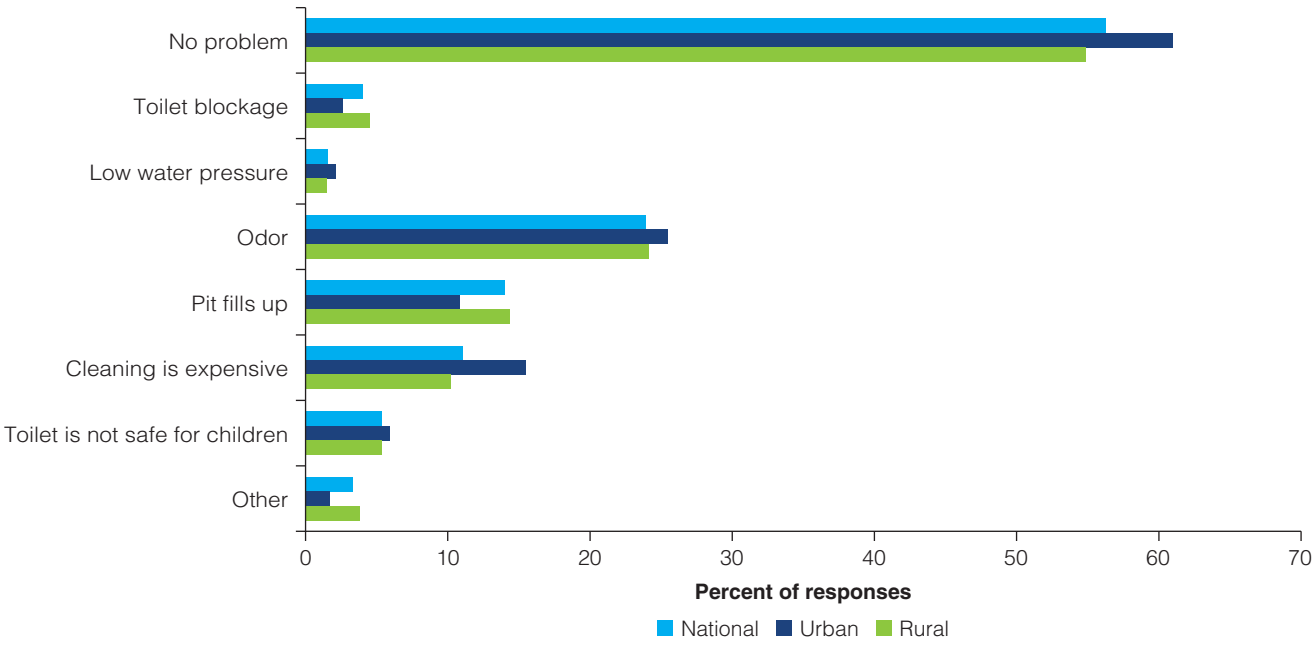
Source: World Bank.

Figure 4.13: Share of Schools with Toilets, by Type and Region (Percent of Schools)



Source: Household WASH Survey 2016.
Note: N = 294 schools. DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; WASH = water supply, sanitation, and hygiene.

Figure 4.14: Problems with Toilets as Reported by School Administrators (Percent of Responses)



Source: Household WASH Survey 2016.
Note: N = 298 schools. Figure shows responses to a multiple-response question. WASH = water supply, sanitation, and hygiene.

Photo 4.6: Hand Washing Facility in a School (Khatlon)

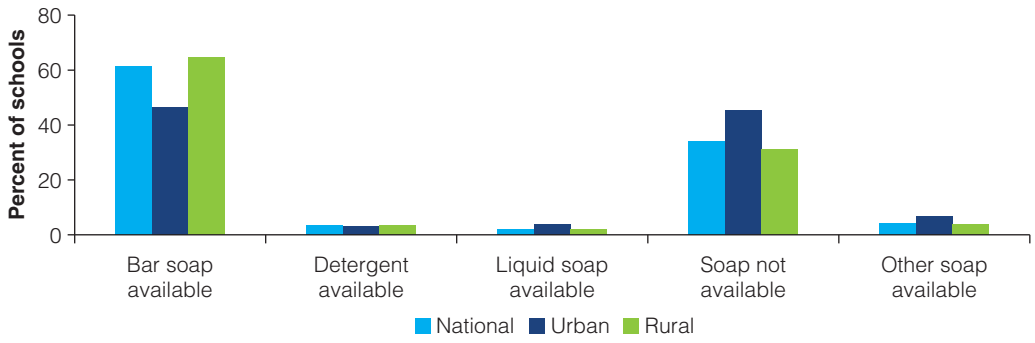
Source: World Bank.

the case for 46 percent of schools nationally and for 80 percent in Sughd. In 84 percent of schools, the facilities are cleaned daily by caretakers, but it was reported during the qualitative work that lack of water can be a significant obstacle to keeping these toilets clean. Parents and focus group participants in the oblast centers of GBAO and Khatlon also noted that some toilets were being used by people who live in the neighborhood who have no toilets in their houses or whose connection to the sewage system is broken. As a consequence, these toilets tend to be dirty all the time. Students prefer not to use these toilets. Those that live close to school try to go home in between classes.

Availability of soap is limited in schools; this problem is least common in Dushanbe and most common in Sughd. At the national level, 34 percent of schools in reported not having soap available in school (figure 4.15). Interestingly, this number is higher for schools in urban areas, where 45 percent of schools report not having soap available, compared to 31 percent of schools in rural areas. There are some regional disparities. While 88 percent of schools in Dushanbe report that soap is available, 75 percent of schools in Sughd report that it is not. Of the schools that report that soap is not available, 18 percent of school administrators do not consider it necessary, while the main reason cited is the lack of funds (59 percent) (figure 4.16). This result is confirmed by the 2016 School WASH Survey data indicating that 95 percent of schools have no access to funding for sanitation and hygiene, and by qualitative testimonies by school administrators, who stated that sometimes they cannot afford to provide soap:

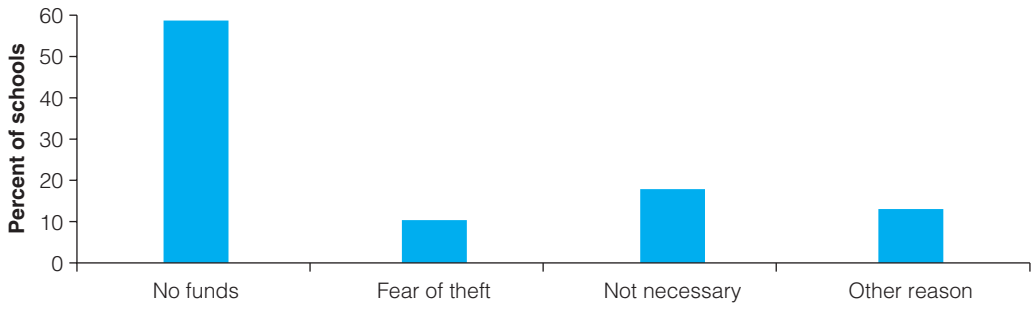
> *Neither school nor parent committee provide soap for children. The budget does not allow it. If there is no problem with funds, we provide soaps to the cleaning ladies [janitors]. However, unfortunately, we do not provide soap to children.* —Key informant, rural school, DRS

Figure 4.15: Availability of Soap in Schools



Source: Household WASH Survey 2016.
Note: N = 298 schools. WASH = water supply, sanitation, and hygiene.

Figure 4.16: Reasons for Unavailability of Soap in Schools



Source: Household WASH Survey 2016.
Note: N = 100 schools. WASH = water supply, sanitation, and hygiene.

Notes

1. Safely managed sanitation is defined as an improved facility that is not shared with other households and where excreta are safely disposed of in situ or treated off-site. Although the Household WASH Survey collected data on the removal of excreta, about 85 percent of the sampled households did not provide a response to this question.
2. http://tab.worldbank.org/t/WBG/views/TajikistanPovertyandWASH/DshNewWASHDashboard?:embed=y&:showShareOptions=true&:display_count=no&:showVizHome=no

Reference

Heijnen, M., O. Cumming, R. Peletz,G K. S. Chan, J. Brown, K. Baker, and T. Clasen. 2014. "Shared Sanitation versus Individual Household Latrines: A Systematic Review of Health Outcomes." PLoS One 9 (4): e93300.

Chapter 5
Linkages with Health and Nutrition

This chapter looks at the correlations and synergies between water supply, sanitation, and hygiene (WASH) conditions and health outcomes, taking into account welfare and geospatial dimensions. It presents the results of the poverty risk model assessment conducted by the University of Florida and the London School of Hygiene and Tropical Medicine, based on data from the Demographic and Health Survey 2012 (DHS 2012) (Rheingans et al. 2016, forthcoming). Then, the chapter discusses additional evidence from the integrated household sample of the Household WASH Survey 2016 and UNICEF Nutrition Survey 2016, focusing on the WASH, nutrition, and care-related determinants of childhood stunting in Tajikistan.

WASH Poverty Risk Model

Approach

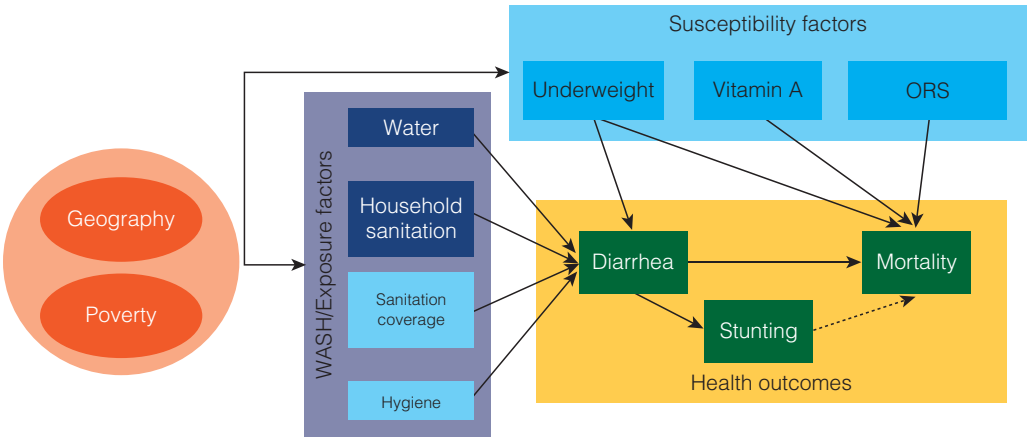
The quality of water supply, sanitation, and hygiene (WASH) services have a complex relationship with disease risk. Global evidence shows that some groups are exposed to much greater risks of infectious diseases such as diarrhea than others. These risks typically co-exist with poor access to quality WASH services, but also depend on factors that are external to WASH service conditions, such as the nutritional status of children and access to preventative or curative services (like vitamin A and oral rehydration therapy). Like WASH conditions, these external factors are often concentrated among certain groups, reflecting broader structural inequities relating to poverty and geography. A systematic review exploring the effects of WASH practices on the nutrition status of children found evidence of a protective effect of WASH interventions on growth in children (Benova, Cumming, and Campbell, 2014).

The WASH poverty risk model (WASH-PRM) is based on the premise that the underlying determinants of disease risk are not randomly distributed. The WASH-PRM looks at the co-distribution of "susceptibility factors" and "exposure factors" that are most relevant to diarrhea, stunting, and mortality. Exposure factors are WASH-related parameters considered to influence the risk of diarrhea. Susceptibility factors are elements that increase a child's susceptibility to or ability to cope with the adverse impacts of diarrhea. The co-distribution of these risk factors magnifies the overall mortality and infection risk among certain subpopulations.

A better understanding of the overlap between WASH conditions and associated health risks can improve the targeting of WASH investments to the populations with the highest risk. The WASH poverty risk model (WASH-PRM) assessment has three main aims: to quantify the proportionate burden of diarrheal disease attributable to WASH services borne by the bottom 20 and 40 percent of the population; to estimate the potential health and other benefits of targeting WASH investments to the bottom 20 and 40 percent; and to assist in identifying priority areas for WASH investment. Taken together, this analysis shows how interrelated risk factors contribute to the distribution of the burden of diarrheal disease within certain subpopulations. The WASH-PRM approach is summarized in figure 5.1.

The model assumes that patterns of susceptibility and patterns of exposure differ within countries based on geographic location and household wealth. The patterns and correlations

Figure 5.1: Conceptual Framework for the WASH Poverty Risk Model



Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016).
Note: WASH/Exposure Factors in dark blue are included in the Exposure Index. WASH = water supply, sanitation, and hygiene.

between these risk factors as well as the how these differ across wealth groups and geographic areas are assessed for Tajikistan using the DHS 2012 data. An exposure index was created by combining the relative risks of the individual exposure factors. The relative risk associated with each susceptibility factor was determined by a child's weight (underweight), whether the child received supplements of Vitamin A, and the child's access to Oral Rehydration Salts (ORS). These were combined to produce a single susceptibility index. Another key part of the WASH-PRM is the development of a WASH risk index, calculated at the level of the child. It combines information on the WASH characteristics of the child's household, individual health vulnerabilities, and the relative risk associated with each factor. The relative risks for each factor in the exposure index and the susceptibility index are multiplied together to develop the WASH risk index. Some risk factors (improved water, access to vitamin A) decrease risk. Others (being underweight) increase risk. The weight of each risk factor is based on what the evidence in the literature provides as a relative risk.

Co-Distribution of Risk Factors

Across rural and urban areas of Tajikistan, WASH-related exposure variables are strongly correlated with household wealth. In general, there are greater disparities in access to improved water and sanitation coverage in urban communities than in rural ones. This is most notable for access to sanitation services. For sanitation, the level of access to sanitation services does not vary much among economic groups in rural settings. Within the urban population, minor disparities exist, with a notably greater access to improved sanitation among children in the bottom 40 percent (B40) of the household income distribution, and particularly the bottom 20 percent group (B20). In urban settings, access to improved sewer service is also concentrated in the top 20 percent group (T20).

There are also significant differences in exposure variables across rural and urban areas. Rural children have approximately equal access to improved sanitation services, but almost no access to improved sewer services. Consequently, the percentage of children with access to improved sewer services is highly skewed toward the T20 group from a national perspective. With respect to household drinking water access, there is little variability in the distribution of children with no access to improved water among the different wealth groups. At the national, rural, and urban levels, patterns of decreased access to improved water on premises and patterns of increased access to improved water off-premises are observed with increasing

economic stability. While the exposure index does not cover hygiene-related exposure factors beyond water and sanitation services, the DHS 2012 data suggest that poor households in Tajikistan are also less likely to have improved handwashing stations, especially in rural areas.

Children belonging to the wealthiest households experience a disproportionately higher share of benefits from improved and safe WASH outcomes than the poorest households. The B40 children account for 37 percent of the cumulative access to improved water and 32 percent of the cumulative access to improved handwashing. In contrast, the T20 subgroup accounts for 25 percent of children with access to both improved water and handwashing services. WASH exposure factors are both associated with wealth and correlated with one another. That is, poor households are more likely to have multiple WASH conditions that increase their exposures to enteric pathogens (gastrointestinal organisms that cause a disease). Clusters with higher improved water coverage also have higher improved sanitation coverage in both rural and urban settings. Correlations between improved water and handwashing are stronger in urban settings. In urban populations, household wealth appears to be a more important driver of exposure and susceptibility.

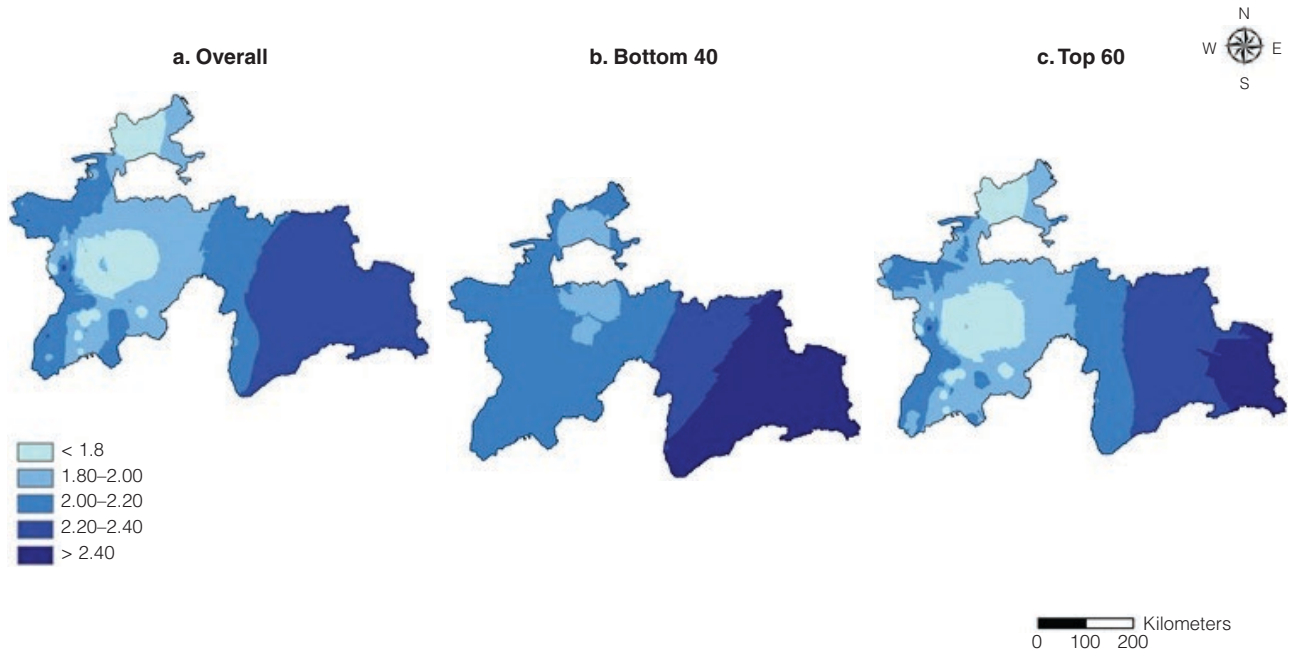
While there are differences in exposure factors and the exposure index across wealth groups, the regional differences are most notable, particularly for the bottom 20 and bottom 40. Among the B40, all communities have exposure indexes greater than 1.80. By contrast, the T60 communities have some pockets of lower exposure (<1.80). The latter are concentrated in DRS region and Fergana valley in Sughd. In general, exposure index values are higher for B40 children than for T60. Geographically, exposure index values are higher in the eastern province of Gorno-Badakhshan Autonomous Oblast (GBAO). If economic disparities are neglected, areas with the lowest exposure indexes seem to be concentrated in central and northern Tajikistan (map 5.1).

In both urban and rural settings, children in poorer households are more susceptible to poor WASH conditions (access to oral rehydration services and Vitamin A). A greater proportion of poor children (B40) are moderately to severely underweight in comparison to the two wealthiest quintiles (T40). Although disparities are typically more pronounced in urban settings, there are considerable disparities in susceptibility due to nutrition (moderate to severe underweight and severe underweight) among both urban and rural children under age 5. The bottom three quintiles (B60) have higher rates of severe underweight in comparison to the top two wealthiest quintiles. This indicates that wealth has a considerable influence on nutrition in Tajikistan. With respect to the probability of access to oral rehydration services, the B40 appear to be at a disadvantage in comparison to the T60. A similar, albeit weaker, pattern is also observed for vitamin A coverage.

The poorest households account for a disproportionate share of children who are underweight. The B40 wealth quintiles account for 46 percent of the cumulative share of underweight children, whereas the T20 households account for only 15 percent of the total population of underweight children in Tajikistan. Worthy of note are the seemingly equal distributions of vitamin A and access to oral rehydration. There are large spatial variations in susceptibility (lower nutrition and access to key health interventions). From a purely geospatial perspective, the highest susceptibility is concentrated in the southwest regions of Khatlon province. There are pockets of high susceptibility in both the B40 and T60. Overall, there are still relatively strong disparities between the B40 and T60. Except for eastern Khatlon, B40 children have higher susceptibility index values than the T60 in all of regions of Tajikistan. Within the B40 subgroup, susceptibility is highest in the southwestern, northeastern, and south-central areas of the country. High susceptibility indexes in the T60 population are observed in the northwestern and southeastern areas of Tajikistan, whereas lower susceptibility index values concentrate around central Tajikistan, most notably in western GBAO (map 5.2).

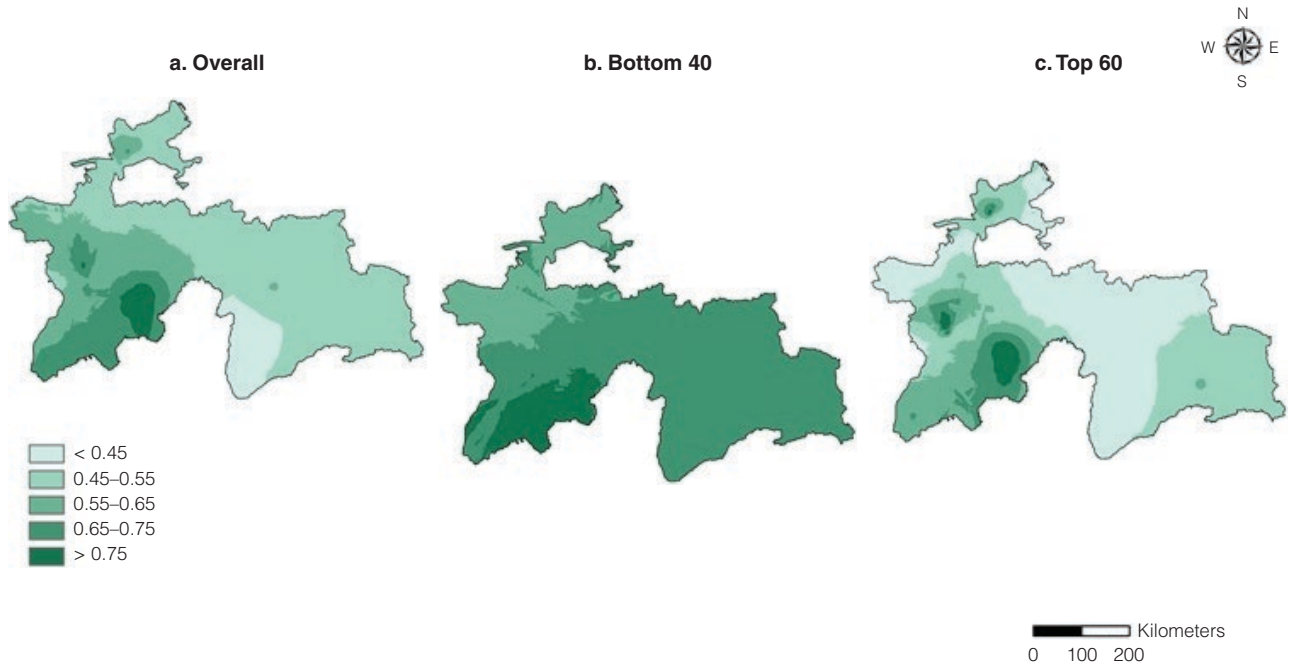
The exposure risk index and risk index are lower in urban areas than in rural areas. Although disparities in the risk index occur in both rural and urban areas, these discrepancies are particularly evident between the B40 and T60 of the urban population. Wealth in the top two

Map 5.1: Exposure Indexes (WASH Conditions) for the Overall Population, Bottom 40, and Top 60



Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016).
Note: B40 = bottom 40; T60 = top 60.

Map 5.2: Susceptibility Indexes for the Overall Population, Bottom 40, and Top 60



Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016).
Note: The susceptibility indexes are for malnourishment, Vitamin A, and access to health services. B40 = bottom 40; T60 = top 60.

quintiles and wealth in the top three quintiles appear to have large impacts on exposure risk and overall risk, respectively. This economic disparity is less apparent when comparing susceptibility indexes across rural and urban areas. In general, more distinct disparities are observed across wealth groups than geospatial subpopulations. Susceptibility is comparable among T60 children, whereas B40 children in rural areas have lower susceptibility risk than B40 children in urban settings. In comparing the cumulative share of children, susceptibility risk is more equitably distributed than disease risk and exposure risk. That said, children in the top two highest risk quintiles disproportionately carry 95 percent and 75 percent of the cumulative risk in urban and rural subgroups, respectively. Despite these noted patterns, it is important to acknowledge that risk varies widely across Tajikistan. Geographic and economic characteristics are inadequate in explaining additional heterogeneities present in the data.

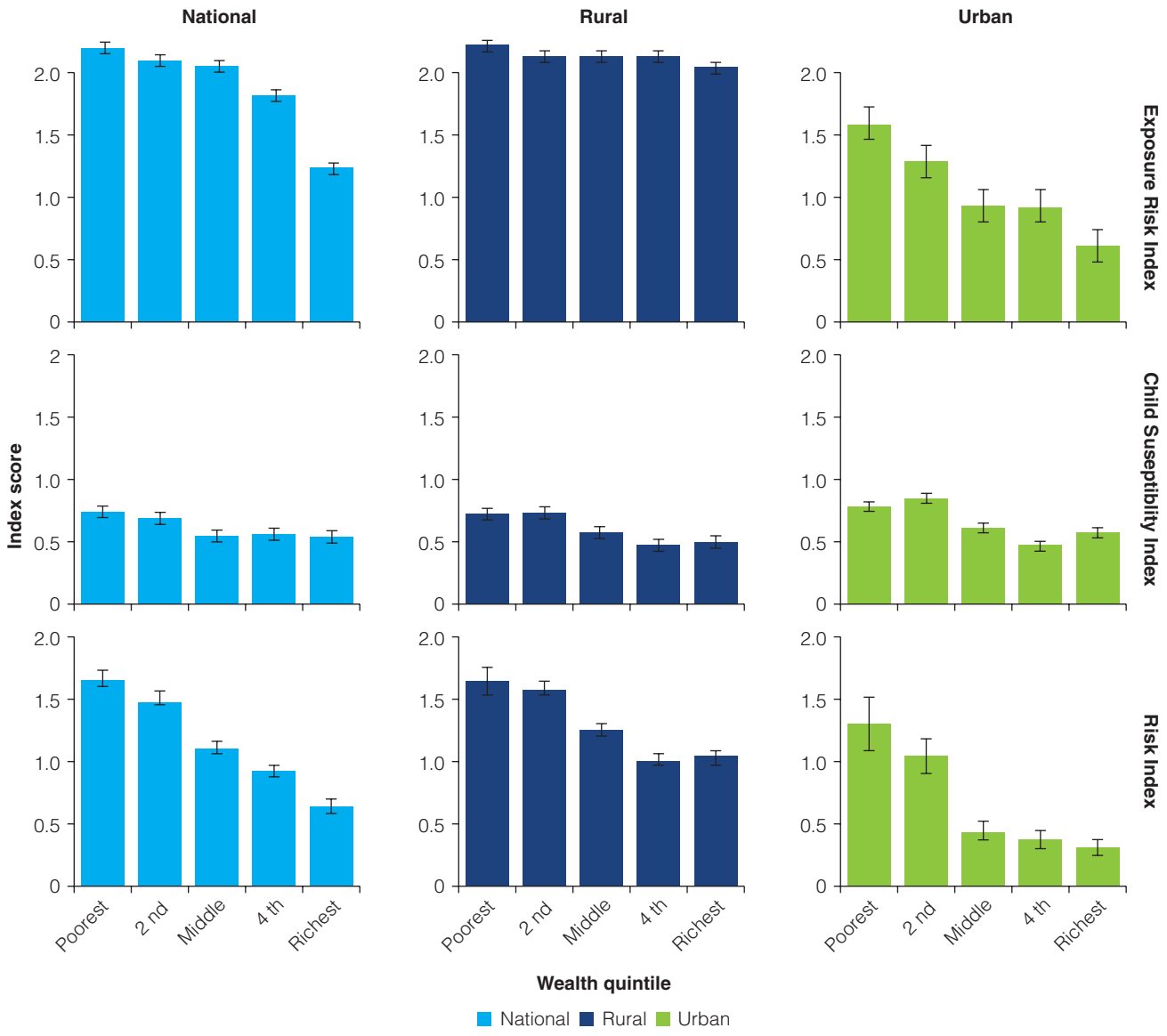
Measures of exposure (WASH conditions), susceptibility (malnourishment, access to Vitamin A, and access to health services), and overall risk are all positively correlated with one another. Children with poor WASH conditions also suffer from poor access to health and nutrition. These correlations between exposure and susceptibility add to (and are likely caused by) underlying wealth and urban-rural inequality. Lower susceptibility, exposure, and risk indexes are associated with higher wealth quintiles. Most notably, there is much higher concentration of high-risk children (more than 10-fold greater risk than the mean) among poor rural and urban households. These correlations are valid for both rural and urban communities. A negative association is found between population density and exposure indexes across all of Tajikistan: areas with higher population density have decreased exposure risk. In strictly urban settings, there is also a negative association between population density and overall risk (figure 5.2).

Most regions show stark disparities in risk factors between wealth quintiles. Dushanbe province has the greatest disparities in risk between wealth groups. The majority of the wealthiest quintile has a risk index of 1.0, while the poorest quintiles exhibit a wide range of moderate to high risk (indexes of 1.0 to 1.5 for most children). GBAO, Sughd, and Khatlon also exhibit considerable disparities, though the discrepancies do not compare to the severity observed in Dushanbe. It is interesting to note that the poorest wealth quintiles exhibit similar risk across all provinces. Map 5.3 illustrates the widespread distribution of risk among the B40 and T60. Pockets of high risk (index values of 1.40–1.60) emerge among the T60, particularly in northwestern, southeastern, and southwestern Khatlon and southeastern regions of GBAO. Khatlon consistently demonstrates concentrated areas of high risk regardless of economic differences. B40 children demonstrably experience higher risk than T60 children.

Visual representations showing the impact of improvements in water access by province indicate risk reduction if the group with the lowest level of water or sanitation (unimproved water or sanitation) receives interventions that will move them one level higher on the improved water scale (from unimproved or none to improved). Map 5.4 shows the impact of moving every group to the highest level possible of access to improved water. Khatlon will gain the most from improved water access (a decrease in risk value of 0.75–1.0). In addition to Khatlon, disease risk would decrease in every other region. If highest level improvements were made (panel b), the greatest impact in risk reduction would also occur in Khatlon. As discussed, this is an area with the greatest magnitude of disease risk across the overall, B40, and T60 populations. Improved sanitation would also have the greatest impact on Khatlon, improving WASH risk by at least 0.75 map 5.5. If the highest level of improvements in sanitation were made, WASH risk would decrease in all provinces, with the greatest improvements occurring in Khatlon.

Susceptibility risk factors exacerbate the impact of inadequate access to WASH services, affecting enteric burdens that are related to WASH, as well as those that are unrelated. Unrelated burdens are considered to be enteric infections that cannot be prevented with improved WASH. The Disability-Adjusted Life Year (DALY) associated with inadequate WASH is representative of both exposure and susceptibility risks of specific subpopulations. Hence, WASH-associated burdens are higher for children in certain subpopulations not only because they are vulnerable to high exposure risks, but also because they are undernourished and lack

Figure 5.2: Distribution of Exposure, Susceptibility, and Risk Indexes by Wealth Quintile, and for National, Rural, and Urban Populations of Children under 5

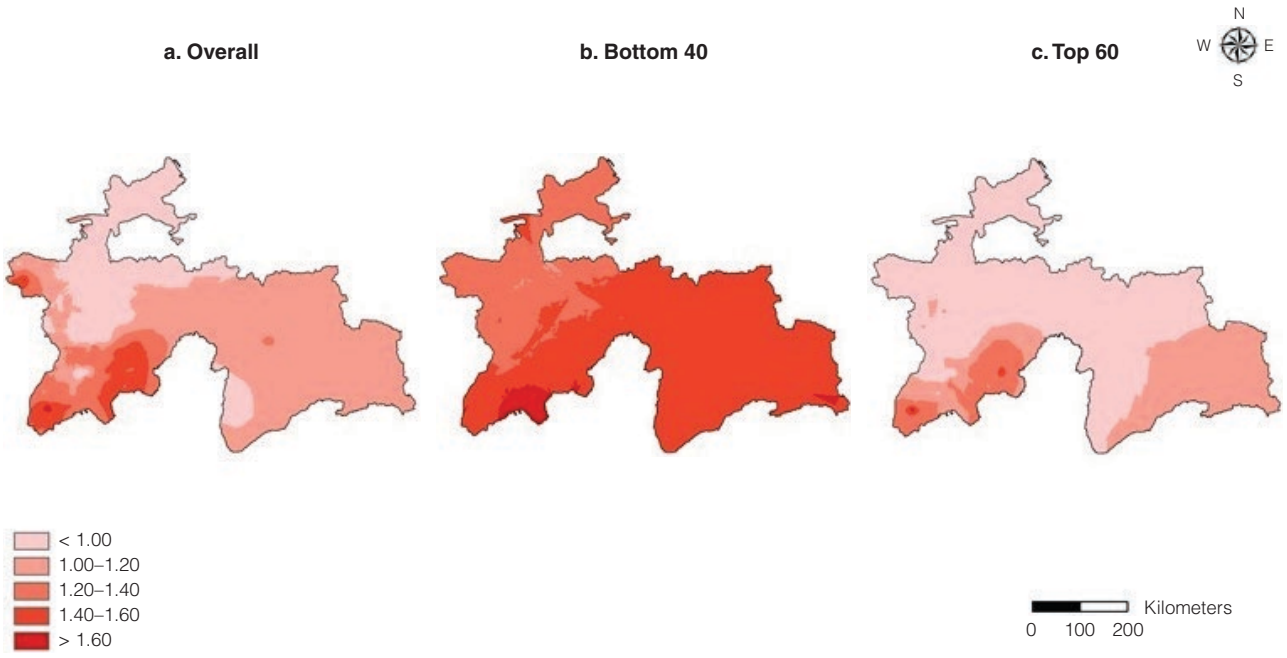


Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016). Tajikistan DHS, 2012.
Note: Quintiles for urban areas are quintiles for the urban population only. Similarly, quintiles for rural areas are quintiles for the rural population only. DHS = Demographic and Health Survey.

proper access to health care services. Analyses demonstrate a pattern of decreasing DALYs with increasing wealth quintile for the national, rural, and urban settings. The contribution of inadequate WASH to DALYs is greater than the contribution of unrelated WASH burdens to DALYs at the national and rural levels across all wealth groups. This trend is observed to a lesser degree in urban settings. In both urban and rural areas, B40 children are subject to noticeably higher burden than T60.

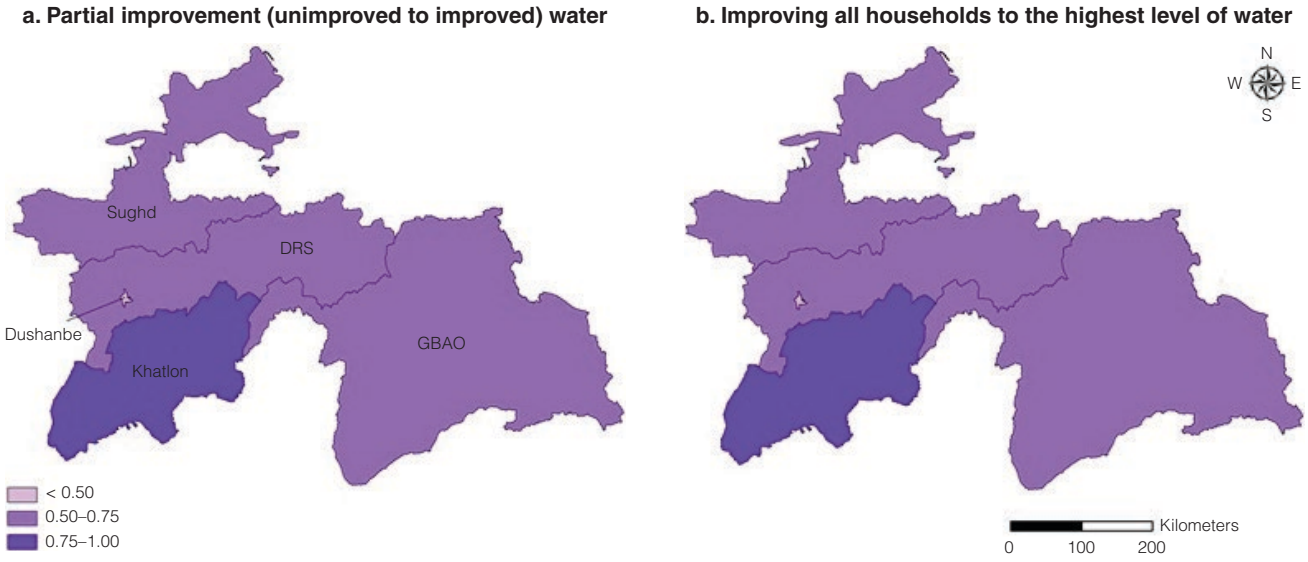
The distribution of total enteric burden and inadequate WASH-attributable enteric burden reveal that children from Khatlon shoulder the highest burden in both cases. From an overall perspective, Khatlon is the only region with DALYs higher than 8,500 per 100,000 children (the highest category) map 5.6. This disparity becomes even more stark in the T60 population.

Map 5.3: Risk Indexes for the Overall Population, Bottom 40, and Top 60



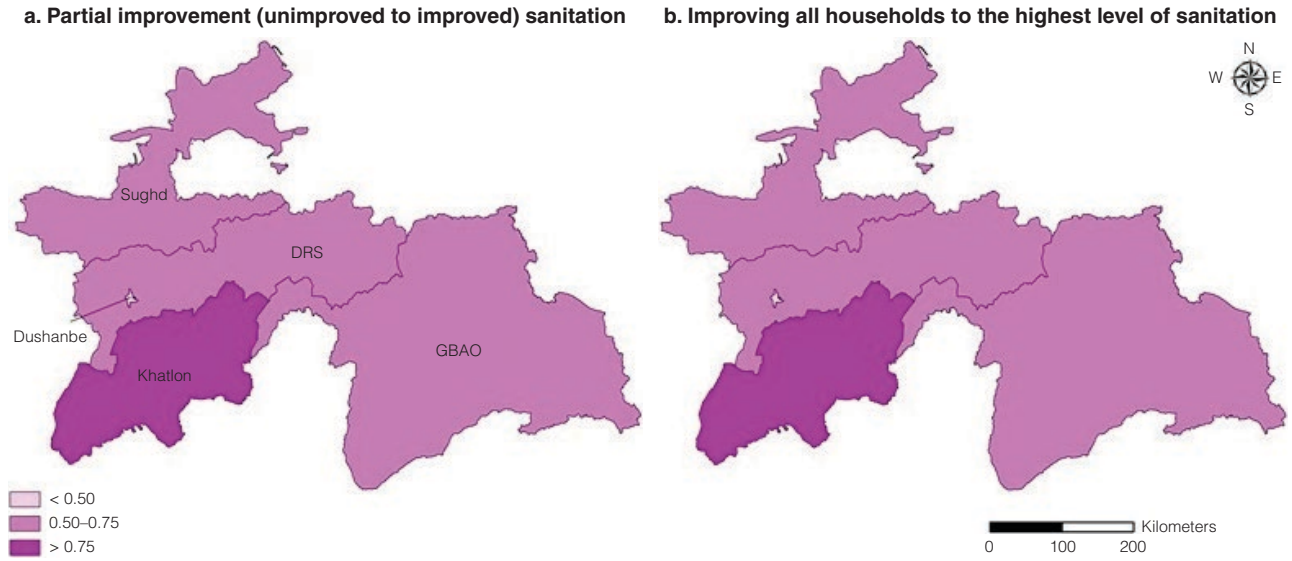
Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016).
Note: B40 = bottom 40; T60 = top 60.

Map 5.4: Impact of Improvements in Water Access, by Region



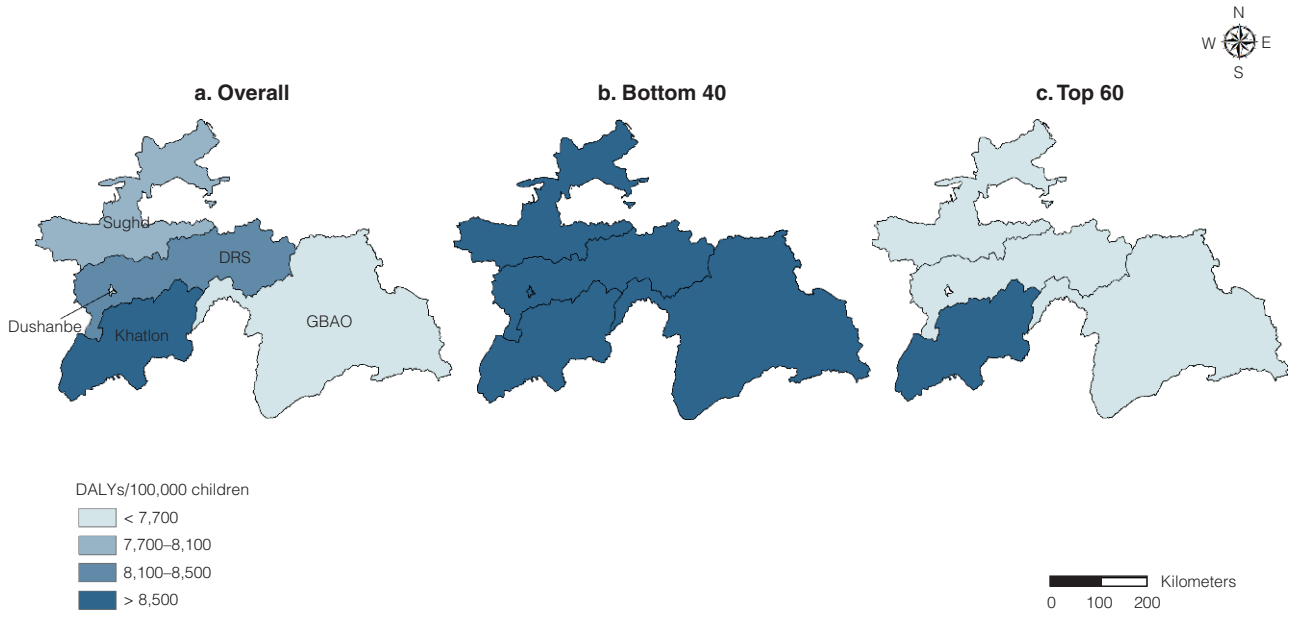
Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016).

Map 5.5: Effect of Sanitation Improvement on WASH Risk Reduction by Region



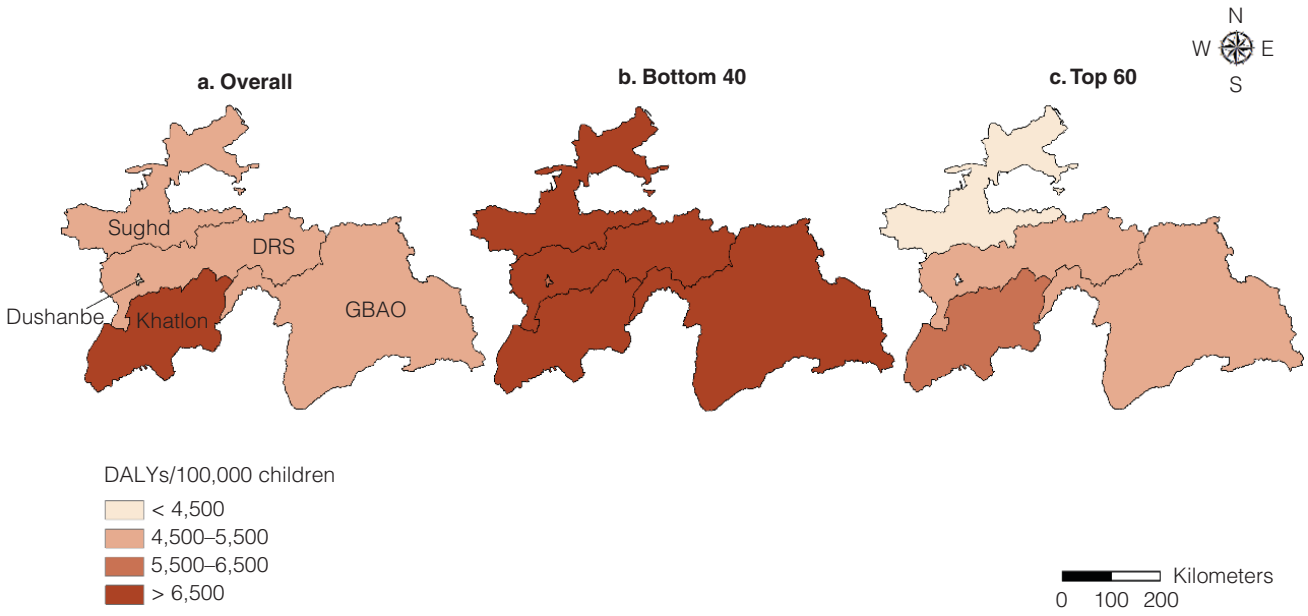
Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016).

Map 5.6: Total Enteric Burden (DALY Rate), by Region



Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016). Tajikistan DHS, 2012.
Note: B40 = bottom 40; T60 = top 60. DHS = Demographic and Health Survey.

Map 5.7: Inadequate WASH-Attributable Enteric Burden DALY Rate, by Region



Source: WASH Poverty Risk Model for Tajikistan (Rheingans et al. 2016). Tajikistan DHS, 2012.
Note: B40 = bottom 40; T60 = top 60. DHS = Demographic and Health Survey.

All other provinces have DALYs in the lowest category (<7,700 DALYs/100,000 children). No geospatial disparities are observed among B40 children. This entire subgroup is subject to the highest classification of total enteric burden (>8,500 DALYs/100,000 children). This uniformity across regions in the highest category of burden (>6,500 DALYs/100,000 children) holds true when evaluating WASH-related impact among B40 children. Within the realm of WASH-attributable burdens map 5.7 Khatlon continues to experience the highest degree of impact. However, risk distribution is homogenous across Tajikistan on a national level and heterogeneous across the wealth quintiles. Regardless of economic disparities, Khatlon again has DALYs in the highest category (<6,500 DALYs/100,000) while the range in all other regions is lower (4,500–5,500 DALYs/100,000 children). Within the T60 subpopulation, Khatlon falls into the range of 5,500–6,500 DALYs/100,000 children and the burden continues to fall to values below 4,500 DALYs/100,000 children in the northernmost region (Sughd).

The Role of WASH, Nutrition, and Care in Childhood Stunting

To provide an additional layer of analysis to complement the discussion of the poverty risk model (PRM), this section presents the results of an analysis of the determinants of stunting and low height-for-age z-scores, based on primary survey data. The nationally representative Household WASH Survey 2016 include detailed questions regarding access to and quality of water and sanitation facilities, as well as a full module on food consumption and expenditure. The UNICEF Nutrition Survey 2016 was conducted at the same time as the WASH survey was in the field. To facilitate the analysis summarized next, the sample for the two surveys were partially integrated where possible. The nutrition survey assessed the nutrition and micronutrient status of the women and children, determined risk factors for deficiencies, and compared the findings with the last nutrition survey completed in 2009.

For households where the two surveys were integrated, anthropometric indicators on stunting and height-for-age z-scores are available for the analysis (about 530 children under the age of 2, and 1178 children under the age of 5).

Tajikistan has the highest prevalence of undernutrition and stunting among countries in the Europe and Central Asia region, though the rate of childhood stunting has decreased in recent years. The rate of childhood stunting declined from about 29 percent in 2009 to nearly 26 percent in 2012 (table 5.1), but it is still the highest in the region. In 2015, Tajikistan was also the only country in Central Asia to not be on track to meet the MDG target for nutrition, according to the Food and Agriculture Organization (FAO) of the United Nations. Stunting and undernutrition in childhood are commonly the result of many contributing environmental, food, hygiene, and health-related factors. The effects of inadequate nutrition during the first few years of a child's life can be irreversible. Inadequate nutrition in childhood can lead to permanent cognitive impairment, and malnourished children tend to be at a much higher risk of death.

Approach

Three sets of nutrition or "food adequacy" outcomes are considered for the analysis of risks relevant to the Tajikistan context. First, to create an indicator of calorie intake, food consumption was first converted into calorie equivalents using a standard FAO concordance. Because nutritional needs vary by age, from newborn to adulthood, amounts are expressed per adult equivalent. Using these definitions allowed an indicator to be created to assess whether each household's aggregate food calorie consumption meets a minimum threshold, in adult equivalent terms. For the integrated sample of children who participated in this study, the adequacy prevalence was strongly associated with monetary welfare (defined as total per capita consumption) and the estimated share of households suffering from this definition of food calorie deprivation decreased monotonically by welfare quintiles. An additional measure of diet diversity was created, based on an index of concentration in food types. This is estimated by grouping observed food consumption into groups, and weighting a diversity measure by the share of household calorie consumption that is allocated to each of the different groups (see Appendix A, Part I for details). Children are considered to be adequate in the food security component if the following criteria are met: their household ranks in the top 80 percent of the dietary diversity index distribution; and each member of the household consumes, on average, at least 2250 calories in adult-equivalent terms. If these conditions are not met, the child is considered to be inadequate in the food component. For some analyses, the related indicators are included directly rather than using a "adequacy" threshold.

The main WASH-related indicator used in the analysis for stunting is a composite measure of adequacy of sanitation facilities and safe drinking water, which is broadly referred to as

Table 5.1: Childhood Stunting, Wasting, and Underweight Outcomes, by Wealth Quintile, 2012

	Height-for-age (stunting)			Weight-for-height (wasting)			Weight-for-age (underweight)		
Wealth quintile	(%) below - 3 SD	(%) below - 2 SD	Mean z-score (SD)	(%) below - 3 SD	(%) below - 2 SD	Mean z-score (SD)	(%) below - 3 SD	(%) below - 2 SD2	Mean z-score (SD)
Lowest	12.0	32.1	–1.4	5.2	9.5	–0.3	4.5	15.8	–1.0
Second	10.1	29.0	–1.2	3.4	10.9	–0.3	4.8	13.7	–0.9
Middle	7.3	23.4	–1.1	3.0	9.6	–0.2	2.3	10.2	–0.7
Fourth	9.9	24.9	–1.1	4.3	10.5	–0.2	3.9	11.5	–0.7
Highest	9.2	20.9	–0.9	3.4	9.0	–0.2	2.7	9.3	–0.6
Total	9.7	26.2	–1.1	3.9	9.9	–0.2	3.7	12.1	–0.8

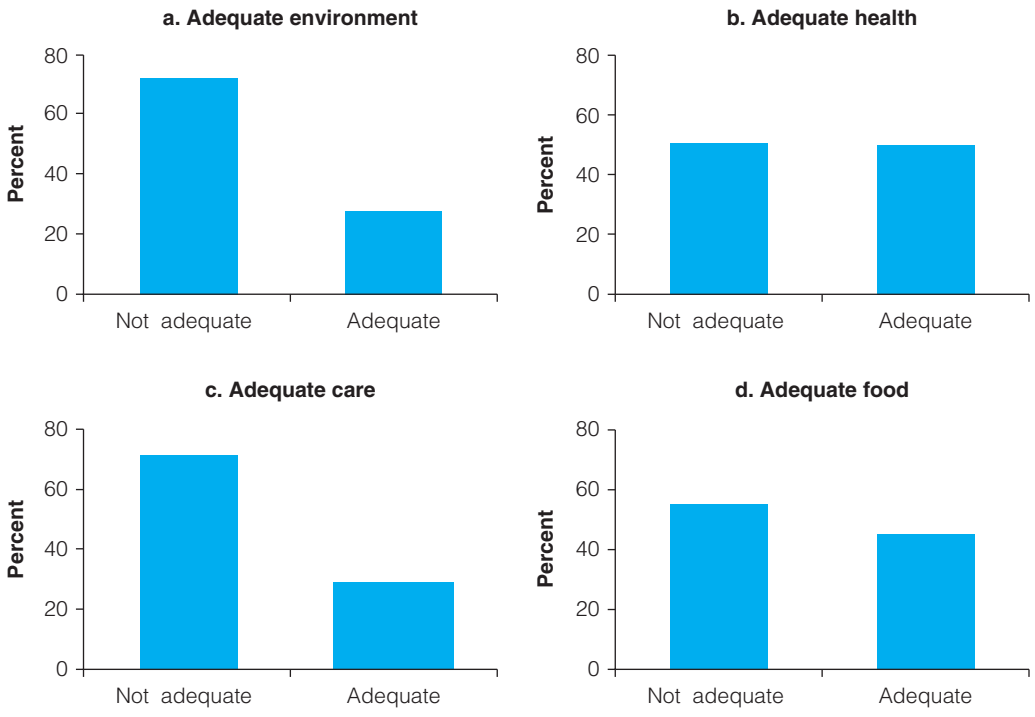
Source: DHS 2012.
Note: Data refers to children under the age of 5. SD = standard deviation.

"adequate environment". This indicator is used rather than estimating z-scores. The measure is defined as simultaneous household access to improved sanitation and improved water, and living in a location where more than 90 percent of households in community have access to improved sanitation. The motivation for this approach is the multidimensional nature of infection risk. For the synergies analysis, an alternative definition is used. A child's environment is considered to be adequate if the household has both a flush toilet and improved water, and if at least 50 percent of the households located in the same primary sampling unit also have a flush toilet.

Following the availability of indicators in the surveys, "adequate care" and "adequate health" are defined differently for children in different age groups. Children under two years of age are considered adequate in the care dimension if the following criteria are met: the child was breastfed within 30 minutes of birth; the child was exclusively breastfed for 6 months, or is still being exclusively breastfed if under 6 months of age; the child is still being complementarily breastfed (for up to two years). Children between 2 and 5 years of age are considered adequate in the care dimension if they have been washed at least once in the previous 24 hours. In terms of health services, they are considered adequate for children under 2 years of age if the child has received at least one visit from a health worker in the previous 6 months (and the health worker asked questions or gave advice on at least one aspect of their health and development). Children aged 2 or older are considered to be adequate in the health component if they have received dietary supplements (such as vitamin A, vitamin B, or iron) in the previous 6 months.

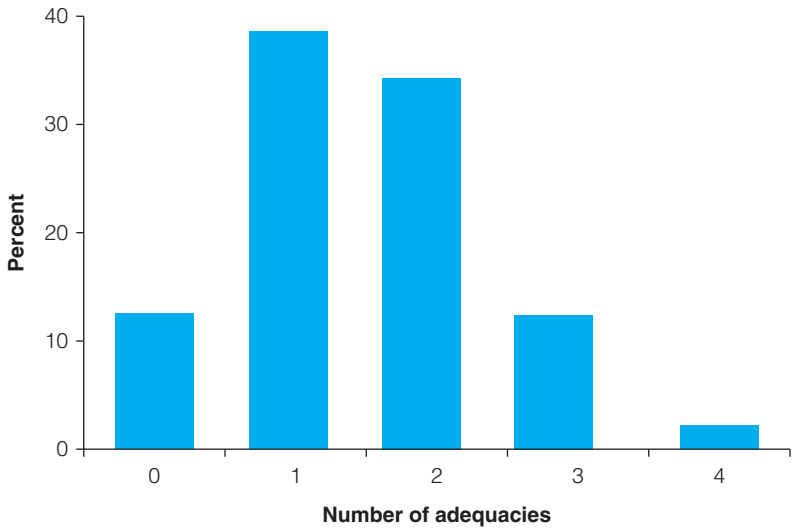
Based on these definitions, only a small share of children in Tajikistan had access to adequate WASH environment, adequate health and adequate care all at the same time. About 45.6 percent of children were adequate in the food component, 32.6 percent of children in the environment component, 29.0 percent in the care component, and 49.7 percent in the health component in 2016 (figure 5.3). While access to one of these four components is quite low, many children (37.3 percent) were adequate in only one out of four dimensions, about 34.2 percent were adequate in two dimensions and 13.7 percent were adequate in

Figure 5.3: Proportion of Children by Adequacy Status



Source: World Bank team calculations based on Household WASH Survey 2016 and UNICEF Nutrition Survey 2016.

Figure 5.4: Proportion of Children by Number of Adequate Components



Source: World Bank team calculations based on Household WASH Survey 2016 and UNICEF Nutrition Survey 2016.

three dimensions. Further, only 2.1 percent were adequate across all four dimensions, whereas about 12.6 percent of children were not adequate in any dimension (figure 5.4).

Analysis of Risk Factors and Determinants

The analysis proceeds using two standard statistical approaches adapted for the analysis of stunting. The first, introduced by Skoufias (2016), focuses on the interactions between risk factors for stunting. As such, the model is estimated using ordinary least squares (OLS) for a set of fully interacted binary explanatory variables:

$$zscore_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 (x_{1i} * x_{2i}) + \varepsilon_i \quad (5.1)$$

where $zscore_i$ is a continuous measure of individual i's height-for-age z-score, x_1 is the first adequacy indicator, and x_2 the second. The terms β_1 and β_2 are the coefficients to be estimated when the associated explanatory variable is equal to one, and β_3 is the coefficient relating to the case when both explanatory variables are equal to one. As such, the comparison category is the case when all adequacy variables are equal to zero. In practice, the model is estimated with all adequacy variables.

The results for the first approach highlights the synergies between adequacy indicators, suggesting that single interventions to address stunting may be less effective than approaches that take into account the full breadth of factors. In table 5.2, columns 1 and 2 contain inclusive interactions, while columns 3 and 4 contain exclusive interactions. Inclusive interactions (columns 1 and 2) allow other adequacy variables to be positive. Exclusive interaction indicators (columns 3 and 4) are created such that the interaction is positive only when both/all are equal to one, and no other positive values for adequacy variables are allowed. Adequate food, care, and environment, absent other types of adequacy, do not explain the variation in z-scores at a significant level. However, interaction terms between the various adequacy indicators are significant and in the expected direction, indicating that the full set of determinants that may lead to stunting need to be addressed holistically.

Table 5.2: Determinants of Childhood Stunting, OLS Results with Inclusive and Exclusive Interactions, Full Sample

	Inclusive interactions		Exclusive interactions	
	(1)	(2)	(3)	(4)
Adequate food	0.010	0.093	0.010	0.093
	(0.191)	(0.217)	(0.191)	(0.217)
Adequate care	0.056	0.158	0.056	0.158
	(0.234)	(0.248)	(0.234)	(0.248)
Adequate environment	0.350	0.426	0.350	0.426
	(0.393)	(0.406)	(0.393)	(0.406)
Adequate health	0.301*	0.378**	0.301*	0.378**
	(0.168)	(0.173)	(0.168)	(0.173)
Adequate in: Food and care	0.555	0.312	0.621	0.562
	(0.493)	(0.595)	(0.469)	(0.526)
Adequate in: Food and environment	0.018	-0.103	0.378	0.416*
	(0.551)	(0.579)	(0.246)	(0.243)
Adequate in: Food and health	–0.145	–0.152	0.166	0.318
	(0.267)	(0.275)	(0.201)	(0.214)
Adequate in: Environment and care	0.237	0.190	0.644	0.774**
	(0.566)	(0.555)	(0.408)	(0.369)
Adequate in: Health and care	0.864**	0.697*	1.222***	1.232***
	(0.336)	(0.369)	(0.254)	(0.281)
Adequate in: Health and environment	–0.405	–0.514	0.247	0.290
	(0.479)	(0.495)	(0.306)	(0.314)
Adequate in: Food, care, and environment	–0.691	–0.430	0.535	0.645
	(0.930)	(0.991)	(0.469)	(0.470)
Adequate in: Food, care, and health	–0.579	–0.564	1.063***	0.920***
	(0.603)	(0.694)	(0.309)	(0.290)
Adequate in: Care, environment, and health	–1.288	–1.082	0.116	0.252
	(1.354)	(1.360)	(0.984)	(1.031)
Adequate in: Food, environment, and health	0.701	0.789	0.831***	0.916***
	(0.657)	(0.671)	(0.240)	(0.242)
Adequate in: All four	1.246	1.108	1.231***	1.304***
	(1.573)	(1.615)	(0.283)	(0.322)
Gender		–0.061		–0.061
		(0.096)		(0.096)
Consumption expenditure quintiles		–0.015		–0.015
		(0.045)		(0.045)
Average weight of women 15–49 in household		0.014**		0.014**
		(0.006)		(0.006)
Constant	–1.003***	–1.821***	–1.003***	–1.821***
	(0.143)	(0.401)	(0.143)	(0.401)
Number of observations	1,178	1,066	1,178	1,066
R^2	0.053	0.059	0.053	0.059
Adjusted R^2	0.041	0.043	0.041	0.043

Source: World Bank estimates based on Household WASH Survey 2016 and UNICEF Nutrition Survey 2016.
Note: * = 10 percent, ** 5 = percent, *** 1 = percent; OLS = ordinary least squares.

Separate results for rural children indicate that synergies across different dimensions are larger and more significant in rural areas, where stunting rates are the highest (table 5.3). In rural areas, the height-for-age z-scores of children who are adequate in three out of four dimensions are on average 0.62 higher than those of children who are not adequate in three dimensions. This difference drops to 0.45 when urban children are also included in the sample. Similarly, the z-scores of rural children adequate in all four dimensions are on average 0.81 higher those of rural children adequate in fewer dimensions. For the whole sample, the average difference decreases slightly, to 0.71. Overall, the positive synergies across environment, health, food, and care seem to be stronger in rural areas, where child malnutrition is also a more pressing problem.

The second approach modifies the estimation strategy to use binary outcome (probit) model of the type:

$$\Pr(stunt_i = 1 | x_i) = \theta\,(x_i \beta) \tag{5.2}$$

where $stunt_i$ is a binary measure of whether individual *i*'s height-for-age z-score was less than two standard deviations from the median of the reference population, θ is a standard normal distribution function, x_i is a vector of explanatory variables, and β is a vector of coefficients to be estimated.

Table 5.3: Determinants of Childhood Stunting, OLS Results, Rural Sample

	(All)	(Rural)
Adequate in: Food only	0.031	0.028
	(0.270)	(0.282)
Adequate in: Care only	–0.263	–0.101
	(0.257)	(0.246)
Adequate in: Environment only	0.364	–0.237
	(0.436)	(0.293)
Adequate in: Health only	0.263	0.453**
	(0.221)	(0.225)
Adequate in two dimensions	0.337	0.446**
	(0.205)	(0.210)
Adequate in three dimensions	0.450*	0.623**
	(0.236)	(0.244)
Adequate in four dimensions	0.713*	0.806*
	(0.425)	(0.479)
Gender	–0.043	–0.064
	(0.095)	(0.102)
Consumption expenditure quintiles	–0.031	–0.022
	(0.046)	(0.056)
Average weight of women 15–49 in household	0.015**	0.022***
	(0.006)	(0.007)
Constant	–1.677***	–2.208***
	(0.415)	(0.500)
Number of observations	1,031	803
R^2	0.025	0.041

Source: World Bank estimates based on Household WASH Survey 2016 and UNICEF Nutrition Survey 2016.
Note: * = 10 percent, ** 5 = percent, *** 1 = percent; OLS = ordinary least squares.

The results from the second approach, which provide a more detailed account of the determinants of stunting than overall z-scores, indicate a strong association between stunting and key indicators relating to environment, adequate care, and the sufficiency of the calories consumed. These relationships are robust to the addition of spatial indicators in the model (column 5), and the coefficients are relatively stable in magnitude as additional covariates are added (table 5.4, moving from left to right). The coefficients can be more easily interpreted in terms of odds ratios. "Adequate water and sanitation" reduces the relative risk of stunting by about 29 percent; "adequate care" reduces it by 35 percent; and "sufficient daily calories" reduces it by about 37 percent. Children living in Dushanbe and GBAO are at significantly lower risk of stunting, after controlling for other risk factors, as compared with children living in Khatlon (the reference region).

The results from the second approach also indicate a strong association between stunting and key indicators relating to environment, adequate care, and the sufficiency of the calories consumed. The second approach focuses on the determinants of stunting in particular, rather than overall z-scores. As before, these relationships are robust to the addition of select spatial indicators (column 5), and the coefficients do not change by much as additional covariates are added (table 5.4, moving from left to right).

Table 5.4: Determinants of Childhood Stunting, Probit Regressions (on Binary Dependent Variable Indicating Childhood Stunting)

	(1)	(2)	(3)	(4)	(5)
Adequate Environment = 1	−0.273**	−0.281**	−0.261**	−0.266**	−0.223*
	(0.120)	(0.121)	(0.119)	(0.119)	(0.121)
Adequate Care =1		−0.230**	−0.244**	−0.225*	−0.224*
		(0.117)	(0.120)	(0.129)	(0.131)
Calories > 2250 per adult equiv. = 1			−0.192*	−0.203*	−0.197*
			(0.112)	(0.113)	(0.111)
Diversity index			−1.947***	−1.933***	−2.115**
			(0.740)	(0.739)	(0.835)
Adequate health = 1				−0.056	−0.075
				(0.104)	(0.108)
Female = 1					0.006
					(0.008)
Dushanbe region					−0.079
					(0.310)
DRS region					0.137
					(0.146)
Sughd region					0.125
					(0.149)
Rural = 1					0.069
					(0.156)
Constant	−0.799***	−0.713***	1.132*	1.149*	1.047
	(0.094)	(0.103)	(0.658)	(0.657)	(0.680)
Number of observations	1,183	1,182	1,182	1,177	1,177
Adjusted R^2	0.009	0.015	0.025	0.026	0.031

Source: World Bank estimates based on Household WASH Survey 2016 and UNICEF Nutrition Survey 2016.
Note: * = 10 percent, ** 5 = percent, *** 1 = percent OLS = ordinary least squares. DRS = Districts of Republican Subordination.

Discussion

WASH-PRM findings show that disease risk is negatively associated with wealth and is largely driven by exposure rather than susceptibility. Risk is often higher in the poorest and most vulnerable communities. B40 children carry 55 percent of the cumulative share of exposure risk and overall disease risk. In addition, 95 percent of the risk in urban settings and 75 percent of the risk in rural areas are carried by 40 percent of children in Tajikistan who suffer the highest risk level.

WASH and health vulnerabilities are both consequences of economic and geospatial inequalities. The largest disparity in disease risk between the B20 and T20 quintiles is observed in Dushanbe. Children from Khatlon and the Districts of Republican Subordination (DRS) are subject to the greatest disease risk. Improvements in access to water and sanitation, regardless of extent, would benefit all regions across Tajikistan. Children from Khatlon would experience the greatest risk reduction. The burden associated with inadequate access to WASH services disproportionately falls on the shoulders of poorer children in rural areas. On a national level, the enteric burden attributable to WASH for B20 children is greater than the enteric burden for T20 by a factor of 2.6. This disparity is much more pronounced in urban settings, where the burden for the poorest households is four times the burden borne by the richest ones. In rural populations, this disparity shrinks to a factor of 1.6.

Exposure and susceptibility are also positively associated, suggesting that children with access to poor WASH conditions are likely also to have poor access to health care and adequate nutrition. This relationship is further exacerbated by wealth. This finding is also supported by the analysis of primary survey data from the UNICEF Nutrition Survey on indicate a strong association between stunting and key indicators on WASH-related environment, adequate health, adequate care in the early phases of infancy, and food security. Together, these findings reiterate the notion that single interventions to address the health consequences of poor access to WASH and related factors may not be as effective as approaches that take into account the full set of conditions.

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Chapter 6
Consumer Experiences in Meeting WASH Needs

This chapter discusses consumers' experiences in meeting their water supply, sanitation, and hygiene (WASH) needs. It begins with a discussion of the monetary, time, and health costs that households incur in obtaining drinking water. This information comes primarily from the qualitative data, although some descriptive quantitative data are also presented. The chapter then turns to consumer experiences in interacting with service providers and discusses issues of transparency, accountability, and consumer willingness to pay for improved services.

Costs Incurred by Households

Monetary Costs

Households in Tajikistan incur a range of direct and indirect monetary costs related to their main drinking water supply. In the qualitative fieldwork, focus group participants indicated that they incur a range of costs, including payments for piped water supply and for alternative water sources. Some households, such as those living in oblast or raion centers that rely on piped as well as nonpiped sources like bottled water, incur both costs. That said, in the Household WASH Survey, only 58 percent of households indicated that they pay a fee for their water supply. The proportion of households that pay for water is higher in urban areas (88 percent), among households that have a piped connection into their dwelling (88 percent), and among households that use water delivered by tanker trucks as their main drinking water source (73 percent). In rural areas, on the other hand, only 47 percent of households indicated that they pay a fee for water. Those who stated that they never pay for water are either not connected to a piped water network or rely entirely on open water sources, such as rivers, springs, irrigation canals, and rain water.

For those who make water payments, drinking water expenses make up a substantial share of their total annual expenditures, especially for the bottom 40 households. Among households that report that they pay for water, expenditures on cold water supply make up 5 percent of their total annual expenditure. The average expenditure per household is TJS 201 per year at the national level. It is higher in urban areas (TJS 266, or 6 percent) and lower in rural areas (TJS 144, or 4 percent). Across administrative regions, the annual expenditure share is the highest in Gorno-Badakhshan Autonomous Oblast (GBAO) (7 percent, or TJS 458) and lowest in Khatlon (5 percent, or TJS 171). The top 60 households have higher annual expenditures on cold water supply (TJS 208), but this corresponds to a lower share of their total expenditure (only 3 percent). On the other hand, households in the bottom 40 percent spend an average of TJS 187, which comprises a larger share of their total expenditures (8 percent). Among the different types of piped connections, households with private connections into their dwelling have the highest cost (TJS 250), followed by piped connection to compound (TJS 237) and piped connection to a shared public tap (TJS 120).[1]

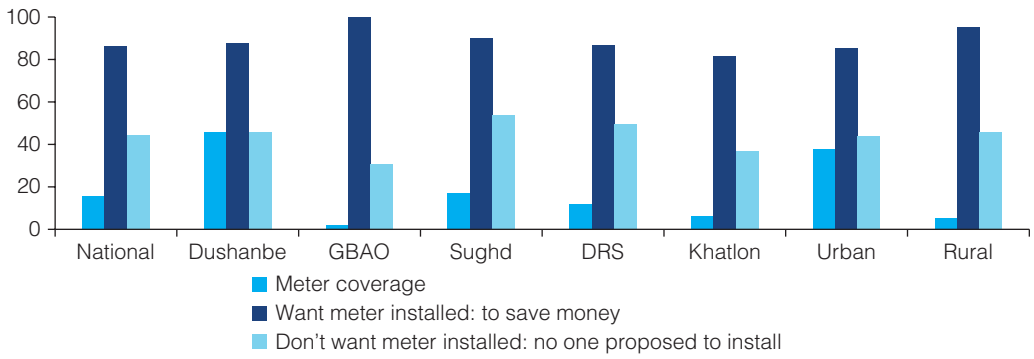
Because water meters are not widespread, most households that are connected to a centralized water supply system (private or shared) usually pay a fixed normative tariff. At the national level, only 15 percent of households have a water meter installed at their water source, ranging

between 46 percent in Dushanbe to only 2 percent in GBAO (figure 6.1). Most water meters are located in urban areas, where 38 percent of household report having a water meter, as opposed to rural areas, where this share is only 5 percent. Among the large majority of households in Tajikistan that do not have a water meter, 86 percent report that they want a meter installed because it would help them save money. This percentage is the highest in GBAO, the region with the lowest meter coverage and the highest average annual water expenditure. On the other hand, the most common reason for not wanting a water meter is because this option has never been offered by the service provider. That water meters can improve the quality of service and reduce monetary costs was mentioned during key informant interviews in the Khudjand Vodokanal. Service providers claimed that after water meters were installed, consumers started saving water, which reduced their monthly payments, and water pressure in the pipes increased. However, Vodokanal officials stated that they lack resources to install meters for all households in their area.

Nominal tariffs are often arbitrarily selected. Typically, tariffs are determined on the basis of household size. In the qualitative study, focus group respondents indicated that the nominal tariff rates vary between TJS 3 and TJS 6 ($0.40–0.80) per person per month. The fee also depends on the region and the type of connection to the water source. Although household size is the main determining factor, key informants stated that some household members are not registered. Therefore, it is likely that most households underpay for the amount of water they use. On average, focus group participants in the qualitative study indicated that they pay TJS 290–310 ($40–45) per year, which is higher than the cost suggested by the statistically representative Household WASH Survey. The reason for this higher figure is that the qualitative study research sites were generally remote and poorer settlements. The proportion of household expenditures spent on drinking water comprises up to 15 percent among the focus group participants, with the mean proportion at 8 percent, similar to the survey data. The qualitative data, moreover, indicate that urban low-income households spend the highest proportion of their expenditure on drinking water.

Households who pay for nonpiped water services incur higher per unit costs than households with piped connections. Data collected during focus group discussions suggest that centralized water supply can be cheaper than obtaining water from alternative sources, such as water delivered by private trucks or cars. The latter is common in rural areas of Khatlon and Sughd, where some villages depend entirely on delivered water. Households that can afford it also build storage tanks (photo 6.1), which can cost somewhere between TJS 2500 and TJS 5000 ($400–$700), to pool the water fetched from various sources. During the qualitative work,

Figure 6.1: Water Meter Coverage and Primary Reasons for Wanting or Not Wanting a Meter, 2016 (Percentage of Households)



Source: Household WASH Survey 2016.
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast.

Photo 6.1: Storage tank (Shartuz, Khatlon)

Source: World Bank.

this was the case in one mahalla in Istaravshan in Sughd. Here, low-income households have smaller storage capacity and can afford to only buy one to two truckloads of water per month at TJS 30–60 ($4–8) per truck load. This is more than what households that are connected to a centralized supply pay per month (TJS 24–26, or $3.50–4.00). People claim that the quality of water that is delivered by trucks is not good either because it usually contains dirt and have a strong smell. People boil this water before drinking, which adds fuel costs that strain the household budget even further.

For households that use multiple water sources, the amount spent on energy costs required for transporting and treating water can be greater than the amount spent on their piped water supply (table 6.1). Households relying on water from artesian wells usually need to use electric pumps and incur significant electricity expenditures. This was stressed particularly by participants living in houses in oblast and raion centers of Khatlon. On average, these households spend around an TJS 20–30 on electricity per month. With frequent electricity outages or drops in voltage, especially during the winter season, supply can be irregular. The only group that pays more for water than energy are households that rely on water delivered by

trucks (box 6.1). Some households, particularly those living in raion centers and rural areas in Sughd region, use private vehicles to transport buckets of water they collect from the nearest river or canal. The main additional costs households incur include the fuel cost for the car, which varies between TJS 10 and TJS 50 ($1.50–7.00) per month, depending on the distance and number of trips.

Another category of monetary expenses is the repair costs for infrastructure, which, in most cases, are covered by consumers rather than the service provider. Focus group participants indicated that if there are any breakdowns in the centralized water supply system, the local population usually collects money to fix it themselves, since they cannot rely on service providers. This is confirmed by representatives from the local water utility, Vodokanal, who also indicate that it is not their responsibility to maintain infrastructure in their coverage area in the face of limited revenues. Officials from Vodokanals stated that they do not receive any financial support from the local or central government and that the tariffs are too low to cover the costs of maintenance and new equipment. For example, at the time of the interview, the Vodokanal

Table 6.1: Typology of Monetary Expenses Households Incur to Obtain Water Per Qualitative Field Research

Indicator	Centralized water supply	Artesian well/ private well	Water brought by private cars[a]	Water delivered by water trucks
Average monthly expenditure (TJS)	20–30	20–30	10–50	30–120
Average annual expenditure (TJS)	240–360	240–360	120–600	600–1440

Source: Focus group discussions conducted as part of the qualitative field research.
a. Includes only car fuel.

Box 6.1: Water Scarcity and Delivery Trucks in Rural Khatlon

Gulnora and Sobir have four children and live in a rural area of Khatlon. The household's only source is the household head's daily wage for labor, which usually amounts to TJS 500 ($70) per month. However, he is able to work for only seven months a year (from May to November). Thus the total annual cash income of the household is TJS 3500 ($500), or TJS 583 ($80) per person per year. The household relies on its kitchen garden for most of its food. It has difficulties meeting basic expenditures, especially costs related to schooling of children, including books and uniforms. There are no permanent sources of water in the village, so the household relies on water delivered by trucks and stores the water in the yard. Private individuals deliver water from the nearby canal. To deliver one truck of water (4 tons), the household pays TJS 50 ($7). The household needs at least 30 liters of water per day. One truck load of delivered water lasts for about one month, so the households' annual expenditures is TJS 600 ($90), which roughly corresponds to 17 percent of its annual income. There are times when the household cannot afford to pay for the water delivery. In these cases, household members borrow water from their neighbors.

Source: Qualitative field research.

in Khorugh owed a significant amount of debt to the electricity utility firm. Similarly, the Vodokanal in Ganchi could cover only 80 percent of its costs with its revenues. In Khudjand, where tariffs were higher and metering was more common among the city population, the cost recovery rate was reported to be close to 100 percent.

Nonmonetary Costs

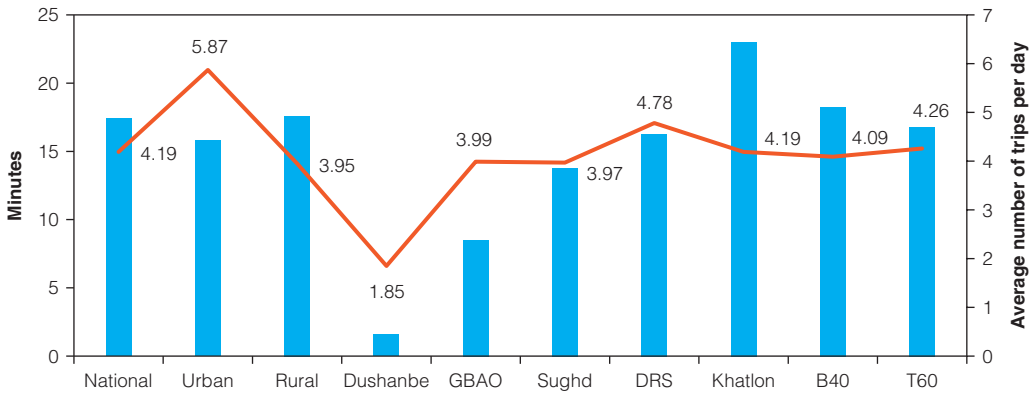
Households also incur nonmonetary costs, the most important of which is the time and physical labor spent for collecting drinking water from sources located outside household premises. In recognition of these adverse impacts, the Sustainable Development Goal (SDG) criteria for safely managed drinking water is to be "on-premises." Depending on the water source, nonmonetary costs can be greater than monetary costs (table 6.2). In 2016, according to the Household WASH Survey, households in Tajikistan reported spending on average 17.4 minutes to reach their water source, collect water, and come back home. Considering that households report that their household members make an average of 4.19 trips on a typical day, the amount of time spent on water collection quickly adds up (figure 6.2). In urban areas, for example, more than five trips a day that last over 15 minutes each means that household members spend, on average, more than an hour collecting water.

Table 6.2: Monetary, Time, and Health Costs Households Incur for Each Water Source

Water source	Monetary costs	Time costs	Health costs
Centralized water supply	Low/Medium	Medium/High	Medium/High
Open sources (rivers, canals, aryks, etc.)	Low	High	High
Water delivered by trucks	High	Low	Low
Water brought by private cars from other places	Medium/High	Medium/High	Low
Artesian well/private well	Low/Medium	Low	Low
Bottled water	High	Low	Low

Source: World Bank team analysis of qualitative data collected through focus group discussions.

Figure 6.2: Average Time to Reach the Main Water Source and Average Number of Trips per Household, by Location and Wealth, 2016



Source: Household WASH Survey 2016.
Note: Blue bars indicate how long it takes to go to the main source, get water, and come back. Orange line indicates average number of trips per day. B40 = bottom 40; DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; T60 = top 60.

The amount of time that households spend on water collection overlaps with the water sources available in each locality. In rural areas, where piped water sources are rarer, 52 percent of the respondents indicate that their main drinking water source was outside their dwelling or plot. This figure is only 12 percent in urban areas. Across regions, GBAO and Sughd have the highest proportion of households reporting that the main drinking water source was located outside their dwelling or plot, at 58 and 49 percent, respectively, followed by Khatlon at 45 percent, and the District of Republic Subordination (DRS) at 35 percent. In Dushanbe, this figure was only 2 percent (figure 6.2). As a result, rural households and less well-off households report spending more time on water collection (17.6 minutes and 18.3 minutes per trip), while urban and well-off households report less (15.8 and 16.8 minutes per trip). There are significant differences across regions, with households in Dushanbe spending only 1.6 minutes to reach their water source and making the least number of trips per day, as opposed to households in Khatlon who spend 23 minutes per trip and make as many trips as the national average, 4.19 trips per day.

Because water supply from piped networks is unreliable, urban households with piped water supply inside their dwelling also spend time collecting water. This is particularly true during the months when no water is available through their taps. For instance, this was the case in oblast centers in Khatlon and GBAO, and raion center in DRS and Sughd, and in Kurgan-tube. However, water collection in urban areas is more common among poorer households. The qualitative field research found that well-off households tend to install electric pumps that deliver water from a public water source directly to their dwellings. They often complement these connections with private water storage tanks that they fill with water from a public source or delivery trucks. The stored water is then delivered into their dwellings using electric pumps.

In rural areas, where public taps are the most common water source, fetching water can be a physically demanding experience (photo 6.2 and photo 6.3). The physical burden of water collection depends on the distance to the water source, the transportation mode, and the length of the water queue or the waiting time (box 6.2). In the Household WASH Survey, 81 percent of households that collect water from sources outside of their homes indicated that they travel to the water source by foot, while 14 percent reported using an animal or a drawn cart. Motorized transportation is quite rare (figure 6.3). The queues are longer in summer when people need more water for drinking and domestic needs. In winter, electricity outages cause water in pipes to freeze and public taps to run dry. In areas where people are not connected to a centralized water supply network and there are no public taps, participants reported collecting water from rivers, canals, springs, or wells. These water sources can be several kilometers away. In winter, the path to the water source can be icy and dangerous to walk on, so participants claimed that it can take twice as much time to collect the same amount of water from a distant source. However, in winter and spring, participants also collect rain water and snow. In extreme cases, households reported spending up to 4 hours per day for obtaining water. This was the case for households living in private houses in the oblast center in Khatlon, people in raion centers and in rural areas in Gissar, and in remote rural areas in Sughd. In the Household WASH Survey, nearly 90 percent of rural low-income respondents reported spending more than one hour per day collecting water (figure 6.4).

Another health effect of water collection are the health problems associated with carrying heavy buckets of water from long distances. In the qualitative work, participants said that collecting water leads to health problems because they must carry heavy buckets of water every day, leading to pain in the kidneys and lower back pain. For example, 21 percent of the Household WASH Survey respondents reported having back pain and 12 percent of respondents reported having musculoskeletal problems because of carrying heavy water buckets in the year preceding the survey. The responsibility of collecting water from rivers, canals, and wells typically falls on women and children, who carry the bulk of the physical burden. In the household survey, 63 percent of respondents from households that collect water from sources outside their house stated that women are responsible for water collection. This was followed by young girls below age 15, which comprised 15 percent of the responses (figure 6.5). Local leaders and representatives of local government also stated that women and children fall ill in winter when they carry heavy buckets of water in the cold.

Photo 6.2: Water Collected from a Spring (Gonchi Raion, Sughd)

Source: World Bank.

Photo 6.3: Water Collected from a Public Tap (Rudaki Raion, DRS)

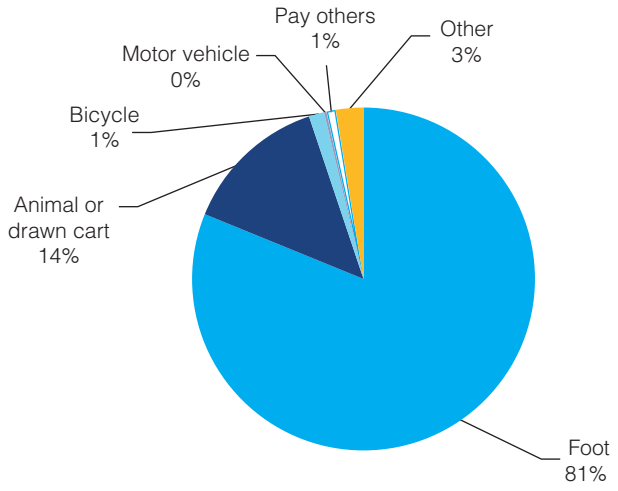
Source: World Bank.

Box 6.2: Time Spent Collecting Water in Urban Istaravshan

Households in Istaravshan in Sughd that live in apartments and are connected to a poorly functioning centralized water supply system have no water inside their premises. They need to use a public tap in the street. Water is supplied to these public taps only on Tuesdays. The residents line up early to collect sufficient water for a whole week and spend up to three hours waiting. They go to the water pipe several times that day to stock enough water in the apartment for a week. In winter, residents spend even more time because electricity supply is often interrupted, preventing pumps from operating, leading to low water pressure in taps. Women cannot leave their neighborhoods on Tuesdays because they cannot afford to miss the water delivery time. People try to collect water for all possible additional sources. Households with lower income go with buckets and search for water in the neighborhood, asking people in private houses that have private artesian wells for water. Higher-income households arrange private water storage tanks (Hauz) on the street or roof of their building and pay for water delivery by private trucks as well as buying water in bottles.

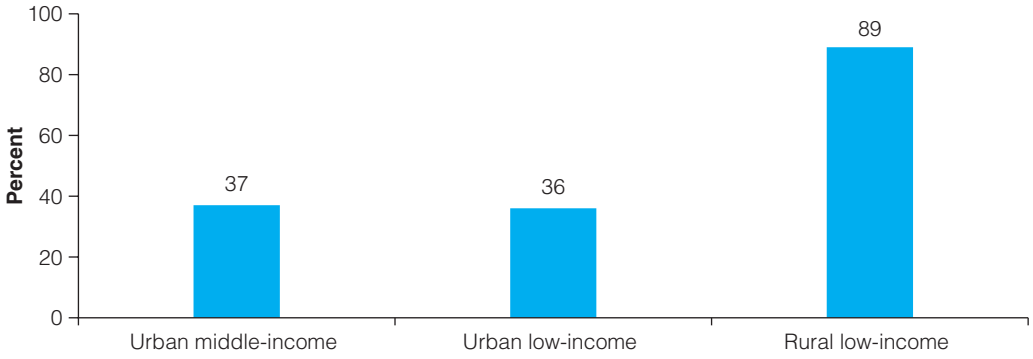
Source: Qualitative field research.

Figure 6.3: Means of Transport Used to Fetch Water from Sources Outside of Home



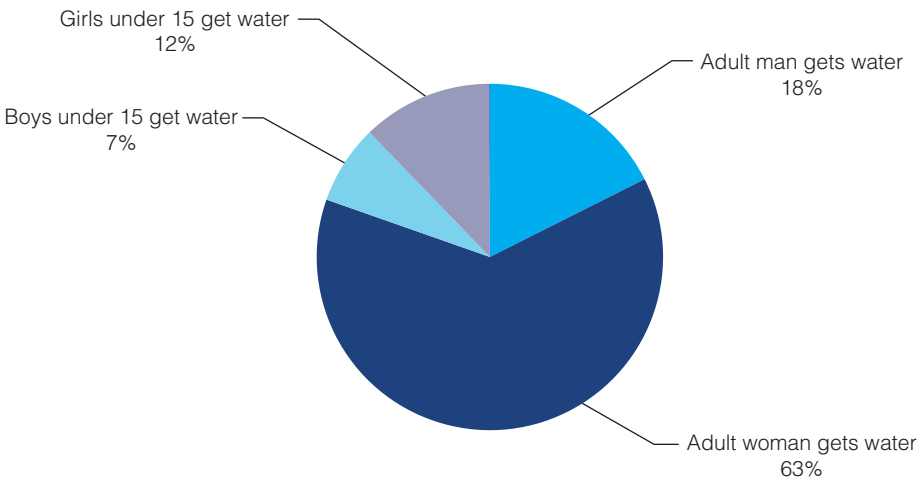
Source: Household WASH Survey 2016.
Note: N = 1370 responses by 1237 households that report collecting water from a source outside of their house.

Figure 6.4: Focus Group Participants Who Report Spending More Than One Hour per Day to Collect Water, by Income Group



Source: Focus group discussion conducted as part of the qualitative research.
Note: N=287 individuals.

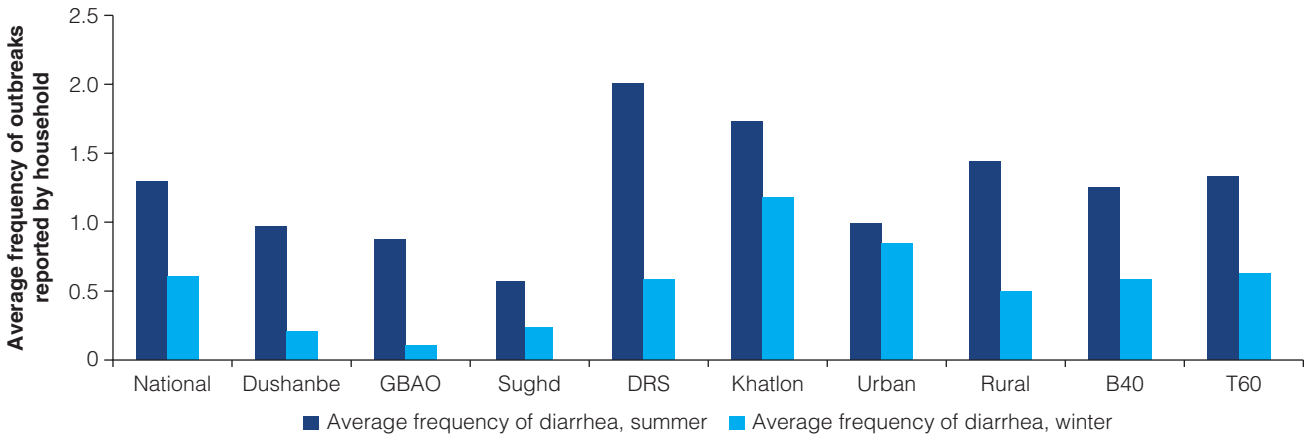
Figure 6.5: Division of Responsibility for Water Collection within Households



Source: Household WASH Survey 2016.
Note: N=1,712 responses by 1237 households that report collecting water from a source outside of their house.

The quality of water collected from open water sources is usually poor, which correlates with incidences of waterborne illnesses such as diarrhea. Although self-reported diarrhea rates are not always reliable and are difficult to attribute to the water source, the incidence of diarrhea increases in summer months (figure 6.6). In summer, people drink water from any available source, such as public taps, secondary irrigation canals, and rivers, without sufficiently treating the water. The increase in diarrhea overlaps to some extent with regions where unimproved water sources are commonly used. For example, average diarrhea frequencies are also high

Figure 6.6: Reported Incidences of Diarrhea for Household Members, by Season



Source: Household WASH Survey 2016.
Note: B40 = bottom 40; DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; T60 = top 60.

in Khatlon in summer and winter months. The Household WASH Survey confirmed this finding at the national level, where 16 percent of respondents reported experiencing gastrointestinal disorders in the year leading up to the survey due to poor water quality. This was highest in GBAO at 25 percent and lowest in Sughd at 9 percent. Representatives of local government, schools and health clinics, as well as local leaders also identified the poor quality of drinking water as the main cause of diarrhea outbreaks, and mentioned poor sanitation conditions and hygiene, as well.

Children under age 5 were cited as the group most vulnerable to diarrhea outbreaks. In the qualitative study, all focus groups reported at least outbreak per year, but this frequency was particularly high in rural areas, where participants reported four to five outbreaks per year. According to key informants in rural areas, diarrhea outbreaks are more common during summer, when many people rely on water from open sources such as irrigation canals, and they affect children under age 5 more than adults. Focus group participants indicated that another reason for diarrhea outbreaks is consumption of unwashed fruits and vegetables. Some parents claimed that their children got diarrhea by drinking unsafe water at school. To avoid diarrhea incidents, focus group participants said that they boiled water and kept it in containers with lids. When a household member gets diarrhea, households use traditional medicine first. This includes drinking pomegranate skin water, yellow flower tea, and boiled rice water. When infection is, households must spend a significant amount of money on treatment. As a consequence, households must cut expenditures on food, clothing, and receiving guests. Some focus groups participants claimed that their household put away some money for such cases.

Interaction with Service Providers and Local Leaders

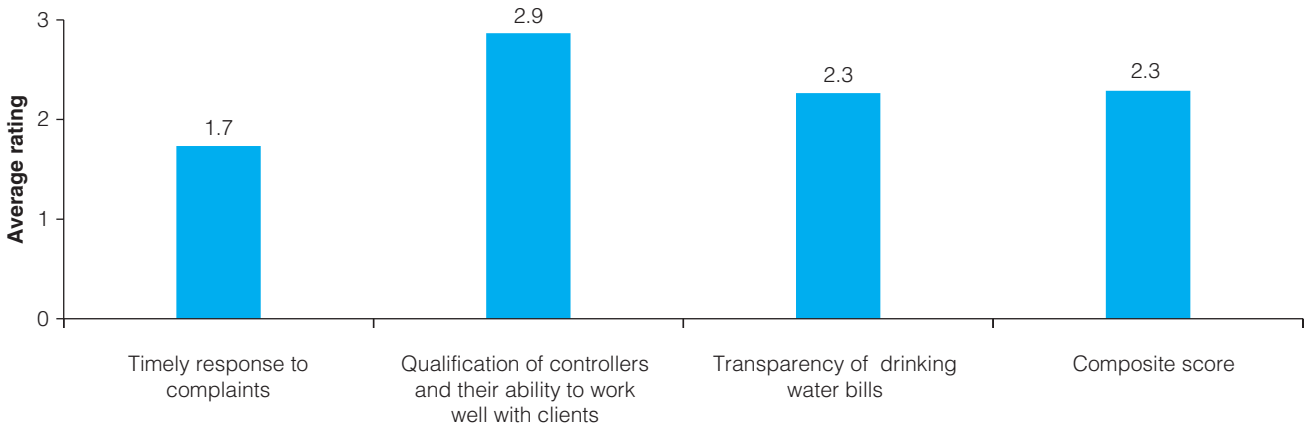
Interaction with Service Providers

As part of the qualitative research, focus group participants were asked to rate the performance of service providers. These exercises were conducted with participants who are connected to a centralized water supply network. The ratings focused on three main areas: timely response to customers' complaints; service providers' qualifications and their ability to work well with clients; and transparency of the drinking water bills. A four-point scale was used varying from 1 (bad) to 4 (good).

Generally, consumers consider service providers to be unresponsive or unable to resolve drinking water problems. The focus group participants gave the lowest score to service providers with regard to "timely response to complaints." Participants connected to a centralized water supply system claimed that the service providers never or rarely respond to consumer complaints. In case of emergencies, such as frozen water pipes in winter, participants reported that the representatives of service providers either pay a visit after a long wait, or they visit but leave without solving the problem. In most instances, service providers do not visit the affected communities at all (figure 6.7). Scores on the "qualification of controllers and their ability to work well with clients" were slightly higher and showed some variation across sites. In some areas, participants mentioned that controllers are trustworthy, experienced and able to answer to consumers' questions. In other areas, the opposite was reported, where consumer questions regarding service quality and tariffs were addressed.

Perceptions on overall service quality are mixed and vary by region, water source, and availability of water meters. The scores were highest in areas where water was metered and where service providers were able to explain consumers how the tariff is calculated. In areas where scores were low, participants complained that the water supply is not reliable, but that they are still asked to pay the full nominal tariff. They claim it is not clear to consumers how these tariffs were calculated and why they increase over time. The overall scores provided by consumers were lowest in the oblast center of GBAO and selected raion centers in Khatlon, which are the regions with the poorest water conditions (table 6.3). The composite score for quality of "interaction with the service provider" was highest in Gissar (DRS), followed by Khudjand (Sughd) and Dushanbe city. The representative of the service provider in Gissar stated that the Vodokanal has recently modernized and extended the centralized network in town with support from the European Bank for Reconstruction and Development (EBRD). The Vodokanal claimed that the number of complaints has since dropped by 90 percent. The lowest composite scores were provided by focus group participants in Khorugh city, Shaartuz (Khatlon), and Istaravshan (Sughd). In Khorugh, participants indicated that the Vodokanal does not respond at all to the complaints of consumers and emergency cases, and the Vodokanal staff has limited capacity.

Figure 6.7: Focus Group Participants' Ratings on Interaction with Service Providers



Source: Focus group discussions conducted as part of the qualitative field research.
Note: N = 164 participants in 15 focus group discussions. Bars show the average of ratings from 1 (bad) to 4 (good). Higher values indicate higher satisfaction. Composite score is an unweighted average of "interaction with the service provider."

Table 6.3: Consumer Satisfaction with Water Supply, by Region and Location

Type of settlement	Dushanbe	DRS	Khatlon	GBAO	Sughd
Selected oblast center	2.7	n.a.	2.3	1.4	2.8
Selected raion center	n.a.	3.7	1.8	n.a.	2.0
Selected rural area	n.a.	No service available	No service available	No service available	No service available

Source: Focus group discussions conducted as part of the qualitative field research.
Note: Data presents the unweighted average of ratings from 1 (bad) to 4 (good) on timely response, qualification of controllers and transparency of bills. GBAO = Gorno-Badakhshan Autonomous Oblast; DRS = Districts of Republican Subordination; n.a = not applicable.

It can be time-consuming and expensive for new consumers to get connected to the centralized water system. To get connected, the house owner must apply to the local utility (Vodokanal), local government (hukumat), and the police. These organizations must assess the feasibility of the building for a connection. Once approved, the household must cover all the costs related to the connection, including the cost of pipes, labor, and potential damage to the road and other infrastructure. Key informants mentioned that only the well-off can afford to start the connection process. Focus group participants noted that most houses that were connected directly to the centralized water supply got connected more than 10 years ago, when it was easier to start a new connection. Those who were unable to get connected at that time rely on water from public stand pipes or invest money in private wells, water storage tanks, and truck water delivery.

Households tend to limit their interaction with service providers to emergency situations; perhaps because of this, their awareness about services and tariffs remains low. In the Household WASH Survey, 54 percent of households that had a recent interaction with the service providers stated that this interaction was related to water outages. This was followed by requests for laying new water pipes (16 percent of responses) and complaints about the water quality (11 percent). Perhaps because their interactions with service providers are limited, many households were unaware of how much and how often they are supposed to pay the service provider. For example, 75 percent of households connected to a piped water supply did not know their tariff rate. Less than half of these households stated that they would contact the service providers about problems concerning their water charge or incorrect bills, while 23 percent did not know who to contact in such a situation. In addition, 90 percent stated that they do not know how the tariff rates are determined. In the qualitative work, respondents noted that because service provider representatives visit households during working hours, it is often non-working household members who interact with them.

Role of Communities and Local Leaders

The role of local leaders in facilitating the interaction between communities and service providers is not fully utilized. In about two-thirds of the focus groups, participants stated that mahalla leaders have no or a very limited role in mediating communication between consumers and the Vodokanals to solve water supply problems. Three reasons were mentioned. First, local leaders often complain to local government offices or the service provider in vain, but never receive a response. For example, focus group participants in a rural area of GBAO conveyed that their local leader has sent written and oral applications to the jamoat leader and to the regional center, but never received a response. Second, sometimes there is a lack

of trust between community residents and local leaders; thus, residents are not supported by local leaders. There have been cases where a local leader took the initiative to install a water pump, but community members did not support the leader. Finally, sometimes mahalla leaders are not willing to confront higher-level authorities. In response, some communities take the initiative themselves.

> *The head of our mahalla constantly tries to solve the issue with the water supply… Poor man… He went to the raion center with our complaints; several times went to Khudjand… We tell him our complaints, and he sends official letters or brings them to the government offices… But there is no response.* —Focus group discussion with low income female participants living in houses, Kishlok Demnora, Sughd

In areas where service conditions and the relationship between communities and local leaders are poor, households take collective action to solve water supply problems. This is usually done through joint activities with neighbors or with wealthy community members, who have the resources and the willingness to improve the situation. It is not uncommon in both rural and urban areas for well-off households to invest in water facilities (mostly artesian wells) and let other households (mostly low-income) use the water. Local schools and clinics are also allowed to connect for free. For example, in rural areas of Gissar raion, focus group participants conveyed that a few wealthy people in the neighboring village had built a common water reservoir and installed water pipes for other residents. But since there are no wealthy households or a proactive community leader in their own village, focus group participants were pessimistic about the prospects of their water supply.

> *Most of the problems of the neighborhood are solved by the residents themselves. Neighbors are the first ones whom we approach for help... One example is the renovation of street running water pipes; in winter pipes are damaged, frozen; the residents of each street repair street water pipes themselves.* —Focus group discussion with low income female participants living in houses, Shokhmansur, Dushanbe

An effective local leader, however, can make a difference in organizing collective action, as illustrated in several cases across Tajikistan. In a minority of cases, focus group participants claimed that local leaders play an important role in solving issues related to water supply and sanitation in their area. For example, in Sino district of Dushanbe city, participants conveyed that a mahalla leader had held a meeting to arrange for the installation of a sewerage system and connection to the centralized network. Through the joint efforts of the mahalla leader and the neighborhood residents, the sewerage was installed in the locality and the households were connected to the system. Participants from a rural area in GBAO provided another example of successful action by a local leader. Here participants noted that each spring and autumn, the chairman of the mahalla committee gathers the population to remove garbage from local streams and to repair the local river banks. Generally, community cohesion was stronger in rural areas compared to oblast and raion centers.

In general, civil society organizations and consumer associations are either nonexistent or unknown to local communities. By global standards, Tajikistan does not have a vibrant civil society and a bottom-up organization culture that can help alleviate drinking water and sanitation conditions through greater community engagement. In the qualitative field research, only 2 out of 38 focus groups conducted across the country had participants who had ever heard about consumer associations (Gissar and Istaravshan). In all 38 focus groups, the majority of participants were not aware of the existence of any such organization. In the Housheold WASH Survey, only 4 percent of households reported that they have made a complaint to a water user association or another consumer association with regard to problems in their water supply. About equal proportions of households reported making a complaint to the mahalla leader or to the water service provider (21 percent and 22 percent, respectively). These low percentages also suggest limited awareness about civic organizational forms and an overreliance on leaders and authorities to solve problems.

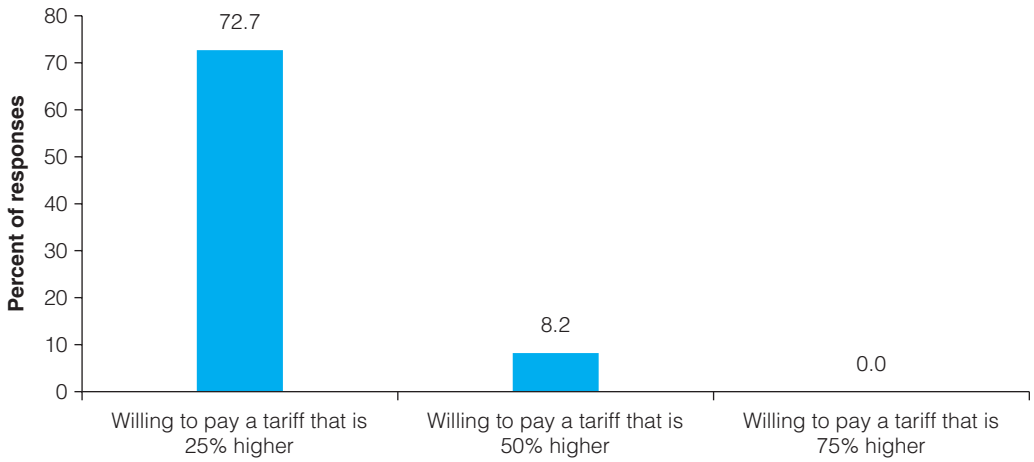
Consumer Willingness to Pay for Service Improvements

According to participants in the qualitative study, consumer willingness to pay for improvements in drinking water supply is moderately high, but only up to the minimum threshold offered. Focus group participants were asked whether they were willing to pay higher drinking water tariffs than those that currently exist in centralized schemes if the service was of high quality. The majority of focus group participants who have been connected in the past to such a system stated that they are willing to pay for higher tariffs. In particular, nearly three-fourths of focus group participants stated they would be willing to accept a tariff increase of 25 percent above the current value, but only 8 percent indicated that they would be willing to pay a 50 percent higher tariff, and none of the participants agreed to a 75 percent higher tariff rate (figure 6.8).

While participants from various income groups indicated that they might accept slightly higher tariffs, they stated that their willingness is conditional on large improvements in service quality. In general, participants from urban middle-income households were more likely to accept higher tariffs than urban low-income households. Similarly, women stated a willingness to pay for water supply improvements more often than men. Eighty percent of female participants said that they are ready to pay a higher tariff if the quality of the service gets better, as opposed to 64 of male participants. This is consistent with the previous findings that women are primarily responsible for water collection, and thus incur the largest nonmonetary burden of poor water supply services. Some participants stated that households already have difficulties paying for water service under the current tariff regime, and an increase in tariffs would translate into cuts in their other basic expenses. Many consumers also had little confidence in the capacity of the Vodokanal or local government to improve the situation. Some focus group participants were worried that even if the tariffs increase, the quality of the service might not improve. In only 2 of 38 focus groups were households satisfied with the level of the services and believed no service improvements were necessary.

In the quantitative survey, where willingness to pay is assessed in a representative sample using a more robust methodology, willingness to pay for service improvements is much lower.

Figure 6.8: Willingness to Pay for Centralized Water Supply among Households Connected to Piped Networks



Source: Focus group discussions.
Note: N = 15 focus group discussions with 110 participants.

In the Household WASH Survey, as opposed to the intended "referendum" approach where households indicate whether they would accept or reject an offered price, a "second-best" option was used to assess willingness to pay for improved services (box 6.3).[2] This entailed a two-step approach. Respondent-specific willingness thresholds were created using either: (i) the offer value (if the respondent accepted the amount that was offered); or (ii) the self-reported value to the follow-up question "what would you be willing to pay?" (if the respondent rejected the offer). In many cases, respondents were unwilling to pay any price, responding "no" for (i) and "0" for (ii). These observations are excluded from subsequent calculations.

More than one-third of rural respondents and nearly half of urban households are not willing to pay any price for water connection and a higher water tariff. For example, at the national level, 41 percent of respondents were unwilling to pay for a connection to the piped drinking water network, ranging from 37 percent in rural areas to 49 percent in urban areas (table 6.4). In addition, 32 percent were not willing to pay any amount for the required tariff for this water supply connection (table 6.5). In both cases, urban households and households in the bottom

Box 6.3: Assessing Willingness to Pay for Service Improvements

The intended method for the willingness to pay estimates was a "referendum" approach, in which respondents would be offered a price, and could either accept or reject the offer. Respondents were read the following text:

I would like you to imagine an ideal scenario. It is not meant to be the same as the level of service currently available where you live. It is only meant to be an example. In this scenario, water is available 24 hours a day, 365 days a year, with sufficient pressure, and is safe to drink from the tap. Also imagine that because you would pay for the water you actually use, your water bill could vary from month to month. But suppose that an average household would use about 15 cubic meters (tons) of water in a typical month.

- Question 1: *Now suppose that a vote was held in [name of town] regarding a project to build a modern drinking water system like the one described. If the price of a connection to this system were TJS [1920, 2400, 2880, 3360, 3840], would you vote for the new water supply project or against it?*

  If voting against it, how much would you be willing to pay?

- Question 2: *Now suppose that the modern water supply system is installed in [name of town]. Would your household purchase water if the cost of 15 cubic meters (tons) was TJS [4.5, 5.5, 6.5, 7.5, 8.5]?*

  If no, how much would you be willing to pay?

For sanitation facilities, similar questions are asked using relevant price vectors, but rural and urban households are asked about different types of service improvements. In urban areas, households are asked about connection to the sewer system. In rural areas, willingness to pay was assessed in reference to a stand-alone sanitation project providing flush toilets with septic tanks with regular service to clean and empty them.

Source: World Bank team.

Table 6.4: Willingness to Pay for Drinking Water Connection, by Region and Quintiles

	Amount willing to pay for water connection (TJS)			Share not willing at any price (percent)		
Region	All	Urban	Rural	All	Urban	Rural
All	1542	1482	1564	41	49	37
Dushanbe	1564	1564	n.a.	58	58	n.a.
DRS	1766	1709	1776	57	55	58
Khatlon	1626	1545	1644	36	51	32
Sughd	1383	1318	1404	29	33	27
GBAO	1420	1353	1436	42	21	46

	Amount willing to pay for water connection (TJS)			Share not willing at any price (percent)		
Quintile	All	Urban	Rural	All	Urban	Rural
1	1476	1370	1508	48	54	46
2	1496	1413	1523	40	46	38
3	1521	1434	1546	38	50	34
4	1539	1456	1567	40	51	35
5	1663	1620	1692	37	46	30

Source: World Bank team estimates based on Household WASH Survey 2016.
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; n.a. = not applicable.

Table 6.5: Willingness to Pay for Drinking Water Tariff, by Region and Quantiles

	Tariff willing to pay for water service (TJS)			Share not willing at any price (percent)		
Region	All	Urban	Rural	All	Urban	Rural
All	6.3	6.3	6.3	32	36	31
Dushanbe	6.3	6.3	n.a.	40	40	n.a.
DRS	6.3	6.4	6.3	51	36	53
Khatlon	6.5	6.5	6.5	30	41	26
Sughd	6.2	6.2	6.2	20	25	19
GBAO	5.1	5.1	5.1	42	16	47

	Tariff willing to pay for water service (TJS)			Share not willing at any price (percent)		
Quintile	All	Urban	Rural	All	Urban	Rural
All	6.3	6.3	6.3	32	36	31
1	6.3	6.3	6.3	39	44	38
2	6.3	6.3	6.3	32	37	30
3	6.3	6.3	6.3	31	35	29
4	6.3	6.3	6.3	30	32	29
5	6.4	6.4	6.4	30	33	28

Source: World Bank team estimates based on Household WASH Survey 2016.
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast. n.a. = not applicable.

quantiles were less likely to be willing to pay for service improvements. Generally, willingness to pay seems inversely related to the coverage of piped connections across regions.

Households that ***are*** willing to pay for service improvements are willing to pay considerably lower average connection fees and tariff amounts than what was offered to them initially. On the basis of the individual-specific threshold, a predicted value of a person's willingness was generated using a regression model with the respondent-specific threshold as the dependent variable, and including location and consumption indicators as explanatory variables. This approach is inferior to the "referendum" approach, but it is better than using unadjusted responses, which may be biased due to the price anchoring effect (resulting from the referendum question that preceded the self-reported amount). The conditional prediction values for drinking water supply and sanitation are lower than the prices offered to the households in each case (table 6.6 and table 6.7). For example, for septic tank connection in rural areas, the offered price ranges based on cost calculations were [2400, 3200, 4000, 4800, 5600, 6400, 7200], but households that were willing to pay for such a connected reported an average willingness to pay of TJS 1929 (table 6.7).

Interviews with service providers suggest that among the service providers, "willingness to charge" is relatively low. Representatives of Vodokanals stressed the importance of increasing tariffs to recover costs, but they realize that tariff increases might lead to more demands from consumers. They claimed that if the tariffs are increased, customers will pay more but may not see immediate changes in the quality of the water supply service. Also, representatives of Vodokanals worried that people might ask to be disconnected from the Vodokanal's service if they become even more dissatisfied about the quality of the service under a higher tariff regime. On the other hand, representatives of local government and local leaders were more optimistic, stating that households would be willing to pay a higher tariff if the quality of the

Table 6.6: Willingness to Pay for Sewer Connection and Tariffs in Urban Areas, by Region and Quintiles

	Connection, by region			Connection, by quantile	
Region	Amount willing to pay (TJS)	Share unwilling to pay (percent)	Quintile	Amount willing to pay (TJS)	Share unwilling to pay (percent)
All	1368	47			
Dushanbe	1470	57	1	1272	57
DRS	1460	48	2	1315	43
Khatlon	1389	49	3	1344	43
Sughd	1246	32	4	1355	44
GBAO	1223	5	5	1470	46

	Emptying service tariff, by region			Emptying service tariff, by quantile	
Region	Amount willing to pay (TJS)	Share unwilling to pay (percent)	Quintile	Amount willing to pay (TJS)	Share unwilling to pay (percent)
All	4.8	38			
Dushanbe	4.8	42	1	4.7	47
DRS	5.2	43	2	4.8	40
Khatlon	5.7	44	3	4.8	33
Sughd	4.2	28	4	4.8	35
GBAO	4.9	5	5	5.0	38

Source: World Bank team estimates based on Household WASH Survey 2016.
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast.

Table 6.7: Willingness to Pay for Septic Tanks and Emptying Service Tariffs in Rural Areas, by Region and Quintiles

Region	Connection, by region	
	Amount willing to pay (TJS)	Share unwilling to pay (percent)
All	1929	50
DRS	1763	71
Khatlon	1952	46
Sughd	2032	43
GBAO	1505	26

Quintile	Connection, by quantile	
	Amount willing to pay (TJS)	Share unwilling to pay (percent)
1	1792	61
2	1845	53
3	1887	47
4	1954	46
5	2162	41

Region	Emptying service tariff, by region	
	Amount willing to pay (TJS)	Share unwilling to pay (percent)
All	235	39
DRS	287	61
Khatlon	223	37
Sughd	228	28
GBAO	179	22

Quintile	Emptying service tariff, by quantile	
	Amount willing to pay (TJS)	Share unwilling to pay (percent)
1	229	52
2	228	40
3	232	37
4	236	33
5	250	32

Source: World Bank team estimates based on Household WASH Survey 2016.
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast.

service improves. They reasoned that if the quality of the supply and water improves, people will be able save on their existing water expenses. In addition, the increase in the tariff might be an additional motivation for households to install meters and use water more effectively. These two viewpoints were reflected in the quotations that follow:

> *I think if there is an increase in the tariff, many households will refuse to receive our service. Already, we have two or three households that came with an application to be disconnected from the centralized water supply; the reason is a difficulty with paying for the service. We should think that if we increase the tariff, let say up to TJS 20 per month, then they (households that receive service) would all come and ask to be disconnected. How much will we lose then?* —Representative of the Vodokanal, Raion Center, Khatlon.

> *Vodokanal needs to renew the equipment to improve the water supply. They need to install new pipes to increase the volume of water that will lead to increased quality of the water supply. People will be glad to pay. It is better to pay TJS 50–100 to Vodokanal than TJS 120–150 to water trucks.* —Representative of local government, Raion Center, Sughd.

Notes

1. Analysis of expenditure shares by water source is not possible because of the small number of observations for nonpiped sources.
2. The intended method for the willingness to pay estimates was a "referendum" approach, in which respondents would be offered a price, and could either accept or reject the offer. The reliability of this method hinges on the random allocation of price offers across the household sample. Because of technical difficulties during data collection, the allocation of offers was not random. As a result, the estimates are biased due to a price "anchoring" effect (in which the response is biased by the first value offered). Such a bias cannot be fully corrected. To extract some information from these questions, a two-step approach was adapted.

Chapter 7
Institutional Constraints and Service Delivery Models

This chapter discusses the challenges facing WASH service delivery in Tajikistan, as well as explores some possible solutions. It focuses on urban and rural drinking water supply, with the objective of understanding current institutional arrangements for WASH sector, and exploring key factors that may affect WASH service delivery given the broader institutional context. The chapter provides a snapshot of the existing bottlenecks and further directions for sector reform. It is based on three sources of information: a desk review of relevant policy, legislation, and legal documents; previous sector assessments prepared by the various members of the Tajikistan Water Supply and Sanitation Network (TajWSS)[1]; and case studies of selected stand-alone water schemes implemented by international donors and other development agencies in Tajikistan.

Institutional Issues and Reform in the Water Supply and Sanitation Sector

Since Tajikistan's independence in 1991, public infrastructure water supply and sewerage systems have rapidly deteriorated across the country. Most of the centralized water supply and sewerage systems were built in the 1960s and 1980s, primarily in large and medium-size cities and urban settlements across the country. Over time, lack of adequate maintenance and investments caused serious degradation to the existing infrastructure. Sector inadequacies over more than two decades have led to systematic and widespread service deficiencies, particularly for smaller secondary towns and rural areas. According to official government figures, only 68 percent of the existing infrastructures in cities and towns is in working condition, while 7 percent of it is working partially and 25 percent is completely dysfunctional. In rural areas, the situation is worse. Only 40 percent of the existing infrastructure is in working condition, 44 percent is working only partially, and 16 percent is completely dysfunctional. Due to such asset degradation, water losses from the water supply system amount to about 60 percent in the large cities a 20 percent in medium-size cities and (Government of Tajikistan 2015).

The large amount of capital investments required to upgrade the degraded infrastructure have translated into chronically poor levels of service delivery and WASH conditions across the country. The sector must deal with undermaintained distribution networks, underfunded operating budgets, and almost nonexistent capital investments. In 2011, the State Unitary Enterprise Khojagii Manziliyu Kommunali (SUE KMK)—which is the government monopoly for public utilities, including water supply—estimated the physical investments needs for water supply and sanitation alone to be near $2 billion. Despite significant efforts exerted by the development community to address the pending infrastructure and institutional deficiencies of the sector, the issues and challenges remain vastly unmet. Currently, SUE KMK provides services in 62 cities, district centers, and urban type settlements, but only 52 of these areas have centralized water supply system and 29 have partial coverage by sewerage systems. Only 5 percent of sewerage systems in rural areas are functional. Reliance on discharge into a sewerage system without effective treatment is a serious health consideration if pathogens can recirculate into the environment, and is under increased focus under the Sustainable Devlopment Goals (SDGs) (see box 4.1).

Sector Organization and Stakeholders

The complex institutional structure of the drinking water and sanitation sector, a reflection of Tajikistan's centralized yet fragmented governance structure, serves as a significant barrier to service delivery. During the Soviet period, drinking water supply and sanitation schemes, along with the other village level infrastructure, were largely owned and operated by kolhozes and sovhozes.[2] After the collapse of the Soviet Union, the vast majority of state farms were reorganized into smaller units, with little clarity on transfer of responsibilities over collectively owned social infrastructure. Service deficiencies following independence spurred the government to experiment with different management and operational models for the water supply systems at the local level. This initially entailed the transfer of ownership of drinking water and sanitation schemes to local self-governing establishments called Local Self-Government Units (LGUs), which was followed by transfer of these services back to the central state public utilities company, SUE KMK.

Today, the sector is characterized by a plethora of stakeholders operating at the national, regional and district levels. The State Unitary Enterprise SUE KMK is the main actor with the widest span of assets, but it coordinates with at least seven other ministries and agencies. Each of these agencies, in turn, has regional and district level structures. Dedicated coordination and cooperation structures exist only at the national level, while local structures typically work independently from one another. The National Water and Energy Council is the highest water policy formulating body in the country. It is responsible for political coordination and decision making at the ministerial level. The Ministry of Energy and Water is in charge of water sector policy and regulation, as well as planning and strategic guidance on rational water use, conservation, protection, and limits of allocation at the basin level. It coordinates activities in five River Basin Organizations, which are charged with the development, operation, and management of reservoirs functions within their catchment area, and for providing the bulk of the water supply for water users (Government of Tajikistan 2015). A range of other agencies have overlapping functions (box 7.1.). For example, because all the water supply and sanitation service providers are considered natural monopolies, an important regulatory function rests with the Antimonopoly Services, which determines tariffs and connection fees (figure 7.1).

In the current operational model, SUE KMK is the owner, regulator, and operator of all drinking water services in Tajikistan. It is assigned as the authorized state body responsible for drinking water supply and municipal services, state control and supervision of drinking water supply, and water quality monitoring.[3] Its functions are mainly economic, but also include some elements of public administration. The internal organigram of the KMK shows that its head office at the central level carries out management functions. At the same time, subsidiary organizations of the KMK, usually referred to as Vodokanals at the municipal level and branches of TojikObiDehot in the rural areas, act as service providers. These subordinate organizations are founded in different legal forms, which leads to ambiguity of the status of SUE KMK and uncertainty in the use, management, and disposal of assets. There is also uncertainty regarding the relationship between different agency structures. For example, in the six largest cities of Tajikistan, which account for more than 60 percent of registered water users in the country, ownership of the water supply and sanitation systems, as well as the responsibility of water supply and sanitation service provision, have been fully transferred to the municipalities.

In addition to holding almost exclusive operational and service provision responsibilities, the SUE KMK has been given the authority to design and implement state policies in public and municipal services. The management functions of the SUE KMK has recently expanded with the transfer to KMK of the Main Department of Tojikobdehot, formerly responsible for rural water supply to population and pastures. With this transfer, SUE KMK has become a single institution responsible for management of both urban and rural water supply at the national level, among many other public services. These powers are generally exercised through the KMK's local subsidiary branches. However, having the policy development functions and the functions of service delivery under one institution is not in line with the Public Administration

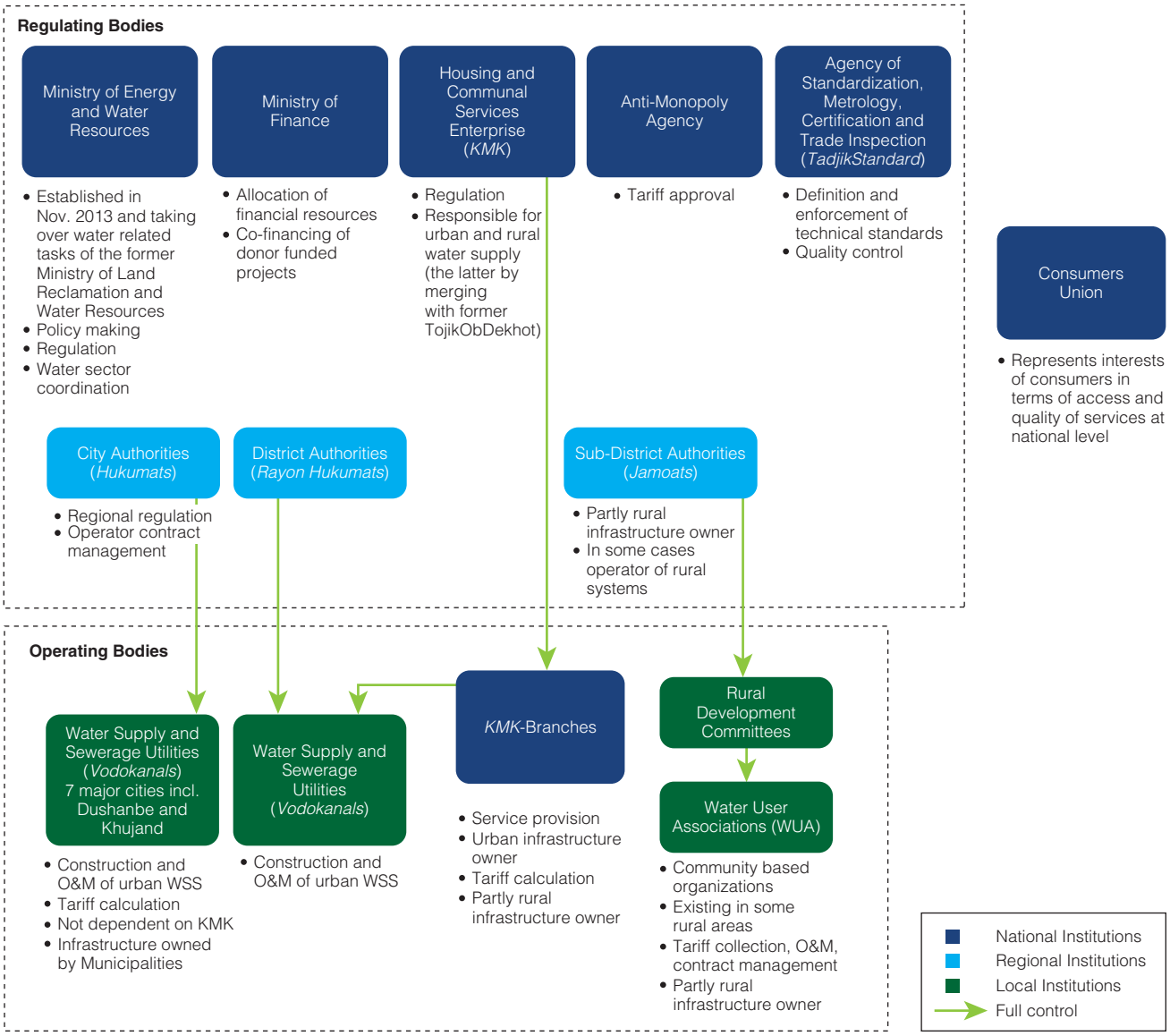
Box 7.1: Selected Agencies Involved in Drinking Water Supply in Tajikistan

In addition to the *State Unitary Enterprise Khojagii Manziliyu Kommunali* (SUE KMK), several government ministries, departments, and agencies are charged with control and supervision functions by the government's "Order of State Control and Supervision of the Drinking Water Supply" and other government decrees on drinking water and sanitation. These include the following:

- *Ministry of Energy and Water*: A central state body responsible for development and implementation of the state policy and regulation of water resources
- *Committee on Environmental Protection:* Responsible for water use permits and licensing. Main roles and responsibilities include setting up and ensuring compliance with environmental requirements for planning, design, construction, and commissioning of the drinking water supply and sewerage infrastructure, and ensuring compliance to standards of wastewater discharges.
- *Ministry of Health, Sanitary and Epidemiological Services Department*: Implements state control in the field of sanitary and epidemiological safety of the population. It is responsible for administering compliance with sanitary rules and norms during the placement, design, construction, reconstruction, and operation of drinking water supply and sewerage systems. In coordination with executive bodies, the department conducts state surveillance and control over protection of water sites, monitoring of contamination levels, and waste water treatment.
- *Agency for Standardization, Metrology, Certification, and Trade Inspection:* Carries out state control and supervision over observance of the technical regulation, certification, and metrological requirements for drinking water.
- *Committee on Architecture and Construction*: Establishes and ensures compliance with building regulations for the location, design, construction, renovation, and commissioning of drinking water supply systems.
- *Main Department of Geology:* State control and supervision of exploration on groundwater sources of drinking water.
- *Main Department on the State Supervision of the Safe Practices in the Industry and Mines Inspection*: Implements technical and technological requirements for location, design, construction, and operation of groundwater wells.
- *Local executive bodies of the State Power:* Third-level administrative divisions that support socioeconomic development initiatives of towns and villages, adopt measures for improving the living conditions of the population and environment protection, and address local issues, including maintenance and improvement of water supply and sewerage systems.
- *Healthy Life Style Promotion Centre*: Organized under the structure of the Ministry of Health and Social Protection to carry out activities related to raising awareness about hygiene and sanitation among the population.

Source: Desk review by World Bank team; Resolutions 679-680 of the Government of Republic of Tajikistan, December 31, 2011.

Figure 7.1: Regulatory and Operating Agencies in the Drinking Water Sector in Tajikistan



Source: World Bank 2016.
Note: O&M = operations and maintenance; WSS = water supply services.

Reform Strategy that was adopted in 2006, which stipulates that the policy development function should be separated from the service delivery function.

Recently, attempts have been made to address the complexities of sector governance through a comprehensive reform program. The drinking water and sanitation sector is moving toward operational and institutional decentralization of service delivery functions. The decentralization process has been spearheaded by the central government, which recently declared its commitment to decentralization of drinking water supply services in the Water Sector Reform Program for 2016–2025.[4] The program is being supported by the European Bank for Reconstruction and Development (EBRD). The program calls for establishing six regional water utility companies to be owned by SUE KMK. These regional utilities are envisaged to provide

independent operations at the regional level and support the local water companies of cities and secondary towns. The establishment of these regional branches is being driven by the concept of economies of scale. Currently, the water utilities in secondary towns are too small to operate on their own and serve only small groups of people, which in turn affects their capacity to recover costs and maintain local infrastructure.

The regional companies are envisaged to support their affiliate utilities by providing technical back-up, engineering support, and enhanced financial management. This is to be achieved through consolidated financial management and leadership in investment planning and implementation, as well as provision of technical equipment and large machinery. Another advantage of establishing regional companies, as envisaged by the EBRD, will be the ability of regional water companies to attract interest and investment from private operators or financiers if the government develops an agenda to move toward privatization of the sector.[5] Recently, SUE KMK and EBRD have established the first two regional water companies in Sughd and the Districts of Republican Subordination (DRS). During the initial stages of implementation, regional water companies will examine a select number of local urban and secondary town water utility schemes, particularly those that have been covered under EBRD projects. Urban settlement types, secondary towns, and rural areas that are not serviced by this regionalization effort will continue to face persistent systemic challenges while under the control of SUE KMK. Since the regionalization process is new, the efficiency of the regional companies can only be determined over time.

The sector reform process is moving slowly and is complicated by budgetary restrictions and the current overlapping authority structures in place. Although the SUE KMK has committed to the decentralization reform under the government-adopted "Concept on Reform of Municipal and Communal Services," the pace of progress is slow. The process should be preceded by strengthening the sector and its regulatory framework. In the meantime, the Water Sector Reform Program proposes to address some of the deficiencies on a broader level. This is to be achieved by way of an action plan, including review and introduction of revisions to the charters and regulations of the relevant water sector entities, as well as introduction of updates to the country's Water Code. However, Tajikistan relies on donor support to implement its water sector program. The expected commitment from donors under the reform is estimated at 90 percent of the total budget requirements. Moreover, the sector is challenged by the need to coordinate a diverse range of internal and external partners and stakeholders, which creates distortions in policies and policy implementation, and leads to an agenda neither firmly led by the government nor consistent across the various reform actions. In the worst case, the reform program runs the risk of establishing duplicative structures to the existing formal institutional arrangements, which would elevate rather than alleviate the sector's structural shortcomings.

Legal and Regulatory Framework for the Operation of Schemes

In Tajikistan, water resources are owned by the state, which guarantees their effective use and protection; the central government is solely responsible for the provision of drinking water services, including the control and regulation of drinking water supplies. The Constitution and the Water Code, last amended in 2012 – along with other laws, bylaws, and international, interstate, and regional agreements and conventions – collectively form the basis of water legislation in Tajikistan. These legal documents establish the roles and responsibilities of the stakeholders in the drinking water sector that were outlined above. As declared in the sector-specific Law on Drinking Water and Drinking Water Supply, the state is mandated to "guarantee universal access to drinking water for individuals and entities to satisfy their vital needs."[6] The government resolution "On Approval of the Procedure of State Control and Supervision of Drinking Water" designates the SUE KMK as the authorized state body in the field of managing drinking water supplies.[7] This translates into a mandate for the KMK to oversee all development and implementation efforts of the state policy in this area. The same decree also specifies the various state agencies responsible for enforcing state control and regulation of drinking water supplies across the country.

Direct management and operation of the drinking water supply systems are open to other legal entities and individuals, as long as the systems are maintained in a functional state. The law allows nonstate actors to run decentralized stand-alone schemes. These are primarily implemented in rural areas. The law is more restrictive on the centralized water systems that have been traditionally kept under the state's ownership. These remain under the responsibility of state agencies—namely, SUE KMK and its local subsidiaries, which can either manage them independently or transfer the systems for operational management and economic use to legal entities. The law is less restrictive on the management of noncentralized and autonomous drinking water supply systems. These can be managed directly by their respective owners or by delegated legal entities and/or individuals. However, the legal form of ownership in such instances remains largely unclear. As a result, decentralized and/or municipal service delivery type models are operational in only a few large cities across Tajikistan, notably in Dushanbe and Khujand. These models also operate in select cities that have opted out of the SUE KMK management structure to pursue independent operation under a special status, such as Nurek and Rogun.

Irrespective of the ownership and management status of the water supply systems, in many instances, the utilities or other legal entities responsible for service delivery at the local level have dual subordination to both the central SUE KMK and to local governments.[8] The legislation prescribes that individuals and entities responsible for drinking water supply are accountable to the authorized drinking water supply entity and local executive state bodies. In addition, they are accountable to the respective institutions in charge of emergency situations and civil defense.

According to the current regulatory framework, water utility operators can define their own cost-recovery tariffs, but the legislation does not provide clear guidelines on the methodology to be used to calculate tariffs. Given that water meters are not a widespread practice in Tajikistan—except in Dushanbe, Khujand, Kurgan-Tube, Farkhor, and several other towns and urban-type settlements—the tariff calculation structure is largely derived from assumed water consumption norms rather than actual demand estimations.[9] Furthermore, according to the legislation, non-revenue water (NRW) can be accounted for in up to 20 percent of the cost calculations. However, this is rarely reflective of degraded systems, where because of significant water leakages, NRW costs can contribute well in excess of 50 percent of total costs. Although the water and sanitation tariffs are largely consistent across cities and towns that are under the governance of the SUE KMK, pricing structures vary by the client group. For instance, businesses are usually subject to higher prices than residential consumers (World Bank 2015a).

As is the case in many post-Soviet contexts, the water utility tariffs in Tajikistan are somewhat arbitrarily determined and priced below cost-recovery levels. At the national level, tariffs are reviewed and approved by the Anti-monopoly Commission. Over the past few years, the SUE KMK has attempted to increase tariffs in an effort to achieve cost recovery, but the Anti-monopoly Commission has not approved these requests, and has permitted only marginal increases. This problem is compounded by inadequate government subsidies. Thus water utilities across the country have endured significant financial losses over time. The result has been a negative feedback loop, perpetuating the lack of available funds for operation and maintenance, capital investments, rehabilitation, and system development. The issues of financial sustainability are far more complicated in rural communities, largely due to the insufficient policy focus on the rural service gap and lack of clarity on service provision responsibilities. Poor institutional performance, tariffs that are below cost-recovery, high turn-over among staff, and capacity constraints at local subsidiary branches have severely limited the amount of resources available to the SUE KMK in tending to urban water supply and sanitation issues, let alone challenges that prevail in rural areas.

As part of recent decentralization efforts, the SUE KMK is considering adopting separate tariff structures for each of the regional companies that will be established under the reform program. This will be one of the first attempts at setting separate water tariffs for individual regional water utility companies in Tajikistan. A system is envisioned to unify the tariffs for

individual cities or towns operating under the same regional company. This will also serve as a cross-subsidization mechanism to cover the shortcomings and underperformance of other utilities. These plans have been met by mixed feelings and considerable resistance from the targeted water utilities. Water utility companies have voiced their concerns that they will be held financially responsible for the underperformance of other regional companies.

The program also calls for legal reforms to streamline the relationship between policy on one hand, and regulation, management, and operation and maintenance of services, on the other hand. As discussed, the sector reform program foresees moving toward a more sustainable approach to the provision of drinking water through the development of self-reliant, independent regional companies tasked with the provision of water supplies to cities, towns, and villages. The delivery of this mandate will be facilitated by a number of aid-funded, co-led projects, but is currently hindered by a number of obstacles. These include the presence of a large amount of debt within the sector; resistance from the SUE KMK to partial decentralization of selected policy, regulatory, and operation functions; and lack of clarity as to whether or not the to-be-created regional structures will fit within the existing regulatory structures at the regional level. As a result, the sector finds itself at the cusp of a much-needed reform program, accompanied by a considerable institutional barriers and skepticism about the reform's prospects. This situation hardly contributes to service conditions on the ground.

Service Delivery Approaches of Select Standalone Schemes

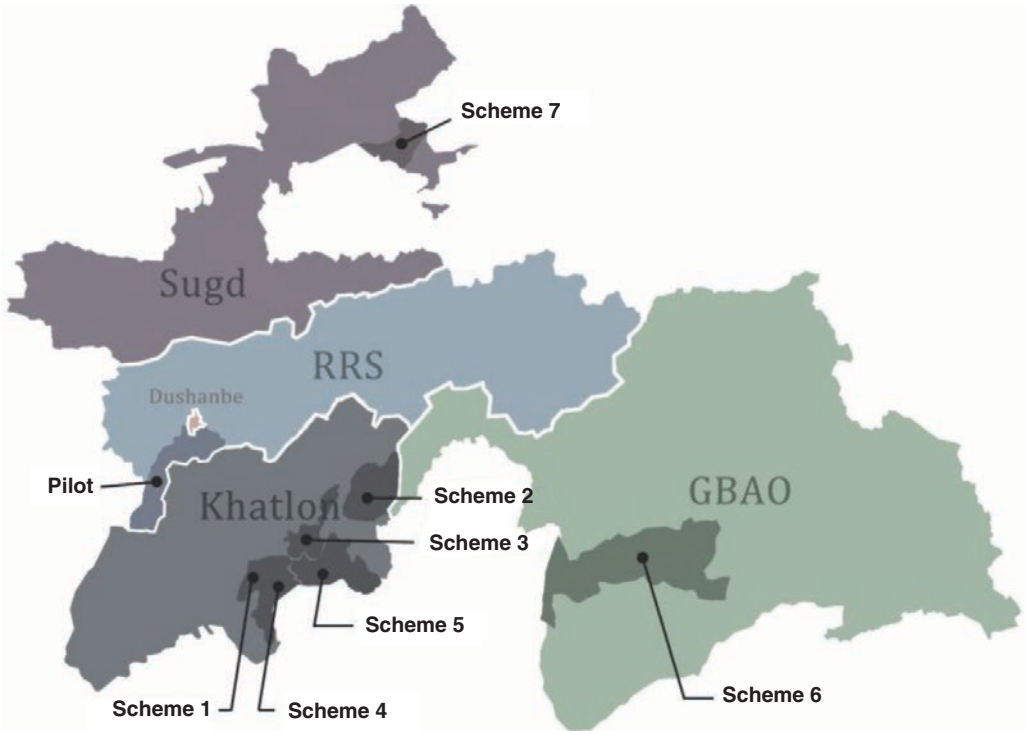
In a context of institutional gaps and uncertain reform prospects, stand-alone water and sanitation schemes in Tajikistan can provide lessons on various service delivery models that can help alleviate poor drinking water and sanitation conditions. Several decentralized drinking water and sanitation delivery models that have been tried in Tajikistan. These models operate within the institutional and regulatory framework discussed in Chapter 6. They show significant variation in terms of: the quality of WASH services delivered to communities; affordability and recovery of initial investment costs and recurrent fees; legal ownership and division of responsibilities for operation and maintenance; and the level of community engagement in decision making. The analysis of these schemes point to ways in which institutional, regulatory, and financial constraints can be overcome to improve the performance of service delivery in the WASH sector.

For this purpose, seven drinking water and sanitation schemes were selected for review. These were selected based on their geographic coverage (map 7.1), water source, management model, and total investment cost (table 7.1). Data collection included 42 key informant interviews and 14 focus group discussions in eight communities located across four regions of Tajikistan. Key informant interviews were conducted with service providers, local government officials, community leaders, and representatives of schools, health clinics and businesses in an attempt to understand their roles and responsibilities. Focus group discussions with local community members revealed insight into the quality of service and the level of consumer engagement (see Appendix A for methodological details). Overall, these data provide a project-level perspective to WASH service delivery within the current institutional and regulatory context in Tajikistan.[10]

Legal Status and Ownership

At the outset, the selected schemes illustrate three main types of legal status and ownership structures for water supply and sanitation schemes in Tajikistan, along with their pros and cons. These are community-led and operated schemes, public schemes, and private schemes. Of the seven schemes that were studied, three of the service providers followed the Water

Map 7.1: Location of the Selected Schemes



Source: World Bank team.
Note: GBAO = Gorno-Badakhshan Autonomous Oblast; DRS = Districts of Republican Subordination.

Users Association (WUA) model, while the others were delivered through public or private enterprise models.

The first service delivery model is community-led schemes that are operated by water user associations. In this model, households are registered as members of the WUA, each with a vote that elects the association board members. General meetings are held among members of the WUA to discuss consumer concerns and organization outlook. WUAs were observed to be common among smaller-scale operating schemes. In such instances, jamoats and mahallas remained active participants in the design and operating stages of the scheme, contributing to the collection of tariffs, communication of complaints, and mobilization of consumers in various decision-making processes. Operating under the WUA model fosters an effective sense of ownership among, and accountability to, community members.

The community-led model is not fully compatible with the existing legislations on the operation of water supply and sanitation in Tajikistan. The WUAs are established organizations recognized by the Law on WUAs (2006) and referred to as partners in the Water Sector Reform Program. However, the Law specifies that WUAs are established for the operation, maintenance, and distribution of "on-farm irrigation systems," not drinking water systems. WUAs have the status of a noncommercial organization and must be established by entrepreneurs or legal entities that have a right to use land for agricultural production and commercial organizations. As such, existing drinking water WUAs fall outside the scope of the existing legislation. Not only does the law not accommodate individuals (consumer households) to register as members of the WUA, but its origin reflects the management solely of irrigation water. That said, it is possible to find standalone schemes operated by WUAs across Tajikistan.

Table 7.1: Characteristics of the Selected Schemes

Scheme Number	Investment size	Region	Date of completion	Number of beneficiaries (households)	Total population served	Water source	Sanitation component	Connection type	Metered connections
Pilot	Medium	DRS	2013	181	1,249	Spring	No	Public taps	None
1	Low	Khatlon	2007	550	5,000	Borehole	No	Direct connections and public taps	Partial
2	Medium	Khatlon	2012	75	627	Borehole	No	Direct connections	Universal
3	High	Khatlon	2016	3,258	23,191	Borehole	Yes	Direct connections and public taps	Partial
4	High	Khatlon	2016	1,842	11,842	Borehole	Yes	Direct connections and public taps	Partial
5	High	Khatlon	2013	3,401	17,734	Borehole	No	Direct connections and public taps	Partial
6	Medium	GBAO	2015	304	1,503	Spring/ Borehole	No	Direct connections	Universal
7	High	Sughd	2010	4,500	32,000	Borehole	No	Direct connections and public taps	Partial

Source: World Bank team.
Note: For investment size, low <$100,000; medium = $100,000 $200,000; high >US$200,000. GBAO = Gorno-Badakhshan Autonomous Oblast; DRS = Districts of Republican Subordination.

The second model is public services delivery, which is performed by the KMK, Vodokanals or KZHKP. As state enterprises, Vodokanal and KZHKP seems to be efficient models of service delivery in terms of attracting investments to the WSS sector. Vodokanal and KZHKP are under the jurisdiction of SUE KMK, which technically is classified as a ministry branch under the government of Tajikistan. Such state entities can leverage their affiliation with the government for financial purposes, though the impact of government subsidization is not clear. For instance, Vodokanals in the selected schemes were reported to have received subsidies from the state government, while the KZHKP's expenses were also subsidized from the district budget to facilitate the provision of municipal services.

With the public model, direct conflicts of interest evolve from the dual nature of SUE KMK as an authorized regulatory agency and a for-profit entity. SUE KMK writes legislation for public functions while balancing profit-oriented goals. This translates into a legal system devoid of proper accountability mechanisms. If schemes run by Vodokanal and KZHKP fail to operate and manage drinking water supplies adequately, the current legislation would not permit the reallocation of such resources. In other words, there are no alternative entities to which these schemes could be legally transferred. As discussed before, this sole control over water provision has important implications for the sector's growth and future outlook, as well as its incentive structures for the delivery of decentralized schemes.

A third model is water supply and sanitation services delivery through private sector or limited liability companies (LLCs). There was only one scheme in the sampling that was operated by a LLC. The director of the scheme was the sole founder of the company. The director assumed all management and executive roles, making all decisions at his sole discretion, which in part, limited the scope for further expansion of the scheme. The LLC, in contrast to other entities, has a legal right to cooperate with private lenders and banks over the course of its activity. The LLC service providers can approach private lenders to fund operation and maintenance activities, thus increasing the financial sustainability of such schemes, assuming availability of funding sources. While a limited liability company (LLC) structure can be efficient and cost-effective in managing financial resources, plans for expansion of this model may be hindered by the lack of human resources.

Despite their investment and service delivery potential, ownership rights over the infrastructure are not clear in the case of privatized LLC schemes. In this specific study, the acquisition of the service provider's property occurred based on the jamoat's decision. However, the validity of this acquisition is questionable since the jamoat was not the original owner of the scheme. Furthermore, such an ownership transfer directly contradicts the law, according to which drinking water supply schemes cannot be privatized. Ownership of water provision schemes

Box 7.2: Legality and Ownership Issues under Three Different Service Delivery Models

Case Study 1 (Limited Liability Company): The service provider is a private sector operator registered in the form of a limited liability company (LLC). The strengths of such an organization lie in the efficient and cost-effective use of existing resources. When registered as a LLC, the service provider can manage its own resources and minimize risks of budget mismanagement. However, this institutional structure contradicts the Law on Privatization of State Property" of Tajikistan, which states that drinking water supply schemes cannot be privately owned, unless constructed by individuals or private entities.

box continues next page

Box 7.2: Continued

Case Study - 3 (State Enterprises): The service providers in the scheme consisted of Vodokanal and KZHKP, both subsidiaries of the state-owned enterprise, SUE KMK. Establishing service providers in the form of state enterprises enables state support of their operational activities. The state is interested in attracting investments into these sectors, and therefore places a priority on cultivating favorable conditions to protect the rights of water users. Its subsequent commitments to addressing social issues are particularly beneficial to the poor. However, many barriers stand in the way of efficient resource allocation. This includes, but is not limited to, the ambiguity of the sector's state administration, various institutional shortcomings, and the lack of budget funds for development opportunities.

Case Study 7 (Water Utility Associations): The service provider consisted of an umbrella of WUAs, covering four village WUAs: Qaraqchiqum, Malham, Marham, and "Committee for Water Users of Zulol. The umbrella organization is now law-abiding, since it is comprised of individual legal entities (as opposed to individual consumers). However, the individual WUAs still exist in conflict with what is stipulated by the legislation and are technically unable to engage in entrepreneurial activities.

Source: World Bank team case studies of selected water schemes.

may be granted only if the infrastructure were constructed by the individuals or legal entities themselves. Current legislation lacks the legal mechanism to support the transfer of ownership of existing drinking water systems to private sector entities (box 7.2).

Service Conditions and Water Quality

The responsibility of the schemes to deliver reliable and high-quality water services is outlined, first and foremost, in the existing legislation. According to current governing laws, water quality control mechanisms are to be developed by the scheme operator, agreed upon with the district-level Sanitary Epidemiologic Service (SES), and approved by relevant local authorities. This is designed to facilitate the constant monitoring of water quality throughout the water supply network, including that of the intake and distribution points. Laboratory tests should be conducted at least four times a year by the service provider or by an accredited laboratory based on prior agreements. According to the study, schemes operated by Vodokanal and schemes operated in rural towns tend to have separate facilities and staff members dedicated to water testing. Conversely, schemes operated under WUAs and LLCs usually contract SES for the task (box 7.3).

In the reviewed schemes, neither service providers nor the local government institutions inform the population about the actual quality of their water supplies. Public awareness about water quality is notably low, despite water quality monitoring efforts from the Committee for Environmental Protection (CEP) and SES. As a consequence, consumers tend to intuitively decide on the need for water treatment, which they typically base on observable qualities such as taste, color, and smell. Moreover, factors such as understaffing, broken equipment and/or lack of sufficient funds, and limited availability of chlorine adversely affect attempts to provide

Box 7.3: Quality and Quantity of Water Supply under a Decentralized Scheme

One of the selected schemes covers 75 households and is operated by a Water Users Association (WUA) management model. Water quality was tested at the design stage and was shown to follow the state regulations. Water quality did not change from 2008 through 2015, and remains suitable for drinking. All the interviewed key informants and scheme consumers believe that quality of water in the scheme is good, considering its taste, smell, color, and safety. However, the Sanitary Epidemiological Service (SES) noted a lack of daily monitoring of chlorine. It highlighted insufficient chlorination as a weakness of the scheme. The service provider reported that they treated water, but not regularly because chlorine was not available on the market on a regular basis. Consumers who believe that the water is sufficiently clean without the addition of chlorine have also requested that the chlorine quantity be decreased.

The water supply schedule is based on the rural lifestyle in the village areas, where water demand decreases significantly at night. To accumulate water in the reservoir, avoid potential losses of water at night, and minimize electricity costs, water in the scheme is supplied every day from 6 a.m. to 8 p.m. in the spring and summer and from 10 a.m. to 7 p.m. in the winter. Water losses in the system are infrequent, typically occurring only in the event of faulty indoor connections or incidences of nonpayment. However, consumers still get illegal connections to avoid the water meters located in the metering wells.

Source: World Bank team case studies of selected water schemes.

clean water. While schemes operated by Vodokanals have access to the state's supply of chlorine, those that are operated by WUAs and LLCs struggle to procure chlorine because supply in the market is inadequate. Thus, these schemes are often confronted with outages in the purifying process, which can directly translate into severely negative consequences for the population's health.

Scheduled delivery of water has been a useful approach to meeting varying supply of and demand for water. There are seasonal differences in the population's demand for drinking water. Demand is highest during the warm season, when people use more water for drinking, clothes and carpet washing, and house cleaning. Demand then falls during the winter heating season, when people tend to use less water for drinking and domestic when snow and rainwater become available as alternative sources. High demand for water in the warm season can cause a substantial decrease in water pressure in pipes, preventing water from reaching all consumers. This issue is much more common in areas with public tap connections and with schemes that do not equip individual connections with meters that monitor consumption. In response to varying supply and demand of water, service providers limit their delivery to certain hours of the day. Water availability can vary from less than 2 hours a day to up to 14 hours a day in the warm season. One of the main reasons for introducing a schedule is to reduce water losses in the system due to leaks or overconsumption. Another reason is to save on electricity costs. Scheduled delivery is also a means of coping with inconsistent electricity supplies. In the winter season, some schemes reduce the hours of water delivery in accordance to scheduled electricity outages.

The reliability of the regional electricity supply has important implications on the performance of a supply scheme, and must be taken into careful consideration during the design of the scheme. Service providers reported that frequent outages and insufficient voltages cause pump burnouts, which are costly to repair and replace. In cases where water delivery relies directly on electricity, electrical outages not only deprive consumers of their water supply, but they also cause the water in the pipes to freeze. This leads to long-term disruption in provision of water services. In response to these complications, service providers have invested in generators and transformers, replaced or combined pumps and gravity water delivery systems, and introduced service schedules for water delivery in the fall and winter months. Some service providers have proposed connecting to the "red lines," a backup network of electricity supply that schools and health clinics buildings and other key infrastructure are connected to during seasonal outages. Since water delivery is not considered by legislation as a socially important service or key infrastructure, the decision to connect depends on the support of local governments and the will of service providers to initiate the conversation. According to the collected data, not all schemes have started the dialogue or managed to receive approval.

Finally, demographic factors, including population growth, should be considered during the design stage of the water schemes. Since these factors were not considered while designing the schemes, all of them continue to struggle with increasing demand. Even recently established schemes receive requests from new households that express interest in connecting to the service. With limited capacity, the new connections can negatively affect the quality of service for current consumers in the form of decreased water pressure, decreased availability of water, and compromised provision of services.

Affordability and Cost Recovery

Before the selected water supply schemes were implemented, participants reported that service fees and coping costs were high. In the selected areas, before the centralized supply scheme was introduced, households were accustomed to spending TJS 70–500 per month on water services. These costs were associated with delivery of water by truck, fuel to deliver water in private cars, or electricity for private well pumps to pump water. In addition to monetary costs, consumers were subject to high time costs, spending more than 2 hours a day fetching water from open sources, standing in queues at public taps, and bringing water home. Women and school-age children were primarily responsible for these tasks. Focus group discussion (FGD) participants also highlighted high health costs affiliated with the previous water arrangements in their respective villages. Health risks associated with fetching water included miscarriages, bleeding, fractures, stretched muscles and joints, back pain, and kidney inflammation. Communities were no strangers to water-borne diseases such as dysentery, typhoid, hepatitis, and diarrhea.

After the reviewed schemes began operating, the majority of community residents reported a decrease in household coping costs and an overall improvement in self-reported well-being (box 7.4). The financial obligations have dropped to TJS 10–120 per household per month, depending on the scheme, presence of meters, number of household members, and time of year. Most households pay only TJS 10-50 per month. In general, consumers have mentioned that the new services have positively impacted the well-being of their households and reduced the financial burdens associated with securing drinking water supplies. In addition, FGD participants and key informants noted the decrease in incidences of infectious diseases within their communities, adding that their improved access to water has positively influenced the frequency and consistency of household hygiene practices, such as frequency of bathing, hand washing, and clothes washing.

Although tariff structures vary, schemes that impose nominal tariffs, where consumers pay a fixed estimate per member of the household, appear to be less affordable for consumers

Box 7.4: Affordability and Cost Recovery

Before one of the reviewed schemes that is operated by a Water Users Association (WUA) management model was implemented, serviced villages suffered a severe shortage of safe drinking water. People either used water from the irrigation canal or bought water transported from elsewhere if they could afford it. After the scheme was constructed, health costs fell considerably because women and children no longer had to travel long distances to fetch water. Consumers also benefitted monetarily. The cost of transported water ranged from TJS 80 to TJS 300, depending on the reservoir size. This supply often lasted only two weeks, depending on household consumption patterns and household size. With the new delivery model, consumers' tariff cost have fallen to TJS 2.40/m^3. This translates to a cost of approximately TJS 7–40 for filling the same reservoir size. Two statements by local residents capture local conditions.]

> *We all use water from the Fergana canal. It has always been so [since the time of] the Soviet Union. During the Soviet Union [era], the water there was fresh and clean. Now, if you had only come in August, you would cry after you saw the canal. The canal is dirty. We are located downstream and all the remaining water and wastewater comes to us. But we have no other source of water so we have to collect it, boil it, and use it for drinking and cooking, too.* —Focus group discussion with men

> *Sometimes, the hospitals were full and not in position to accommodate all the patients, particularly during the seasonal outbreaks in autumn. In summer, there was an outbreak of intestinal diseases. Typhoid was once also an issue, because people drunk irrigation water which is polluted already from upstream.* —Key informant interview with health clinic staff

The annual depreciation of assets reflected in the accounting books of the WUA amounted to TJS 7,328 in 2015. The annual expected revenue of the scheme for 2016 with the current tariff is TJS 250,000. These numbers are evidence that full cost-recovery has occurred. The current collection and receivables ratio fully covers all associated costs, including maintenance, energy, salary, and taxes. The head of the WUA reported that regular maintenance work is being completed on time. Maintenance-related costs within a six-month span in 2016, according to the accounting books, totaled TJS 20,962.

Source: Case study of selected stand-alone schemes.

than metered delivery models. On average, metered households, which pay only for the amount of water they consume, pay TJS 0.87/m^3, while nonmetered households pay an average normative consumption tariff of TJS 2–4 per person per month. State buildings and private organizations pay an average of TJS 1.6/m^3 and TJS 2.4/m^3, respectively. Interviews with service providers reveal that households settle their financial obligations by paying cash to controllers that are hired by the supplier. Service providers and bill collectors visit households once a month, collect the payments, and provide receipts to consumers. Some service providers hire mahalla leaders to be controllers. This practice received positive feedback from both consumers and suppliers, as mahalla leaders are respected individuals

within the community. Collection rates are usually higher in these instances, as mahalla leaders are able to explain the importance of timely payment to community members. According to the FGDs with consumers, most of the population in their respective communities can comply with the imposed tariff structure, with the exception of low-income households with elderly members. Providing a metered supply could facilitate better household budgeting and increase affordability for these households.

Private connections can be an impetus for consumers to increase their willingness to pay. Willingness to pay is lower in schemes that provide public tap connections rather than individual connections. According to participants in this study, consumers are less motivated to pay a normative fee when they witness other households consuming vastly different amounts of water. Current tariffs barely cover the costs of daily operations, and do not support the costs of timely maintenance, repairs, and extensions of the scheme. The current tariffs are lower than the ones proposed by service providers. Household tariffs that would achieve cost-recovery range from TJS 1.0/m^3 to TJS 2.85/m^3, depending on the required costs of electricity, the condition of the pipe and equipment, the number of consumers, and the density of the population. Furthermore, community involvement, satisfaction with the quality of service, and penalties imposed by the service provider on households for not meeting their financial obligations are also factors governing consumers' willingness to pay. These findings demonstrate the importance of developing a clear incentive structure to sustain affordability and cost-recovery efforts. Based on the data collected across the reviewed schemes, the average fee collection rate in rural water supply schemes varies between 65 percent and 85 percent.

Low payment collection rates and a lack of external sources of funding (especially relevant for WUAs) significantly impair the quality of operation and maintenance of the selected schemes. Among the consequences: Schemes cannot afford to properly treat water and/or invest in water treatment equipment. Service providers must introduce a water delivery schedule to minimize electricity costs. Low salaries and low availability of funds result in high frequencies of staff turnover, which ultimately lead existing staff to be overburdened when qualified specialists leave. Consumer satisfaction is low, which translates into a low willingness to pay. Funds to extend the scheme and connect new households are limited or completely lacking. Taken together, these issues may eventually lead to the failure of the water supply network.

Consumer and Community Engagement

Some of the schemes selected for this review were demand driven, while others were delivered by service providers with minimal consumer and community engagement. The main difference lies in the key actors that are responsible for initiating the scheme and the participatory process involved in the design, construction, operation and maintenance of the scheme. In demand-driven schemes, the community plays a significant role in initiating the scheme by meeting, preparing, and submitting requests and applications to different donors and the local government. In supply-driven schemes, the local or central service providers take the initiative in collaborating with donors to perform these tasks.

Demand-driven schemes were observed to be effective, particularly in small rural settlements where community cohesion can be an asset. In some of the reviewed schemes, it was evident that community involvement built a degree of ownership and commitment within the public service (box 7.5). In future schemes, it would be essential to align citizen participation with an incentive structure. For instance, in some schemes, cofinancing the project appears to have effectively induced community engagement. Willingness to pay and community involvement in maintenance and repair stages were higher in schemes that adopted a cofinancing mechanism. The population's investment varied from 1.5 to 15 percent of total costs. Apart from direct financing, community members also volunteered and provided in-kind labor in the construction stage. Meaningful engagement with local communities from an early stage, including during

Box 7.5: Community Engagement and the Role of Grievance Redress

One of the selected schemes was operated under a limited liability company (LLC) management model. This scheme represents a demand-driven approach, where the donors took the responsibility of initiating rehabilitation efforts. The community was involved in the initial discussion of financial contributions. Mahalla heads in the covered villages visited households during the design phase of the project to discuss contributions. Community gatherings, social events, and mosque prayer times were also used as means of reaching out to the community to inform and discuss relevant information.

At the construction stage, men contributed in-kind by digging trenches. Women cooked and provided meals to workers. After the completion of the scheme, the community stayed actively involved in the operation, maintenance, and repair functions of the scheme. Early community participation has resulted in greater community ownership and sustainable service delivery since project inception.

The service provider has a complaint registration book, used to record all the incoming complaints and appeals received by the office. Among the recorded details are the parties involved, the dates of receipts, and the specifics of proposed resolutions. However, consolidated data or statistics on the number and nature of complaints are not generated or analyzed in systematic way. So far, community involvement in the scheme's operation and maintenance has preempted any major service disruptions.

Source: World Bank team case study of selected stand-alone schemes.

the appraisal of options was instrumental in establishing a sense of ownership in the scheme. When community members were not consulted or when their opinions were not reflected in the scheme design, they reported being dissatisfied with the resulting service delivery.

Households tend to prefer voicing their concerns with mahalla leaders as opposed to submitting formal complaints. The Law on Citizens' Appeal establishes the procedure that citizens should follow in bringing their proposals and complaints to public and government authorities. It also outlines the appropriate procedure for considering them and the timeline for responding. Based on the Constitution, citizens have the right—individually, collectively, or through their authorized representatives—to apply to the public bodies at all levels for resolution of appeals. Formal grievance redress mechanisms, such as log books, hot lines, and/or specialists were reported to be in place, but few written service complaints had been submitted by the consumers to their service providers or local governments. Instead, communities preferred to interact directly with mahalla leaders to resolve or address service concerns. This preference was linked by the communities to the following factors: low level of awareness of the legal system; local norms that expect mahalla leaders to provide advice and support to community members in difficult situations; and the cost of additional travel required to reach the formal organization office of Vodokanals and state agencies in raion centers when formal complaints must be submitted in writing. These factors suggest that the current formal grievance redress mechanisms are largely ineffective and fail to serve the needs of communities. In one of the reviewed schemes, when the informal channels were unable to resolve the problem with water quality (excessive hardness and salinity, bad taste, insufficient chlorination), community members switched back

to their alternative water source (irrigation water) instead of submitting a formal complaint to the service provider, and began using the scheme water for domestic purposes.

Lessons and Implications for Service Delivery

The provision of drinking water and sanitation services in Tajikistan is characterized by institutional gaps, overlapping authorities, and financial sustainability issues. The current organizational structure imposes several complexities in decision making, covering subsidies from scarce and underfunded budgets, and developing tariff policies. The direct superposition of the irrigation legislation on the provision of drinking water has resulted in ambiguity that continues to hinder the sector's development. The limitations on acquiring assets and privatizing schemes continue to stymie the potential to engage investors. The direct conflicts of interest that evolve from the dual nature of SUE KMK as a public governor and a for-profit entity deprive the sector of a robust accountability structure. The lack of explicit boundaries between the regulatory functions of state authorities have resulted in widespread duplication of responsibilities and led to a pattern of inefficient resource management. Despite the government's and development partners' commitment to sector reform, a significant amount of work remains. The implementation of reforms has proven to be challenging because of political economy considerations. The sanitation sector, on the other hand, is almost entirely missing from the ongoing reform discussions, despite the serious deprivation of sanitation and hygiene observed across the population.

The identified gaps in the administrative, policy, and regulatory spheres can be addressed by greater collaboration between government and development partners in the drinking water supply and sanitation sector. For example—as in the case of collaboration between the EBRD and government of Tajikistan on the implementation of the current sector reform program—other development partners can assist government efforts to define and draft the roles and responsibilities of the regional utility companies that are being set up as subsidiary branches of the SUE KMK. Simultaneously, development partners can play a critical role in assembling dedicated funding, creating incentives for hitting the set targets, and providing technical assistance and capacity building for service providers at the national and regional levels. Civil society groups can be meaningfully engaged in information sharing on local needs and social mobilization, which is evidently lacking in this sector.

As the future of the sector reform is being determined in collaboration with the government, stand-alone schemes can provide an effective means to alleviate WASH deprivation across Tajikistan, particularly in rural settlements. The reviewed schemes offer compelling lessons on using stand-alone schemes to overcome overcoming institutional barriers to provide services to rural communities that are disconnected from central water supply networks. Among the three delivery models identified, mobilizing local authorities and communities early on, in the design stage, and sustaining their involvement in the construction and operation of these decentralized schemes, seems particularly effective. Local government and community leaders can assist the service provider in conducting feasibility studies; providing a better understanding of the local context; appealing to donors, central government agencies and vendors; and engaging community members in the decision-making processes. The early and continued involvement of communities could reduce financial costs, increase the sense of ownership, and increase willingness to pay cost-recovery tariff levels for services.

Sector realities at the macro level, as well as local service conditions and population characteristics at the local level, need to be properly taken into consideration and incorporated into the design and implementation of stand-alone schemes. For example, future projects can consider underlying issues such as population growth, seasonal variations in demand, dependence of performance on the reliability of local electricity, abundance of water treatment resources, availability of water-testing expertise, and the ability of metered water to minimize overconsumption of limited water supplies. In addition, rural schemes also tend to face issues of low payment collection rates, a lack of external sources of funding, and tariffs that are lower

than cost-recovery rates. These issues significantly affect the outlook of these schemes, and must be addressed through coordinated, collaborative efforts among stakeholders. Available evidence indicates that these considerations are often overlooked, but play a critical role in the sustainability of water supply and sanitation schemes, as well as in building community ownership and satisfaction with the delivered services. This calls for upstream feasibility studies and preparation activities that not only address technical aspects of the water schemes' infrastructure, but also attempt to understand the social characteristics of the local populations in order accommodate their needs and perspectives through a community-centered approach.

Notes

1. The TajWSS Network is a national multistakeholder platform of actors from government, international institutions, donors, science institutions and academia, public, private and other not-for-profit organizations in the water and sanitation subsector in Tajikistan, who gather regularly in plenary meetings and working groups to advance the national drinking-water and sanitation agenda. See http://www.tajwss.tj for more information.
2. Kolhozes are collective or communal farms organized by farmers/peasants themselves using self-funds. Sovhozes are farms owned and financed by the state.
3. Based on Resolutions #679 and 680 of the Government of Republic of Tajikistan dated December 31, 2011 (supervision authority) and Resolution #231 of the Government of Republic of Tajikistan dated July 1, 2010 (water quality monitoring).
4. Resolution of the Government of Tajikistan, as of December 30, 2015.
5. EBRD presentation on Water Sector Reform in Tajikistan, September 2014.
6. Akhbori Majlisi Oli of the Republic of Tajikistan, #670, December 29, 2010.
7. Resolution # 679 of the Government of Republic of Tajikistan dated December 31, 2011.
8. This is not applicable to several larger towns and cities, including Dushanbe, Khujand, and Nurek, where municipalities have full ownership and control for provision of all municipal and communal services.
9. Dushanbe city and Farkhor town have received support with installation and procurement of residential water meters under the World Bank-financed Second Dushanbe Water Supply and Municipal Infrastructure Development Projects, respectively.
10. The study had certain limitations. First, key documents were not available for the review in most cases, including documentation on land use rights, results of water quality inspections, and ownership transfers. This made it difficult to conduct a full assessment of the processes to transfer ownership, the validity of asset ownership, and the mandated responsibilities of communities, service providers, and local authorities for the operation and maintenance of the water supply schemes.

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Chapter 8
Conclusion

Despite Tajikistan's progress in reducing poverty, WASH conditions across the country remain poor and unequally distributed. Service improvements since 2000 have generally taken place in the lower tiers of WASH services. A large majority of the rural population and the population living in certain regions—particularly in Gorno-Badakhshan Autonomous Oblast (GBAO) and Khatlon regions, and to some extent, Sughd region—continue to face the most severe conditions. Even in urban oblast centers and in the capital Dushanbe, the availability and quality of services is generally poor. This imposes high costs on the population, particularly the less well-off. These costs include monetary and nonmonetary coping costs, as well as more serious adverse impacts on developmental outcomes of children—which not only affect the well-being of the current population, but will likely have significant and irreversible impacts on the next generation. Institutional gaps and the unfulfilled potential of consumer engagement in decision making, accompanied by the large amount of capital investments required to upgrade the degraded infrastructure, overall paint a grim picture for the sector's future.

The diverse evidence synthesized in this report can inspire the government, civil society, and the international community to accelerate their actions toward addressing severe WASH deprivation in Tajikistan. At the policy level, the report can inform the ongoing sector reform discussions, which aim to address the complexities of sector governance through greater regionalization of certain service delivery functions. Soon-to-be-created regional companies are envisaged to support their affiliate utilities by providing technical back-up, engineering support, and enhanced financial management. The design and division of responsibilities across each of these components can be informed by the legal and regulatory gaps identified in this report. Similarly, the report's findings on consumer perceptions of service providers can be used to build capacity and enhance the skills of staff in the newly created regional branches. Further, the location of regional utility companies that are being created can be informed by the detailed spatial analysis provided in the report, which highlights the intersection of population density and the most severely deprived population groups that would benefit the most from service improvements. The priority locations are Khatlon and Sughd, where large numbers of WASH-deprived households are located, along with GBAO, which stands out as the region with the worst conditions and most urgent needs.

While the institutional reform process continues at the national level, the findings can also inform the targeting, design, and implementation of new investments in the WASH sector—particularly in regions that are unlikely to receive large-scale water supply and sewer network investments in near future. In the context of complex environment for institutional reforms, it is necessary to employ a two-pronged approach that promotes stand-alone investments across rural Tajikistan alongside the macro-level reform discussions. Stand-alone WASH schemes can provide much-needed service improvements to remote areas that are otherwise unlikely to see service improvements in near future. They can also provide an impetus toward challenging the status quo, which is characterized by only a few investments in the most severely deprived areas of Tajikistan (such as GBAO region), as well as low cost recovery (by service providers) and low affordability (among consumers). Because of the population density in Khatlon and Sughd, these two regions remain as the priority locations for large-scale stand-alone investments. These investments would be the most efficient in terms of cost per beneficiary. The sparsely populated and remotely located GBAO region, on the other hand, is the priority location for smaller, decentralized, and community-based WASH schemes.

Future investments, whether small or large in terms of the size of the population they serve, can build on the lessons learned from the stand-alone schemes studied in this report. These lessons pertain to strengthening the legal status and ownership of schemes; ensuring affordability of services by consumers and recovery of costs by service providers; and utilizing the resources of communities in the design, construction, operation and maintenance stages. Across the three service delivery models identified in this report—public enterprises, private enterprises, and water user associations (WUAs)—mobilizing local authorities and communities early on, in the design stage, and sustaining their involvement in the construction and operation of these decentralized schemes, seems particularly effective for the sustainability of stand-alone schemes in rural areas. Local government and community leaders can assist the service provider in conducting feasibility studies; providing a better understanding of the local context; appealing to donors, central government agencies, and vendors; and engaging community members in the decision-making processes. The early and continued involvement of communities could reduce financial costs, increase the sense of ownership, and increase willingness to pay cost-recovery tariff levels for services. The interaction between communities and service providers can be enhanced through feedback loops that allow consumers to report infrastructure breakdowns, receive up-to-date information about service interruptions, and demand information about tariffs from service providers.

In the short term, there are immediate measures that the government, civil society, and the international community can take to improve the availability and quality of drinking water across Tajikistan. The analysis has shown that even in the capital Dushanbe, the majority of the population does not have water meters. This results in inefficient use of water resources by consumers, interruptions in water availability (especially in summer months), and difficulties in fee collection by service providers. Installation of water meters in areas where water supply networks already exist can lower the rate of overconsumption and water waste. Water meters can help increase the rate of fee collection, which can contribute to cost recovery by the local water utilities, Vodokanals, and improve the accuracy of water bills received by the consumers. Another relatively straightforward intervention that can yield quick results relates to water treatment methods. According to the results of the water quality tests conducted for this study, even though drinking water in Tajikistan is not contaminated with *E. coli*, it contains other types of bacteria and has low concentrations of chlorine. The most common water treatment method used by the households (boiling water) further reduces chlorine concentration in drinking water, which can impair public health. Therefore, providing sufficient quantities of chlorine to Vodokanals, schools, and health facilities across Tajikistan, as well as promoting the supply of bleach and water filters in local markets, can significantly improve the quality of water consumed by the population. Experience shows that such interventions are most effective when they are supplemented with information campaigns on safe and affordable water treatment methods, not only among water users, but also among service providers.

Several sanitation and hygiene interventions can also yield results in the short term, particularly in rural areas, schools, and health clinics where facilities tend to be in poor condition. At the household and community level, awareness campaigns can promote the construction of safe sanitation facilities that minimize contact with human excreta and promote personal hygiene, particularly in rural areas. These efforts need to be complemented with measures that promote availability and affordability of latrine materials in local markets, as well as those that underscore the interdependent nature of total sanitation measures among community members. In urban areas, where public toilets and shared facilities are common, establishing sanitation zones and sanitation zone management committees that work with city and regional governments (hukumat) and local service providers, can help improve the condition of shared facilities and prevent the spread of disease. Finally, donor and government resources can be directed toward provision of soap, materials to practice safe menstrual hygiene, and other materials in schools and health clinics, as well as in rural markets, where a significant share of the population does not have access to personal hygiene.

The extensive data sources collected for this study can be used for additional research to inform evidence-based decision making and interventions in the WASH sector. While the

analysis and findings presented in this report provide a diagnostic of key issues across the WASH sector, various data sources collected for this study can inform specific interventions on a range of subtopics. For example, one of the unique features of the Household WASH Survey is the availability of detailed information on WASH conditions for people with disabilities. Further, the most innovative future research agenda can focus on the integrated nature of the various data sources. For instance, future research can exploit the integration of the Household WASH Survey and the School WASH Survey to analyze the link between availability and quality of WASH services in schools and households, as well as how these services relate to observed health, education, and other well-being outcomes of children. Similarly, the integration of the Household WASH Survey and the UNICEF Nutrition Survey can be analyzed further to explore the synergies among WASH conditions, nutrition, and care, particularly for infants and children under the age of five. Household-level data can be examined in relation to the division of labor within the household with regard to treatment methods and related water quality results. The extensive qualitative data and case studies can provide additional information to inform the design of future programs. Together, these data sources can provide a solid analytical foundation for future interventions in WASH sector in Tajikistan.

Appendix A Research Methodology and Data Sources

This report uses combined qualitative and quantitative data sources and methods. They were interacted throughout the research process to inform the design of instruments, deepen research questions, and triangulate the information collected through a certain method with information collected through another method. The study was carried out in five phases spread over 18 months from October 2015 to April 2017:

Phase 1: Analysis of water supply, sanitation, and hygiene (WASH) service conditions and poverty using secondary data. This phase analyzed available data from nationally representative household surveys to assess trends in the quality of WASH conditions across the country and for different population groups and locations.

Phase 2: Spatial maps of drinking water and sanitation conditions using secondary data. The second phase produced detailed maps based on the 2011 population and housing census and imputations of WASH conditions into the census data based on estimation models derived from household survey data. The maps were also overlaid with the national poverty maps to show the spatial relationships between poverty and WASH deprivation, as well as to indicate subnational areas that are most deprived. These maps are available online (Link 1, Link 2).

Phase 3: Enhancing understanding of consumer experiences, coping methods, and constraints for service delivery in contrasting contexts through primary qualitative research. The qualitative data collection used information from the two previous phases to purposively select contrasting research sites and to develop research questions to understand the overall WASH patterns suggested by the preexisting survey data. The qualitative research focused on assessing consumer experiences of WASH service conditions and their social impacts on different population groups, and identifying institutional constraints for service delivery across contrasting sites in the country. Primary qualitative data was collected through qualitative research techniques, including interviews and focus group discussions.

Phase 4: Design and administration of WASH surveys to collect nationally representative primary quantitative data at the household and school level. Information and findings from the qualitative research were used to design two detailed WASH surveys, one at the household level and another at the school level. For example, the school survey was carried out after gathering focus group and key informant responses that indicated severe WASH conditions in schools. The household survey, similarly, included water quality testing (using field laboratories), as well as detailed cost categories capturing WASH-related coping costs, which were developed using the qualitative evidence. The survey also contains information on health impacts, willingness to pay for improved services, and linkages between school absence of female and male children and WASH conditions at school.

Phase 5: Review of selected decentralized WASH service delivery schemes through primary qualitative research. The final phase in the research aimed to collect information about WASH service delivery at the level of decentralized projects. It focused on ongoing experiments in WASH service delivery in Tajikistan, which generally concern community-driven interventions and include strong involvement of consumer organizations in decision making concerning the operation and maintenance of schemes. The review looked at lessons learned, options for scaling up good practices, and regulatory constraints that need to be tackled to make this possible.

Household and School WASH Surveys

The Tajikistan WASH survey was conducted on behalf of the World Bank by a local research firm, Zerkalo, between October and December 2016. The survey included an intended 3000 households (3052 actually interviewed) from 150 primary sampling units (PSUs), and 300 schools (302 actually included) that were selected on the basis of whether they served the PSUs that participated in the household survey. The household survey sample design was partially integrated with a nationally representative nutrition survey fielded during the same period.

The Household WASH Survey gathered information regarding the status of WASH-related services and practices for a nationally representative sample of Tajikistan. It was also designed to be representative at the subnational level. The survey instrument covered a range of information for the calculation of household welfare status, access to water and sanitation services, and practices relating to hygiene. It covered nine modules: (i) key demographic characteristics; (ii) housing and infrastructure; (iii) recall (one-week) of household food consumption and expenditure; (iv) consumption and expenditure on nonfood items; (v) water supply; (vi) sanitation facilities; (vii) hygiene practices; (viii) health issues; and (ix) water cleanliness testing at site of consumption/water source (for a subsample).

The School WASH Survey likewise gathered information regarding the status of WASH-related services and practices for a nationally representative sample. The instrument covered eight modules: (i) key school-level characteristics; (ii) information on the available water supply; (iii) self-assessed water quality and safety; (iv) sanitation and hygiene infrastructure; (v) education on hygiene; (vi) menstrual hygiene; (vii) water-borne illnesses; and (viii) water cleanliness testing at site of consumption/water source (for a subsample).

Fieldwork for the WASH survey took advantage of a previous household survey with similar design requirements fielded in 2015 by the World Bank, namely the Proxy Means Test (PMT) Survey. The same primary sampling units were included, but households that participated in the 2015 PMT Survey were ineligible to participate in the WASH survey. The sample was designed for representativeness at the national, urban/rural, and the five main subnational administrative areas. The initial sample frame for the 2015 PMT survey was the 2010 population and housing census. Table A.1 shows the distribution of population in 2010 by administrative area and rural/urban stratum.

Sampling Errors and Design Effect Calculations

To establish the expected precision of the estimates and the potential need to adjust the sample design, the results from the 2015 PMT survey were used to calculate subpopulation

Table A.1: Distribution of Population (in 1,000s) in Tajikistan Census Frame, by Administrative Area, Rural, and Urban Stratum

	Total			Rural			Urban		
Region	2010	2016	Change	2010	2016	Change	2010	2016	Change
Dushanbe	724	803	10.9%	n.a.	n.a.	n.a.	724	803	10.9%
Sughd	2225	2511	12.9%	1674	1889	12.8%	550	622	13.1%
Khatlon	2669	3048	14.2%	2210	2500	13.1%	459	547	19.2%
DRS	1713	1972	15.1%	1483	1713	15.5%	230	259	12.6%
GBAO	203	217	6.9%	176	188	6.8%	27	29	7.4%
National	7534	8551	13.5%	5543	6290	13.5%	1990	2260	13.6%

Sources: National Census 2010; official TajStat estimates.
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; n.a. = not applicable.

Table A.2: Proxy Means Test Intra-Cluster Correlation Coefficients by Strata, 2015

Region	ICC	Prop.	Equal	Actual	HHs	RSE
Dushanbe	0.092	18	17	14	280	0.060
Sughd	0.087	48	33	44	880	0.048
Khatlon	0.191	48	33	53	1060	0.054
DRS	0.149	31	33	35	700	0.066
GBAO	0.530	4	33	4	80	0.026
National		150	150	150	3000	0.028

Sources: National Census 2010 and PMT Survey (2016).
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; HH = households; ICC = intra-cluster comparison; prop. = proportional allocation; RSE = random sampling error.

characteristics, and in particular, the intra-cluster correlation (ICC) of household consumption. The ICC measures the degree of homogeneity for units of analysis within a given area (households within a cluster), which in turn is a key factor in the efficiency and precision of a sample. The more similar the units of analysis are within a given area, the higher the design effects and the higher the error. Increasing the number of units of analysis that are relatively homogeneous in a given area further amplifies the loss of precision.

The sample design for the 2015 PMT survey ultimately did not use either the proportional or the equal allocation. Instead, it opted for an approach that was both simple and minimized the random sampling error (RSE) within regions (table A.2). For all regions, the RSE was below the objective of 0.1. It was thus decided that no sample reallocation was needed.

Selection of PSUs and Households

The selection of PSUs in each stratum for the 2015 PMT survey was based on probability proportional to size (PPS), and the selected PSUs for the WASH survey were unchanged. The PPS method systematically assigns the likelihood of selection for each PSU relative to the percentage of the households in the stratum residing in the PSU. By increasing the likelihood of selection for larger clusters, the sample captures more variation within the population, leading to lower design effects and higher precision.

Due to the age of the most recent population and housing census, a full household listing exercise was conducted before households were selected. This provided an up-to-date account of all eligible households within each PSU and was used for the post-stratification adjustment in the calculation of survey weights. Descriptive statistics from the listing exercise are included in table A.3. Following the listing exercise within the PSU, a target of 20 households was selected utilizing a systematic random sample. A set of “replacement” households was also selected in a further selection step. When households refused to participate, they were replaced by the designated replacement household within the same PSU (table A.4).

Survey Weights

Separate survey weights for each of the samples were calculated and merged with the survey data. Separate weights (adjusted for the PSU size using the results from the listing) were calculated for: (i) the main household sample weights; (ii) weights for the selected drinking water testing sample; (iii) weights for the selected water source testing sample; (iv) weights for the integrated Nutrition/WASH survey sample; and (v) weights for the selected schools sample.

Table A.3: Descriptive Statistics of Listing Data

Region	Total observed HH	Urban HH	Rural HH	Total observed Ind.	Urban Ind.	Rural Ind.
Dushanbe	6210	6210	n.a.	27509	27509	n.a.
DRS	7371	1460	5911	51894	9033	42861
Khatlon	23629	10339	13290	140577	48366	92211
Sughd	21318	5598	15720	119310	23618	95692
GBAO	192	66	126	1266	443	823
Total	58720	23673	35047	340556	108969	231587

Source: Listing exercise for the Household WASH Survey 2016.
Note: DRS = Districts of Regional Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; HH = household; Ind. = individuals; n.a. = not applicable.

Table A.4: Final Achieved Sample WASH Survey, 2016

Region	Total HHs	Urban HHs	Rural HHS	Drinking water HHs	Water source HHs	PSUs
Dushanbe	289	289	n.a.	95	45	14
DRS	709	92	617	232	113	35
Khatlon	1,072	191	881	353	177	53
Sughd	899	203	696	293	147	44
GBAO	83	20	63	28	12	4
Total	3052	795	2257	1001	494	150

Source: Household WASH Survey 2016.
Note: DRS = Districts of Regional Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; HH = household; PSU = primary sampling unit; WASH = water supply, sanitation, and hygiene; n.a. = not applicable.

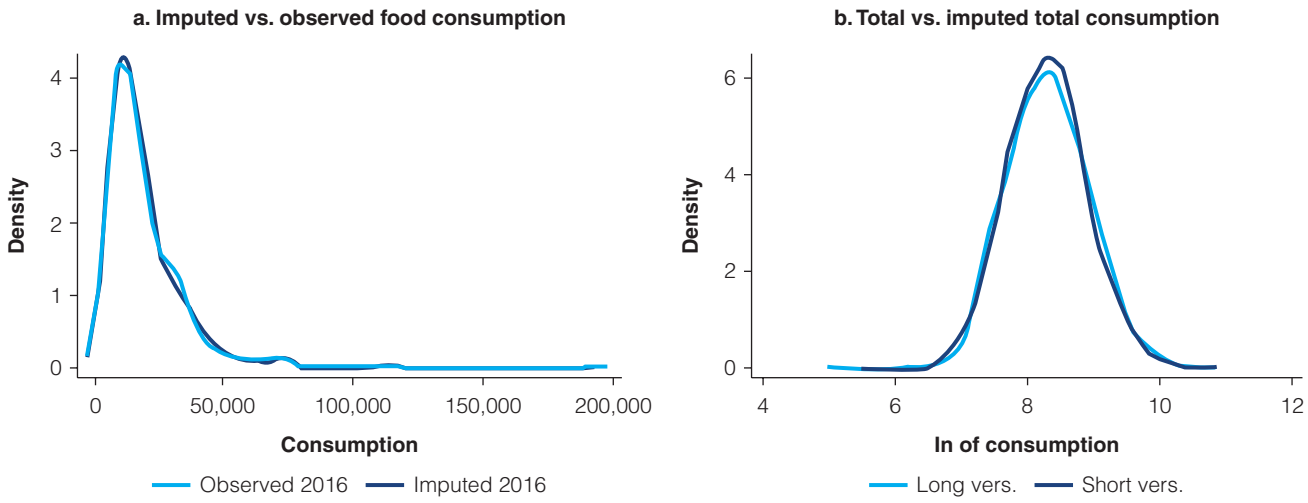
The weights for households were based on the size of the population by strata projected by the Statistics Agency under the President of the Republic of Tajikistan (TajStat) for 2016, updated with PSU-level population estimates from the listing exercise. The weights for schools were assigned on the basis of the number of schools by region according to the official Education Management Information System (EMIS) database maintained by the Ministry of Education.

Consumption Aggregate

Detailed information on total household consumption and expenditure was collected by the Household WASH Survey. To shorten the average interview time, two different versions of the consumption model were used. The first "comprehensive" version was based on the consumption module used in the 2015 PMT survey, and was administered to a randomly selected subsample of 403 households. The remaining 2,572 households were interviewed using a "short" version for the consumption module, which focused instead only on the most common consumption items, as determined through the previous PMT survey consumption categories.

An imputation approach was used to adjust the consumption aggregate measured from the short version of the questionnaire to more closely follow the consumption distribution observed in the comprehensive version of the questionnaire. The imputation approach proceeded separately for each of the principal Classification of Individual Consumption according to Purpose

Figure A.1: Kernel Density Estimates for Food Consumption and Total Consumption



Source: World Bank team's analysis of Household WASH Survey 2016.

(COICOP) categories. Using a forward stepwise approach to select variables, the procedure identified a set of household characteristics and consumption patterns that strongly correlated with overall consumption for each COICOP category. A conditional prediction was then generated for each household on the basis of the resulting model, and aggregated to arrive at total household consumption. In practice, there were only slight differences in the two consumption aggregates for items that were commonly consumed, such as food (figure A.1).

For consumption of items that were rare, a two-stage procedure was used instead. In such cases, a first stage generated a predicted likelihood that each household had any consumption of the relevant goods at all. The second stage estimated the value of that consumption. The predicted value of consumption for the rare items was then assigned to the appropriate household, conditional on the household as having a predicated positive value (table A.5).

Water Testing Subsamples

Water tests were conducted for a subsample of households in the Household WASH Survey. Drinking water was tested for a randomly selected 1000 households, while water sources were further tested for a subset of 500 of these households. Selection proceeded by first assigning each PSU to have water tested for either 6 or 7 households. Within these selected households, a subset was then assigned to also have water sources tested. On the other hand, all 300 schools included in the School WASH Survey had drinking water tested in every case, but did not have water source tests conducted. The data from the school interviews was augmented using the official EMIS database maintained by the Ministry of Education.

Nutrition Survey Integration

The UNICEF Nutrition Survey of 2016 was conducted at the same time as the WASH survey was in the field. To allow for additional analyses, the sample for the two surveys were partially integrated where possible (table A.6). The nutrition survey assessed the nutrition and micronutrient status of the women and children, determined risk factors for deficiencies, and compared the findings with the last nutrition survey completed (in 2009). For integrated

Table A.5: Consumption Items

Consumption items	Mean Consumption (TJS)		Share positive (percent)	
	Comprehensive version	Imputed short version	Comprehensive version	Imputed short version
Food	3055	3046	62	63
Alcohol, tobacco, etc.	58	51	1	1
Clothing	227	229	5	5
Housing and utilities	629	579	13	12
Furnishings/household items	161	161	3	4
Transport	317	335	6	6
Communications	61	55	1	1
Recreation and culture	81	88	1	1
Education	324	299	7	6
Restaurants and hotels	282	338	5	6
Durables	49	41	1	1
Total	5002	4975	100	100

Source: World Bank team's analysis of Household WASH Survey 2016.
Note: Mean consumption is expressed in per capita terms.

Table A.6: Household WASH Sample and Nutrition Sample Integration

Region	WASH clusters	Nutrition clusters	Nutrition clusters added/ or subtracted	Planned integrated clusters	Planned maximum HHs	Achieved integrated clusters	Achieved integrated HHs
Dushanbe	14	36	22	14	112	13	53
Sughd	44	36	–8	36	288	36	244
Khatlon	53	36	–17	36	288	35	241
DRS	34	36	2	34	272	33	179
GBAO	4	36	32	4	32	4	29
National	150	180	31	124	992	121	746

Source: World Bank team's analysis of UNICEF Nutrition Survey and Household WASH Survey.
Note: DRS = Districts of Republican Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; HH = household; WASH = water supply, sanitation, and hygiene.

households, anthropometric indicators on stunting and height for age z-scores are available for the analysis (approximately 530 children under the age of 2, and approximately 1200 children under the age of 5).

The WASH survey included a full module of food consumption. To create an indicator of calorie intake, food consumption was first converted into calorie equivalents using a standard Food and Agriculture Organization (FAO) concordance. Because children from birth to adulthood have different nutritional needs, measures are defined differently for children in different age groups. They were standardized using an adult equivalence factor (table A.7). Amounts are expressed per adult equivalent, calculated according the rules described below.

Using these definitions allowed an indicator to be created that can measure whether each household's aggregate food calorie consumption meets a minimum threshold, in adult

equivalent terms. For the integrated sample of children who participated in this study, the adequacy prevalence was strongly associated with monetary welfare (defined as total per capita consumption). The estimated share of households suffering from this definition of food calorie deprivation decreased monotonically by welfare quintiles. Table A.8 presents the unweighted shares of children living in households that exceed this threshold by consumption quintile for the participating sample.

An additional measure of diversity was created based on an index of concentration in food types. This is estimated by grouping observed food consumption into groups (see categories

Table A.7: Adult Equivalence Factors

	Age (years)	Calories (kcal)	Adult Equivalence Factor
Newborns			
	0–1	750	0.29
Children			
	1–3	1300	0.51
	4–6	1800	0.71
	7–10	2000	0.78
Men			
	11–14	2500	0.98
	15–18	3000	1.18
	19–50	2900	1.14
	51+	2300	0.90
Women			
	11–14	2200	0.86
	15–18	2200	0.86
	19–50	2200	0.86
	51+	1900	0.75

Source: World Bank team's analysis of UNICEF Nutrition Survey.

Table A.8: Percent of Children Living in Households with "Adequate" Estimated Calorie Consumption

Area	All	Urban	Rural
Dushanbe	56	56	n.a.
DRS	58	67	57
Khatlon	57	65	55
Sughd	45	40	46
GBAO	21	n.a.	n.a.
All	53	56	52

Quintile	All	Urban	Rural
1	22	23	22
2	41	27	44
3	66	74	64
4	74	78	73
5	82	80	83
All	53	56	52

Source: World Bank team's analysis of UNICEF Nutrition Survey.
Note: DRS = Districts of Regional Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; n.a. = not applicable.

in Appendix B), and weighting a diversity measure by the share of household calorie consumption that is allocated to each of the different groups. The measure is of the type:

$$H = 1 - \left(\sum_{i=1}^{N} s_i^2 \right) \qquad \text{eq. A.1}$$

Where H is the index value, s_i is the calorie share of food group i in the consumption basket, and N is the number of food groups. In such an index, higher values indicate greater diversity. The resulting average index values are presented (without the use of survey weights) in table A.9.

For the purposes of this study, children's diets are considered to be adequate in the food security component if two criteria are met: i) their household ranks in the top 80 percent of the dietary diversity index distribution; and ii) each member of the household consumes, on average, at least 2250 calories in adult-equivalent terms. If these conditions are not met, the children's diet is considered to be inadequate in the food component. For some analyses, the related indicators are included directly rather than using a "adequacy" threshold.

The main WASH-related indicator used in the analysis for stunting (rather than estimating z-scores) is a composite measure of adequacy of sanitation facilities and safe drinking water. The measure is defined as simultaneous household access to improved sanitation and improved water, and living in a location where more than 90 percent of households in the community have access to improved sanitation. The motivation for this approach is the multidimensional nature of infection risk.

For the synergies analysis, an alternative definition is used. A child's environment is considered to be adequate if the household has both a flush toilet and improved water, and if at least 50 percent of the households located in the same primary sampling unit also have a flush toilet. This indicator was constructed to best reflect the WASH context of Tajikistan, where an overwhelming majority of households surveyed seem to have access to both adequate sanitation and improved water (using standard adequacy definitions).

Following the availability of indicators in the surveys, both the adequate care component and the adequate health components are defined differently for children in different age groups. Children under two years of age are considered adequate in the care dimension if three criteria are met: i) the child was breastfed within 30 minutes of birth; ii) the child was exclusively breastfed for 6 months, or is still being exclusively breastfed if under 6 months of age; iii) the child is still being complementarily breastfed (for up to two years). Children between 2 and 5 years of age are considered adequate in the care dimension if they have been washed at least once in the previous 24 hours.

Table A.9: Share of Children Living in Households with "Adequate" Estimated Calorie Consumption, Index Values

Area	All	Urban	Rural
Dushanbe	0.920	0.920	n.a.
DRS	0.905	0.909	0.905
Khatlon	0.900	0.904	0.899
Sughd	0.909	0.911	0.909
GBAO	0.906	n.a.	n.a.
All	0.906	0.912	0.904

Quintile	All	Urban	Rural
1	0.882	0.887	0.881
2	0.906	0.910	0.905
3	0.913	0.916	0.912
4	0.914	0.915	0.914
5	0.927	0.934	0.924
All	0.906	0.912	0.904

Source: World Bank team.
Note: DRS = Districts of Regional Subordination; GBAO = Gorno-Badakhshan Autonomous Oblast; n.a. = not applicable.

Health services are considered adequate for children under two years of age if the child has received at least one visit from a health worker in the previous 6 months (and the health worker asked questions or gave advice on at least one aspect of their health and development). Children aged 2 or older are considered to be adequate in the health component if they have received dietary supplements (such as vitamin A, vitamin B, or iron) in the previous six months.

Spatial Mapping of Poverty and WASH Conditions

Spatial maps of poverty were developed using poverty mapping (small area estimation technique), which is an approach for measuring welfare for highly disaggregated geographic units. Using multiple imputation techniques, poverty mapping generates poverty estimates for small areas, which would be impossible to reliably derive with survey data alone. The standard approach—often referred to as the ELL poverty mapping method after its originators, Elbers, Lanjouw, and Lanjouw—was used in in Tajikistan on the basis of the 2010 Census. The method is described in detail in Elbers, Lanjouw, and Lanjouw (2003) and Bedi, Coudouel, and Simlr (2007).

The ELL approach leverages the strengths of two data sources. First, the method makes use of survey data from the 2009 Tajikistan Living Standards Survey (TLSS) that include detailed information on consumption and other individual and household characteristics. Second, it employs individual and household-level information from the full micro data of the national census. In Tajikistan, as in most countries, the census provides less detail than the survey for any individual or household. Instead, the main advantage of using the census is that it provides complete coverage of the entire population, and is therefore free of sampling error.

Spatial mapping of WASH indicators is conducted based on two methods. The first type involves using those indicators that appear in the Census questionnaire. For these, it is possible to report highly disaggregated outcomes without concern of sampling error, and without need for additional imputation once poverty estimates have been derived. Another advantage for the first group is that because the poverty mapping utilizes the Census data, WASH questions that are included in the Census questionnaire can also be reported for poor/nonpoor subpopulations—as well as for bottom 40 (B40) and top 60 (T60)—within each small area imputed using poverty mapping techniques.

However, the answer categories for drinking water conditions in the Census lack precision. There are five categories: (i) a water pipe from the municipal system; (ii) a water pipe from the individual system; (iii) a water pipe outside the dwelling; (iv) a well, spring, or other water source; and (v) water is absent. Answer option (iv) combines water from improved wells, pumps, and boreholes with open water from rivers, lakes, and irrigation canals, while the latter could possibly also be included under answer option (v). Answer option (iv) receives about half the answers.

For sanitation conditions, the answer options are similarly imprecise. There are four categories: (i) a flush toilet inside the dwelling; (ii) a different type of toilet inside the dwelling; (iii) a toilet outside the dwelling; and (iv) no toilet. The bulk of the answers fall in category answer option (iii), but from its not clear whether this toilet is “improved” as defined by the MDG (Millennium Development Goal) indicator or not.

A WASH deprivation index was constructed to summarize vulnerability and deprivation in terms of several dimensions simultaneously (for the same households) and in a way that is straightforward to visualize in map form. The index is comprised of three dimensions: (i) monetary poverty status; (ii) presence of children age 0–6 in the household; and (iii) no connection to a sewer system and no access to piped water. Each of the dimensions is given equal weight. A household is “deprived” if the index is above 0.5. The household is either “vulnerable” or “deprived” if the index is above 0.3.

Analysis of WASH Conditions and Poverty with Preexisting Data Sources

Since 1999, nine household surveys have been conducted in Tajikistan that have covered access to drinking water and sanitation services. The population census conducted in 2010 and the Demographic and Health Survey (DHS) conducted in 2012 are the most recent ones. Only the Multiple Indictor Cluster Survey (MICS) 2000 and 2005, the Tajikistan Living Standards Survey (TLSS) 2005 and 2007, and the DHS 2012 have adequate data to measure access to "improved water" (MDG indicator) and access to "basic water" (SDG indicator). The other surveys, including the census, have ambiguous answer categories that make it impossible to use them to track these international indicators. None of them allow measurement of "safe water," which is the highest rung on the SDG ladder of drinking water and sanitation conditions. Access to "piped water on premises" can be measured by the census as well as the PMT 2015 survey (table A.10).

Table A.10: Household Surveys in Tajikistan and their Ability to Measure the Emerging "Ladders" of the Global SDG Reporting of Progress on Water Supply, Sanitation and Hygiene

Survey	Year	Poverty data	Tier 1: Improved	Tier 2: Basic	Tier 3: Safely managed	Piped water on premises	Improved water on premises
AQPSP	2011	Consumption	Insufficient disaggregation	Insufficient disaggregation	One of four conditions met		
CALISS	2013		Insufficient disaggregation	Insufficient disaggregation	No conditions met		
Census	2010		Ambiguous categories	Ambiguous categories	No conditions met		
DHS	2012	Wealth			Two of the four conditions met		
MICS	2000	Wealth			Two of the four conditions met		
MICS	2005	Wealth			Two of the four conditions met		
PMT	2015		Ambiguous categories	Ambiguous categories	No conditions met		
TLSS	1999	Consumption	Ambiguous categories	Ambiguous categories	One of the four conditions metplus one proxy for "free from fecal and chemical contamination" and one proxy for "free from fecal and chemical contamination"		

table continues next page

Table A.10: Continued

Survey	Year	Poverty data	Tier 1: Improved	Tier 2: Basic	Tier 3: Safely managed	Piped water on premises	Improved water on premises
TLSS	2003	Consumption	Ambiguous categories	Ambiguous categories	One of the four conditions met plus one proxy for "available when needed"		
TLSS	2007	Consumption			Two of the four conditions met plus one proxy for "free from fecal and chemical contamination"		

Compliant with the standard

Compliant if assumptions are made about indicators

Not compliant, but provides some information towards satisfying the tier

Not compliant with the standard

Source: Water and Sanitation Program (WSP) (World Bank).
Note: AQPSP = Tajikistan Household Panel Survey; CALISS = Central Asia Longitudinal Inclusive Society Survey; DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey; PMT = Proxy Means Test Survey; TLSS = Tajikistan Living Standards Survey.

Table A.11: Household Surveys in Tajikistan and their Ability to Measure the Emerging "Ladders" of the Global MDG and SDG Reporting of Progress on Sanitation and Hygiene

Surveys	Year	Consumption-based or asset index-based wealth categories	Open defecation	MDG "improved"	Flush to sewer
TLSS	1999	Consumption		Ambiguous categories	
MICS	2000	Asset index		Ambiguous categories	
MICS	2005	Asset index			
TLSS	2007	Consumption			
TLSS	2009	Consumption		Ambiguous categories	
AQPSP	2011	Consumption		Insufficient disaggregation	
DHS	2012	Asset index			
CALISS	2013	Consumption		Insufficient disaggregation	
PMT	2015	Consumption		Ambiguous categories	

Compliant with the standard

Not compliant with the standard

Source: Water and Sanitation Program (WSP).
Note: AQPSP = Tajikistan Household Panel Survey; CALISS = Central Asia Longitudinal Inclusive Society Survey; DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey; PMT = Proxy Means Test Survey; TLSS = Tajikistan Living Standards Survey.

From three household surveys conducted during 2000–12 in Tajikistan, data are available to assess the trend in access to sanitation conditions along the "improved sanitation" (an MDG indicator). This is "Tier 1" of the access to sanitation ladder of the new SDG indicator. However, only one survey is available that measures "basic sanitation" (whether toilets are shared, which is "Tier 2" of the SDG sanitation ladder) or "safely managed sanitation" (whether there is safe disposal and whether handwashing material is present in the latrine, which are "Tier 3" under the SDG indicators). Five observations are available for "Tier 0 - Open Defecation" and four observations are available for "Flush to Sewers" (see table A.12). An overview of the multi-tier SDG indicators for water supply access is discussed in Appendix B.

Table A.12: Distribution of the Focus Group Discussions, Key Informant Interviews and Mini Case Studies across Research Sites

Region	Regional center	District center	Rural village	Total
Focus Group Discussions				
Dushanbe	Dushanbe Mahalla 1 (connected to the pipe water): 1 FGD with men (low-income, apartment buildings); 1 FGD with women (middle-income, apartment buildings) Mahalla 2 (not connected): 1 FGD with women (low-income, private houses); 1 FGD with men (middle-income, private houses)	—	—	4
DRS	—	Gissar Mahalla 1 (connected): 1 FGD with women (low-income, apartment buildings) Mahalla 2 (not connected): 1 FGD with men (low-income, private houses)	Mahalla 1 (Dekhonabad jamoat connected): 2 FGDs with women (low-income, private houses) Mahalla 2 (Dekhonabad jamoat, remotely located from the water source): 2 FGDs with women (low-income, private houses); 1 FGD with men (low-income, private houses)	7
Khatlon	Kurgan-tube Mahalla 1 (connected to the water supply): 1 FGD with men (low-income, apartment buildings) Mahalla 2 (not connected): 1 FGD with women (low-income, private houses); 1 FGD with women (middle-income, private houses)	Sartuz Mahalla 1 (connected): 1 FGD with women (low-income, private houses); 1 FGD with women (middle-income, private houses) Mahalla 2 (not connected): 1 FGD with women (low-income, apartment buildings)	Mahalla 1 (Frunze jamoat, not connected, close to the water source): 1 FGD with women (low-income, private houses); 1 FGD with men (low-income, private houses) Mahalla 2 (Frunze jamoat, not connected, remotely located from the water source): 2 FGDs with women (low-income, private houses)	10

table continues next page

Table A.12: Continued

Region	Regional center	District center	Rural village	Total
Sughd	Khujand Mahalla 1 (connected to the water supply): 1 FGD with men (low-income, apartment buildings) Mahalla 2 (not connected): 1 FGD with women (low-income, private houses	Istaravshan Mahalla 1 (connected)—1 FGD with women (low-income, apartment buildings) Mahalla 2 (not connected): 1 FGD with men (low-income, private houses); 1 FGD with women (middle-income, private houses)	Mahalla 1 (Mudgun jamoat, connected)—1 FGD with men (low income, private houses) and 1 FDG with women (low income, private houses) Mahalla 2 (Rosrovut jamoat, not connected, remotely located from the water source): 2 FGDs with women (low-income, private houses); 1 FGD with men (low-income private houses)	10
GBAO	Khorugh Mahalla 1 (connected): 1 FGD with women (low-income, private houses); 1 FGD with men (middle-income, private houses) Mahalla 2 (not connected): 1 FGD with men (low-income, apartment buildings)		Mahalla 1 (Roshkala jamoat, Bidizi poen village, WSS project area): 1 FGD with women (low-income, private houses); 1 FGD with men (low-income, private houses) Mahalla 2 (Mirzodgon Siringonov jamoat, Sokhcharv village, not connected, remotely located from the water source): 1 FGD with women (low-income, private houses); 1 FGD with men (low-income private houses)	7
TOTAL	14	6	18	38
Key Informant Interviews				
Dushanbe	1. Local government 2. Local leader 3. Supplier	—	—	3
DRS	—	1. Local government 2. Local leader 3. Supplier 4. Social building	1. Local government 2. Local leader	6
Khatlon	1. Local leader 2. Supplier 3. Social building (clinic)	1. Local government 2. Supplier	1. Local leader 2. Social building (clinic)	7

table continues next page

Table A.12: Continued

Region	Regional center	District center	Rural village	Total
Sughd	1. Local government 2. Supplier 3. Social building (clinic)	1. Local government 2. Local leader 3. Supplier	1. Local leader 2. Supplier	8
GBAO	1. Local government 2. Supplier 3. Local leader	—	1. Local government 2. Supplier 3. Social building (clinic)	6
TOTAL	12	9	9	30
Mini Case Studies				
Dushanbe	1. Low-income household 2. Social building (hospital)	—	—	2
DRS	—	Low-income household	Social building (school)	2
Khatlon	—	Social building (school)	Low-income household	2
Sughd	—	Low-income household	Social building (school)	2
GBAO	Social building (school)	—	Low-income household	2
Total	3 (1 with low-income households and 2 with social buildings)	3 (2 low-income household and 1 social building)	4 (2 low-income households and 2 social buildings)	10

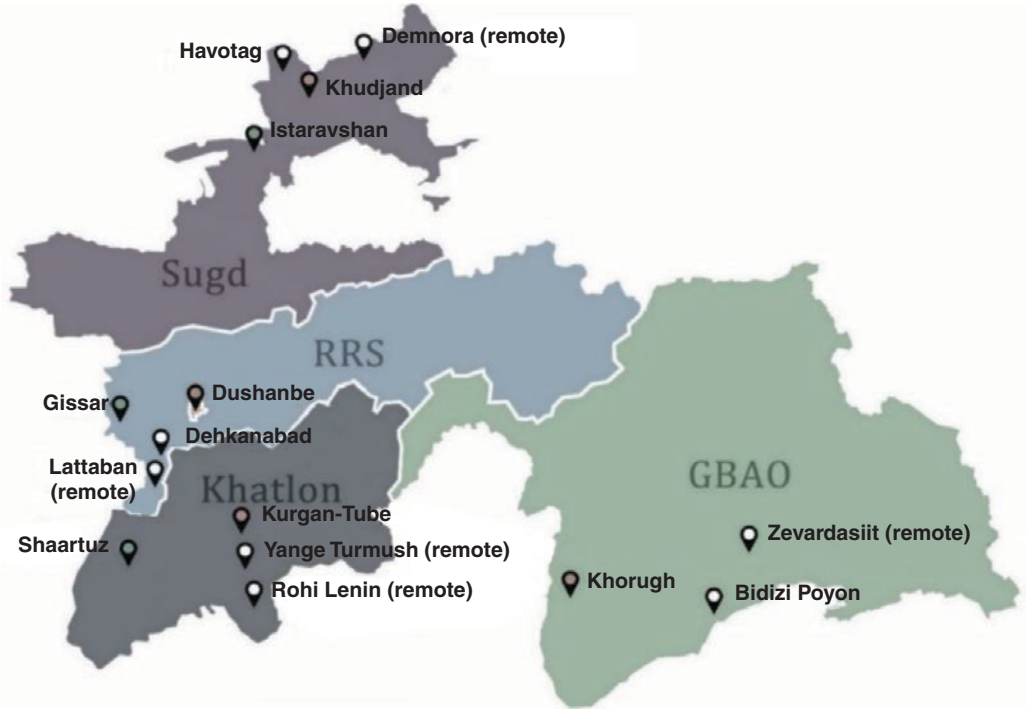
Source: World Bank team.
Note: Jamoats are third-level administrative divisions. DRS = Districts of Republican Subordination; FGD = focus group discussion; GBAO = Gorno-Badakhshan Autonomous Oblast; — = not available.

Qualitative Data: Focus Groups, Key Informants, and Mini Case Studies

The qualitative data were gathered from oblast (region) centers, raion (district) centers, and rural villages in each of Tajikistan's five regions. Fifteen research sites were covered (map A.1). Raion centers with a high or a low percentage of households connected to a centralized piped water system were selected for the study. Rural villages that were close as well as those that were far ("remote") from a water source were selected. While the qualitative data sources are not statistically representative of the country, they provide information from a diverse and contrasting sample of households that can help explain how WASH service conditions are experienced by different population groups. They are also useful to document consumer experiences and to answer "why" questions and can help explain the trends that emerge from the statistical data that exist through the quantitative household surveys.

Four core research questions guided the qualitative data collection: (i) What is the availability and condition of water supply, sanitation, and hygiene services in different regions? (ii) What types of costs are being incurred and how are different groups coping with poor service? (iii) What other factors have a bearing on service quality and interaction with service providers? (iv) What changes do consumers want to see and how are they willing to contribute? Analysis focused on a range of comparisons such as: Are some sites (such as rural areas) more likely to have poor service than others? Do some households (such as poor households) incur larger costs than others? Are some household members- (such as women and children) disproportionately affected? Do various groups' priorities for improvements differ? Are there differences in the perception of the quality of the service and direction of change among consumers, suppliers, and local utility firm/ government officials /leaders?

Map A.1: Location of Research Sites for Focus Group Discussions and Key Informant Interviews



Source: World Bank team.

Separate focus group discussions (FGDs) were held with low-income and middle-income households, men and women, and residents in apartments and private houses. A local research firm (Centre for Sociological Research, Zerkalo Analytics) gathered the qualitative data between November 1 and December 25, 2015. Group discussions and interviews were conducted in local languages (Tajik, Uzbek, and Russian) and were based on the field discussion guides prepared by the World Bank team. In total, 287 individuals participated in FGDs conducted for the study.

Within each region, for all settlement types (region center, district center, and rural village), two mahalla (neighborhoods) were sampled for focus group discussions. *One* mahalla was connected to the piped water and the other was not connected to the piped water. The selected mahallas identified low-income focus group participants or middle-income focus group participants, based on the series of primary and secondary indicators (table A.12).

Case Studies of Stand-alone WASH Schemes

The case studies reviewed the design of eight selected schemes with respect to six focus areas: (i) institutional arrangements; (ii) quality of WASH service conditions (including continuity of service, water pressure, water quality, cleanliness of latrines, and safe emptying of latrines); (ii) affordability of initial connection costs as well as recurrent fees for different income groups; (iv) aspects of legality in terms of asset ownership, as well as responsibilities for operations and maintenance of schemes; (v) cost recovery of the investment (contribution to capital costs and tariff payment for water use); and (vi) level of consumers and community engagement in decision making and ownership (table A.13).

Table A.13: Structure of Key Research Questions and Methodological Tools

Areas of focus	Questions
Institutional arrangements	What was the availability and quality of water and sanitation services (WSS) services and centralized infrastructure before the project was started? How was the design of the scheme developed? What is the effect of design on the quality of the service? Who are the project beneficiaries and stakeholders? Who is the current service provider? What national level agencies or policies do the schemes operate under? How has the project impacted the community (socially, economically, environmentally)?
Quality of service	Do consumers receive water in substantial quantities (pressure, disruption of services)? What are the frequencies and causes for disruptions? Do consumers receive water in satisfactory quality? Are there any health risks related to the water? Was the general practice of cleaning or emptying latrines affected by the scheme? (For example, are people observed to clean toilets more frequently if they have access to greater availability of water?)
Affordability	What costs do consumers have in relation to the scheme (fees, maintenance, repair, and so on)? How was the amount calculated? Is the payment affordable for all consumers? How are consumers billed and how do they pay their bills? What happens when consumers are late to pay the bill? Are there any subsidies?
Legality	Who is legally responsible for the provision of drinking water in the area? What are the legal responsibilities and liabilities of service providers? What legal agreements exist between different parties? How are parties kept accountable? Who legally owns the scheme (land, infrastructure, equipment)? Were there any ownership transitions since the scheme was implemented? Were there any legal conflicts?
Cost recovery	Where do funds to build the system come from? Did the funding cover project costs; and if not, how were more funds raised? Is the scheme currently financially independent from the donor? What are financial challenges of the project? What are the revenues and expenses for each stage of the project (design, construction, operation, maintenance)? What is the tax structure? Were there any changes in the fee for consumers? How did these changes affect the consumers and supplier?
Consumer and community engagement	How were the community members involved in each stage of the project implementation? How can consumers complain on the quality of the service? How does the service provider address the complaints?

Source: World Bank team.

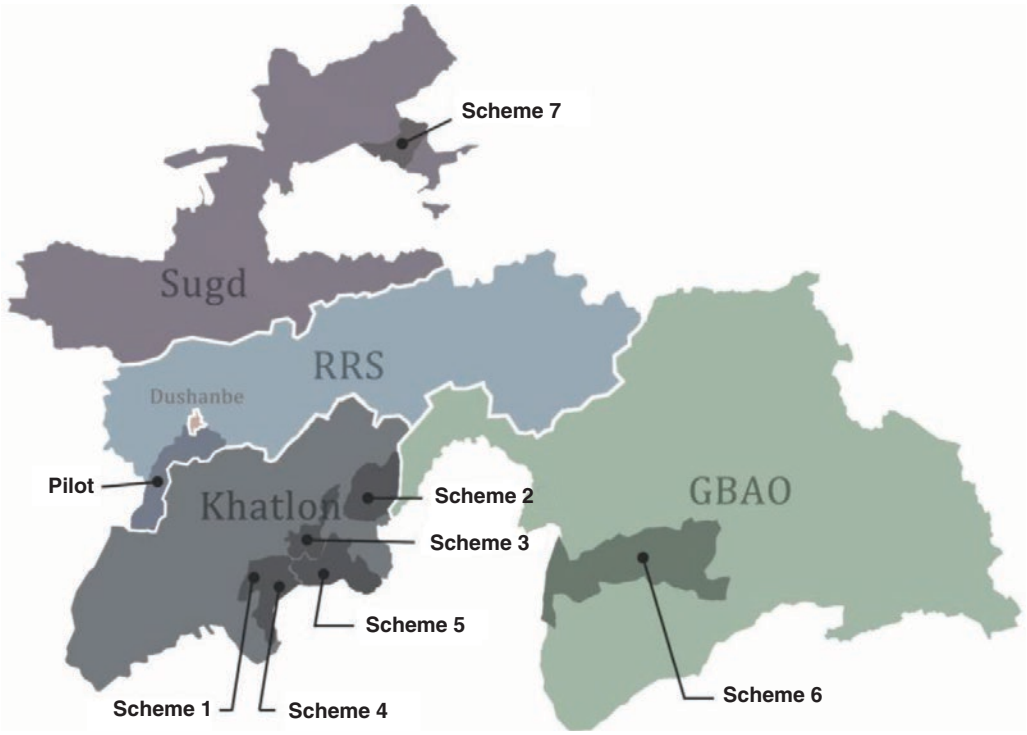
The water supply schemes were selected based on geographic coverage, prime water source, availability of both water and sanitation components, and investment costs. The qualitative data were collected from various stakeholders, including: service providers, local government officials, community leaders as well as representatives of social buildings and businesses through Key Informant Interviews (KII); and WASH service consumers through

Focus Group Discussions (FGDs). The study covered four out of five regions of Tajikistan. The sampling included a combination of spring and borehole source drinking water supply systems to identify how the main water source affects per capita investments, the management model, the coverage of services, and further scalability or replicability of the schemes. The selected schemes included large-, medium-, and small-scale investments and cost schemes (map A.2, table A.14).

The field visits were conducted from July to December 2016. For each scheme, two separate FGDs were conducted for male and female representatives at household level. Six KIIs were conducted for service providers, community leaders, representative of social building and business, and district-level representatives (at the village/town level), and for government representatives at the district level (SES, SUE KMK, Vodokanal, and so on). The interviews included a tour of all main parts of the scheme (source, pump station, purification facility, office, and so on). One pilot case study had been carried out before the team began the data collection to field test and finalize methodological tools but was not included in the data analysis carried out for the seven case studies.

The case studies are subject to a number of limitations. Key documents were not available for the review in most cases, including, but not limited to, documentation on land use rights, results of SES inspections, and ownership transitions (from former collective farms to jamoats[1] or from donors to service providers). The lack of documents made it difficult to conduct a comprehensive assessment of ownership transition processes, asset ownership validity, and mandated responsibilities of communities, service providers, and local authorities for the operation and maintenance of the water supply schemes. A lack of proper record-keeping was prevalent across most schemes. Therefore, the number of consumers, magnitude of water

Map A.2: Location of the Schemes Selected for Case Studies



Source: World Bank team.

Table A.14: Characteristics of the Schemes Selected for Case Studies

Scheme ID	Investment size[a]	Region	Date construction was completed	Number of beneficiary households	Total population	Main water source	Sanitation component (yes/no)	Type of connections	Meter coverage
Pilot	Medium	DRS	2013	181	1,249	Spring	No	Public taps	None
1	Low	Khatlon	2007	550	5,000	Borehole	No	Direct connections and public taps	Partial
2	Medium	Khatlon	2012	75	627	Borehole	No	Direct connections	Universal
3	High	Khatlon	2016	3,258	23,191	Borehole	Yes	Direct connections and public taps	Partial
4	High	Khatlon	2016	1,842	11,842	Borehole	Yes	Direct connections and public taps	Partial
5	High	Khatlon	2013	3,401	17,734	Borehole	No	Direct connections and public taps	Partial
6	Medium	GBAO	2015	304	1,503	Spring/ Borehole	No	Direct connections	Universal
7	**High**	**Sughd**	**2010**	4,**500**	**32,000**	**Borehole**	**No**	Direct connections and public taps	Partial

Source: World Bank team.
Note: a. Low < 100,000; Medium = $100,000-$200,000; High >$200,000.

losses, tariff collection, and water consumption and demand were not documented properly. The choice of conducting FGDs with consumers permitted a general understanding of consumers' experiences with each scheme. However, the data are not statistically representative and the findings do not lend themselves to further disaggregation or comparative analyses by geographic region or location.

Note

1. Jamoats are third-level administrative divisions, similar to communes or municipalities.

References

Bedi, T., Coudouel, A., & Simler, K. (Eds.). 2007. *More than a pretty picture: using poverty maps to design better policies and interventions*. World Bank, Washington, D.C.

Elbers, C., Lanjouw, J. O., & Lanjouw, P. 2003. "Micro–level estimation of poverty and inequality". *Econometrica*, 71(1), 355–364.

Appendix B
Multi-Tier Service Levels and SDG Definitions of WASH

Table B.1: Multi-Tier Matrix for Household Water Supply Access

Dimensions			Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Access	Type of drinking water source		Surface water and/ or unimproved water	Improved water[a]	Basic drinking water (MDG improved)[a]		Piped water	
	Time to source				Within 30 minutes roundtrip from home	On premises		Inside the dwelling
Quality						Not more than[b]: - *E. coli* (0/100 ml)	Not more than[b]: - *E. coli* (0/100 ml) - Fluoride (1.5 mg/ liter) - Arsenic (0.01 mg/ liter)	Guideline values for naturally occurring chemicals that are of health significance in drinking-water[a,c] Not more than: - *E. coli* (0 per 100 ml of water year round)[c] - Fluoride (<1.5 mg/liter) - Arsenic (<0.01 mg/liter) - Barium (0.7 mg/liter) -Boron (2.4 mg/liter) -Chromium (0.05 mg/liter) -Selenium (0.04 mg/liter) -Uranium (0.03 mg/liter) -Microcystin (LR 0.001 mg/ liter)
Availability	Continuity	Days/ week			Available at least 3 days/week	Not interrupted for a full day in the past 2 weeks	Available 7 days/week	
		Hours/ day					24 hours a day[e]	
	Quantity 2, 3 (liters per capita per day)						At least 50 l/c/d	At least 100 l/c/d

table continues next page

Table B.1: Continued

Dimensions		Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Affordability						Financial expenditure on water supply, sanitation and hygiene of households in the bottom 40 percent as a percentage of their income[f]	
Accountability	Management of service					Individuals know who they are paying for services	Individuals are satisfied with service AND know who to interact with to address grievances. (That is, have the households made any complaints in the past 1 year? If so, to whom?)
	Intra-household decision making					Women participate equally in making decisions on payment for services (measured by % of households where women make the decision to pay for water services)	
Sustainability							
Financial sustainability						Operating expense ratio should be equal to 1 (that is, the service provider is able to recover all operating costs)	
Institutional sustainability						TBD	TBD

table continues next page

Table B.1: Continued

Dimensions	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Water security Sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development; for ensuring protection against water-borne pollution and water-related disasters; and for preserving ecosystems in a climate of peace and political stability[g]					EITHER ratio of water production (lpcpd) to total water consumption (lpcpd) OR per capita renewable water resources[h]	

Highest standard of dimension attainable | Second highest standard of dimension | Lowest standard of dimension | No standard set for dimension

Source: World Bank team.
Note: a. Piped drinking water supply on premises; public taps/standposts; tubewell/ borehole; protected dug well; protected spring; rainwater. Packaged water is considered improved if households use an improved water facility for other domestic purposes.
b. JMP 2014. c. WHO 2011. d. Howard and Bartram 2003. e. Based on data from Sub-Saharan Africa that suggests achieving 50 lpcd requires 24-hour supply (Torres 2013). f. The definition as per the JMP Green Paper is "percentage of population in the poorest quintile whose financial expenditure on water supply, sanitation, and hygiene is below 3% of the national poverty line (disaggregated by rural and urban)," but it has not been operationalized JMP 2015). g. UN-Water 2013. h. JMP 2013.

Table B.2: Multi-Tier Matrix for Household Sanitation Access

Dimensions		Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Access	Type of sanitation	Open defecation and/or unimproved	Use of improved latrine[a] structure	SDG "basic": use of an improved latrine that is not shared beyond the household	SDG "safely managed": Use of an improved latrine that is not shared beyond the household, and safe management and disposal of human urine and feces on site or safe transport and treatment off-site		
	Child feces disposal		Child feces put/ rinsed into latrine OR child used latrine (regardless of whether households used improved or unimproved sanitation facilities)	Child feces put/ rinsed in latrine OR child used latrine AND households have basic sanitation	Child feces put/rinsed in latrine OR child used latrine AND household has safely managed sanitation		
	Handwashing				Availability of a place of handwashing with soap and water present at home		
	Menstrual hygiene management				Household access to suitable facilities (space, privacy, water, soap) and materials for menstrual hygiene		
Affordability						Financial expenditure on water supply, sanitation and hygiene of households in the bottom 40 percent as a percentage of their income[c]	

table continues next page

Table B.2: Continued

Dimensions		Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Accountability	Management of services					Individuals know who they are paying for services	Individuals are satisfied with service AND know who to interact with to address grievances. (That is, have the households made any complaints in the past month? To whom?)
	Intra-household decision making					Women participate equally in making decisions on payment for services (measured by % of households where women make the decision to pay for water services)	
Conveyancec_3						Manual emptying of pit latrine or septic tank[d]	Mechanical emptying of pit latrine or septic tank[d]
Treatment of sludge and effluent[e]						Hygienically safe treatment of black water, brown water, grey water, or effluent AND treatment of sludge	
Use and/or disposal[e]						Safe use/disposal of effluents and sludge after treatment	

Highest standard of dimension attainable | Second highest standard of dimension | Lowest standard of dimension | No standard set for dimension

Source: World Bank team.
Note: a. Flush toilet connected to a septic tank or a sewer (small bore or conventional); a pit latrine with a superstructure, and a platform or squatting slab constructed of durable material. A variety of latrine types can fall under this category, including composting latrines, pour-flush latrines, and ventilation improved pit latrines (VIPs). b. JMP 2015. c. The definition as per the JMP Green Paper is "percentage of population in the poorest quintile whose financial expenditure on water supply, sanitation and hygiene is below 3% of the national poverty line (disaggregated by rural and urban). This standard, however, has not been operationalized (JMP 2015). d. The JMP is currently piloting the questions for potential inclusion in future international household surveys. e. Tilley et al. 2014.

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Appendix C
Joint Monitoring Programme (JMP) Definitions of Improved and Unimproved Services

"Improved" sources of drinking-water

- *Piped water into dwelling* (also called a *household connection*) is defined as a water service pipe connected with in-house plumbing to one or more taps (for instance, in the kitchen and bathroom).

- *Piped water to yard/plot* (also called a *yard connection*) is defined as a piped water connection to a tap placed in the yard or plot outside the house.

- *Public tap or standpipe* is a public water point from which people can collect water. A standpipe is also known as a public fountain or public tap. Public standpipes can have one or more taps and are typically made of brickwork, masonry, or concrete.

- *Tubewell or borehole* is a deep hole that has been driven, bored, or drilled with the purpose of reaching groundwater supplies. Boreholes/tubewells are constructed with casing, or pipes, which prevent the small diameter hole from caving in and protect the water source from infiltration by run-off water. Water is delivered from a tubewell or borehole through a pump, which may be powered by human, animal, wind, electric, diesel, or solar means. Boreholes/tubewells are usually protected by a platform around the well, which leads spilled water away from the borehole and prevents infiltration of run-off water at the well head.

- *Protected dug well* is a dug well that is protected from runoff water by a well lining or casing that is raised above ground level and a platform that diverts spilled water away from the well. A protected dug well is also covered, so that bird droppings and animals cannot fall into the well.

- *Protected spring* is a spring typically protected from runoff, bird droppings, and animals by a "spring box" that is constructed of brick, masonry, or concrete and is built around the spring so that water flows directly out of the box into a pipe or cistern, without being exposed to outside pollution.

- *Rainwater* refers to rain that is collected or harvested from surfaces (by roof or ground catchment) and stored in a container, tank, or cistern until used.

"Improved" sanitation

- *Flush toilet* uses a cistern or holding tank for flushing water, and a water seal (which is a U-shaped pipe below the seat or squatting pan) that prevents the passage of flies and odors. A *pour flush toilet* uses a water seal, but unlike a flush toilet, a pour flush toilet uses water poured by hand for flushing (no cistern is used).

- *Piped sewer system* is a system of sewer pipes (also called *sewerage*) that is designed to collect human excreta (feces and urine) and wastewater and remove them from the household environment. Sewerage systems consist of facilities for collection, pumping, treating, and disposing of human excreta and wastewater.

- *Septic tank* is an excreta collection device consisting of a water-tight settling tank, which is normally located underground, away from the house or toilet. The treated effluent of a septic tank usually seeps into the ground through a leaching pit. It can also be discharged into a sewerage system.

- *Flush/pour flush to pit latrine* refers to a system that flushes excreta to a hole in the ground or leaching pit (protected, covered).

- *Ventilated improved pit latrine* (VIP) is a dry pit latrine ventilated by a pipe that extends above the latrine roof. The open end of the vent pipe is covered with gauze mesh or fly-proof netting and the inside of the superstructure is kept dark.

- *Pit latrine with slab* is a dry pit latrine whereby the pit is fully covered by a slab or platform that is fitted either with a squatting hole or seat. The platform should be solid and can be made of any type of material (concrete, logs with earth or mud, cement, and the like) as long as it adequately covers the pit without exposing the pit content, other than through the squatting hole or seat.

- *Composting toilet* is a dry toilet into which carbon-rich material (vegetable wastes, straw, grass, sawdust, ash) are added to the excreta and special conditions maintained to produce inoffensive compost. A composting latrine may or may not have a urine separation device.

- *Special case*. A response of "flush/pour flush to unknown place/not sure/don't know where" is taken to indicate that the household sanitation facility is improved, as respondents might not know if their toilet is connected to a sewer or septic tank.

"Unimproved" sanitation

- *Flush/pour flush to elsewhere* refers to excreta being deposited in or nearby the household environment (not into a pit, septic tank, or sewer). Excreta may be flushed to the street, yard/plot, open sewer, a ditch, a drainage way, or other location.

- *Pit latrine without slab* uses a hole in the ground for excreta collection and does not have a squatting slab, platform, or seat. An open pit is a rudimentary hole.

- *Bucket* refers to the use of a bucket or other container for the retention of feces (and sometimes urine and anal cleaning material), which are periodically removed for treatment, disposal, or use as fertilizer.

- *Hanging toilet or hanging latrine* refers to buckets or similar latrines.

- *No facilities or bush or field* includes defecation in the bush or field or ditch; excreta deposited on the ground and covered with a layer of earth; excreta wrapped and thrown into garbage; and defecation into surface water (drainage channel, beach, river, stream or sea).

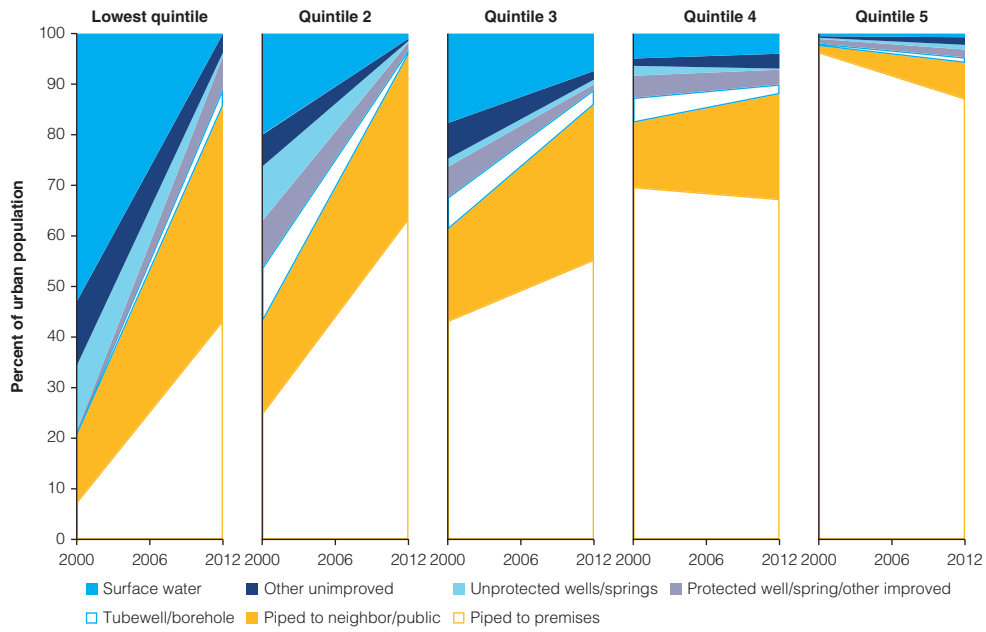
Appendix D
WASH Trends Based on Secondary Data

The figures that follow present trends in access to WASH, based on the methodology used by the UNICEF/WHO Joint Monitoring Program (JMP), disaggregated by wealth category.

In all water trend figures:

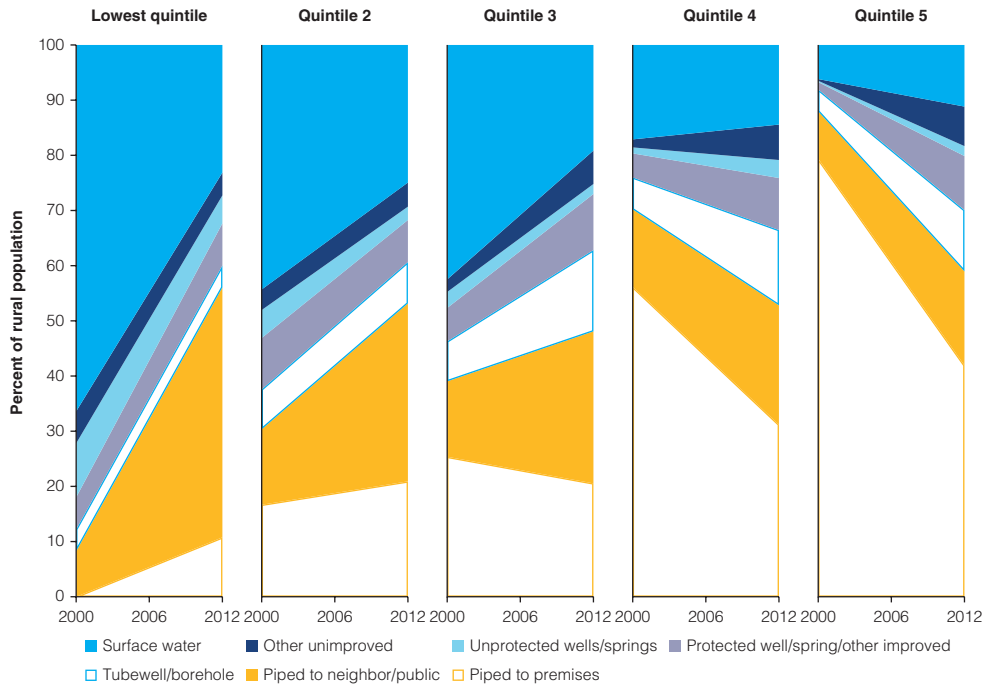
- *Piped to premises"*includes original survey response categories "piped into dwelling" and "piped to yard/plot."
- *Piped to neighbor/public* includes original survey response categories "public tap/ standpipe."
- *Tubewell/borehole* includes original response category "tubewell/borehole with pump."
- *Protected well/spring/other improved* includes original survey response categories "protected dug well" and "protected spring."
- *Rainwater* includes "rainwater collection."
- *Unprotected well/spring* includes original survey response categories "unprotected well" and "unprotected spring."
- *Tanker/cart* includes "tanker-truck/vendor" and "cart with small tank/drum."
- *Other unimproved* includes original survey response categories "other," "missing," "99," and "no answer or do not know." "Tanker/cart" was also grouped with "other unimproved."
- *Surface water* includes original survey response categories "surface water," "pond, river or stream," and "river, dam, lake, ponds, stream, canal, irrigation."
- The categories "*bottled water*" and "*rainwater*" represented less than 10 percent of the population in all quintiles and were grouped with "protected well/spring/other improved."

Figure D.1: Percentage of Urban Population by Type of Drinking Water Source, by Wealth Index Quintile, 2000–12



Source: World Bank team calculations based on MICS 2000, MICS 2005, and DHS 2012 survey datasets for Tajikistan.
Note: There were fewer than 25 unweighted cases in the lowest quintile in the MICS 2000 dataset. There were fewer than 49 unweighted cases in the following: lowest quintile in MICS 2005, lowest quintile in DHS 2012, and quintile 2 in MICS 2000. These components should be interpreted with additional care since they are based on fewer cases than the usual threshold for analysis of 50 unweighted cases. DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey.

Figure D.2: Percentage of Rural Population by Type of Drinking Water Source, by Wealth Index Quintile, 2000–12

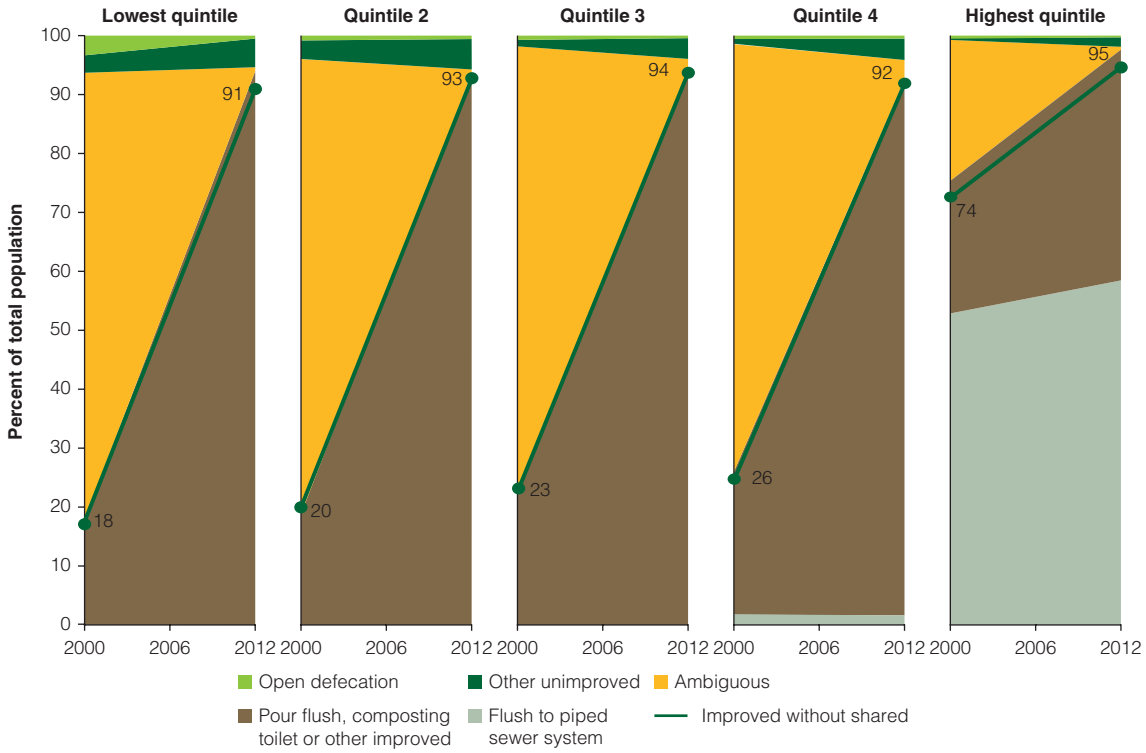


Source: World Bank team calculations based on MICS 2000, MICS 2005, and DHS 2012 survey datasets for Tajikistan.
Note: DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey.

In all sanitation trend figures:

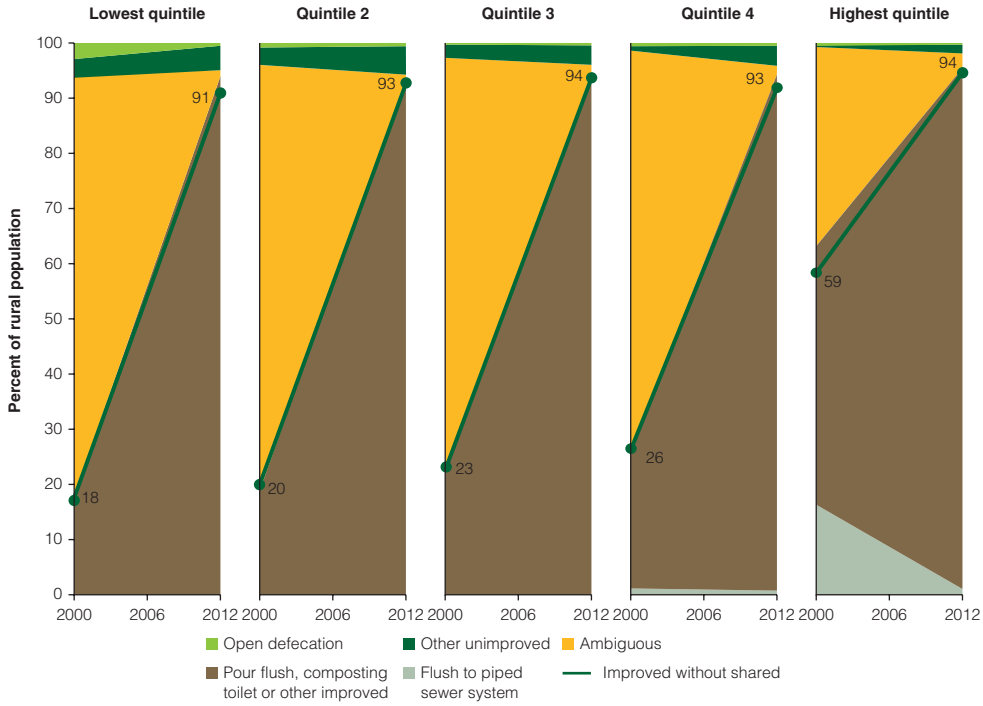
- *Flush to piped sewer system* includes original survey response categories "flush to sewage system or septic tank."
- *Flush to pit, septic tank or to unknown place* includes original survey response categories "flush to septic tank," "flush to pit (latrine)," and "flush to unknown place/not sure/don't know where."
- *Pour flush, composting toilet or other improved* includes original survey response categories "pour flush latrine," "pit latrine with slab," "ventilated improved pit," and "composting toilet."
- *Ambiguous* includes original survey response categories "traditional pit latrine" and "open pit."
- "*Bucket/Hanging toilet*" includes original survey response categories "bucket" and "river."
- *Other unimproved* includes original survey response categories "pit latrine without slab/open pit," "flush to somewhere else," "other," "99," and "missing."
- *Open defecation* includes "no facilities or bush or field."
- "*Flush to pit, septic tank or to unknown place*" represented less than 10 percent of the population in all disaggregated analyses and was thus grouped with "pour flush, composting toilet, or other improved."

Figure D.3: Percentage of the Population by Type of Sanitation Facility, by Wealth Index Quintile, 2000–12



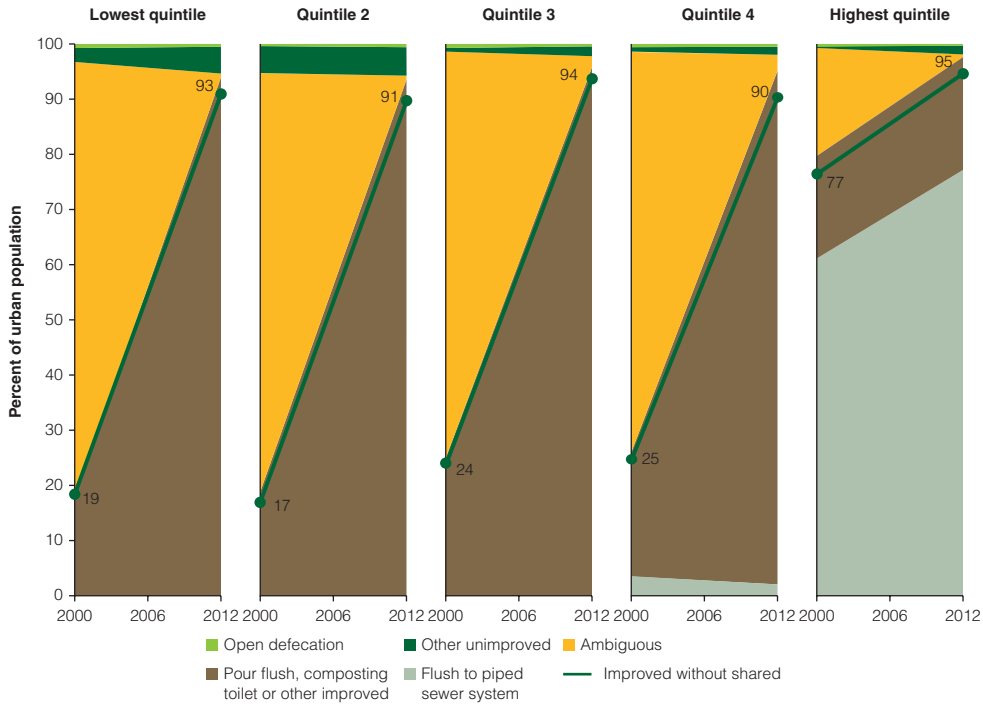
Source: World Bank team calculations based on MICS 2000, MICS 2005, and DHS 2012 survey datasets for Tajikistan.
Note: The data points from 2005 to 2012, the resulting linear regression, and the fact that the proportion using "other unimproved" does not change drastically over time, all suggest that in all data cuts shown here, the majority of people in the "ambiguous" category in 2000 had improved sanitation. DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey.

Figure D.4: Percentage of Rural Population by Type of Sanitation Facility, by Wealth Index Quintile, 2000–12



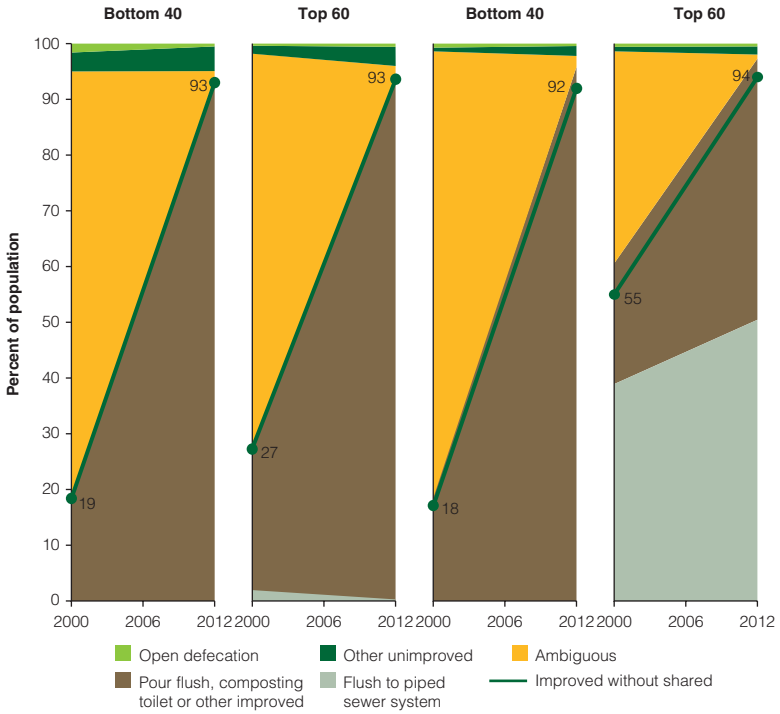
Source: World Bank team calculations based on MICS 2000, MICS 2005, and DHS 2012 survey datasets for Tajikistan.
Note: DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey.

Figure D.5: Percentage of Urban Population by Type of Sanitation Facility, by Wealth Index Quintile, 2000–12



Source: World Bank team calculations based on MICS 2000, MICS 2005, and DHS 2012 survey datasets for Tajikistan.
Note: There were fewer than 25 unweighted cases in lowest quintile and quintile 2 in MICS 2000. There were fewer than 49 unweighted cases in lowest quintile in MICS 2005 and lowest quintile in DHS 2012. These cases should be interpreted with additional care because they are based on fewer cases than the usual threshold for analysis of 50 unweighted cases. DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey.

Figure D.6: Percentage of the Bottom 40 and Top 60 by Type of Sanitation Facility, by Wealth Index Quintile, Rural and Urban, 2000–12



Source: World Bank team calculations based on MICS 2000, MICS 2005, and DHS 2012 survey datasets for Tajikistan.
Note: DHS = Demographic and Health Survey; MICS = Multiple Indicator Cluster Survey.

Only MICS 2000 had ambiguous survey response categories: "traditional pit latrine" and "open pit." The ambiguities were resolved into improved or unimproved categories by the time MICS 2005 and DHS 2012 were conducted, but seem to be resolved more gradually in the figures because of the linear regression estimation methodology. The pink ambiguous band represents some improved and some unimproved sanitation facilities, so the green trends alone do not represent the whole story of changes in access to improved in the period between 2005 and 2012. Similarly, the adjustment to indicate the proportion of the population using "shared" sanitation relies on the calculation of access to improved sanitation. Some people represented in "ambiguous" could be expected to use "shared," as well.

Appendix E
Water Quality Testing Methodology

For the water quality testing component of the household survey, the World Bank team developed a comprehensive water quality testing manual, which was used as the main source of guidance in training and data collection. Efforts were streamlined to ensure that the experimental procedure was well explained and well-practiced by the field team before commencing data collection efforts. To facilitate the learning process and ensure compatibility with the local language, two consultants with local experience were hired to lead the training for the larger field team.

Training

The initial training was led by the World Bank team and focused on training the local consultants, trainers, and field coordinators. The four-day training ensured that field coordinators were familiar with the instrumentation, understanding the basic theory behind each parameter test, practicing each procedure indoors for a number of times, and piloting the entire water quality testing fieldwork sequence in two households and a school. The training for the larger field team held with all the field enumerators, team leaders, and regional managers was then led by the two extensively trained consultants. These two individuals were also tasked with the responsibility of being the first points of contact within Tajikistan if any questions arose during the fieldwork.

Identification of Samples

Drinking water samples were collected at two sampling locations of interest: the point of consumption and the water source.

The point of consumption represented the quality of water just before ingestion. This was explained to households and schools as water that would be given to a child to drink. If the household or school usually gave children tea to drink as a fluid, the boiled water used to prepare the tea was tested instead. If the household did not have children, the household was asked to provide the water that would be hypothetically given if a child had visited.

The source water test was performed on the household's or school's main source of drinking water. These data represent the quality of drinking water provided by the government and/or the region's water service provider. Field enumerators were instructed to take the sample directly from the source themselves. For instance, if the water source is a neighborhood pipe, a sample was collected directly from the neighborhood pipe even if the household was in possession of a storage container filled with water from the same pipe. In certain instances, the source sample was difficult to acquire. Depending on the response of the household or school, the field team was trained to follow the instructions outlined in table E.1.

Data collection efforts varied depending on the type of source. The guidelines were used to determine the most appropriate course of action.

Table E.1: Instructions for Collecting Source Samples

Questionnaire response	Sampling instructions
Water source was not functional	There is damage to the source of drinking water and therefore the enumerator cannot access it. For example, the pipe is broken and the tap does not turn on. If the source is not functioning during the first visit, attempt a second visit if the problem can be fixed within three days. For example, if the pipe operates only during certain hours, a second trip should be attempted during its functional hours. If the source is not functioning during the first visit and is not expected to become functional within the next three days, mark "water source was not functional" and select a new household to perform the source test. If the water source is still not functioning on the second visit, mark "water source was not functional" and select a new household to perform the source test.
Water source too far	The source of drinking water is far from the household and it is not possible for the enumerator to reach it. If the trip back and forth from home to the source of drinking water source will take more than 30 minutes, then this answer is appropriate. Mark "water source too far" and select a new household to perform the source test.
Unable to access source	The source is inaccessible because of some physical impediment. For example, the water source may be enclosed by a fence that another person has locked, there is not enough daylight to allow sampling, or the physical condition of the place is unsafe or may jeopardize the safety of the enumerator. If the source becomes accessible within the next three days, attempt a second visit. If the source is not expected to become accessible within the next three days, mark "unable to access source" and select a new household to perform the source test. If the source is still inaccessible on a second visit, mark "unable to access source" and select a new household to perform the source test.
The respondent denied access	The household did not give permission to sample the source. Mark "the respondent denied access" and select a new household to perform the source test.
Do not know where source is located	The household does not know where the drinking water source is. Mark "do not know where the source is located" and select a new household to perform the source test.
Other (specify)	For example, the household does not allow the enumerator to take the sample. If, for any reason, a source test was not conducted at the selected household, a new household needs to be selected to perform the source test.

Source: World Bank team.

Aseptic Controls and Checks

Many precautions were exercised to prevent accidental contamination of the sample collected during the field work. Enumerators were trained to always wash their hands with soap or to use the supplied hand sanitizer prior to the start of each water quality testing sequence. Individuals were also taught to avoid touching the sampled water, the insides of the *E. coli* MUG bottles, Whirl-Pak bags, test tubes, and any powder reagents. Prior to the use of each probe and test tube, 95 percent isopropyl alcohol was used to disinfect the sensor and measurement cap. This was followed by the use of distilled water to remove any remaining contaminants. A similar procedure was also exercised after the use of each equipment for each tested sample.

Table E.2: Instructions for Measuring Source Samples

Source	Course of action
Faucet, spigot, hydrant or pump	1. Do not remove any screens or aerators. 2. Let the water flow at a moderate rate for 30 seconds. Explain to the household that water that has been sitting inside the pipes may have extra metal in it. Therefore, we want to run the water to see what the water quality is like when it reaches the household. Do not adjust the flow rate while collecting the sample. 3. Fill Whirl-Pak bag until indicated line.
River, lake, or reservoir	1. Push the beaker (open face down) into the water to prevent the collection of surface scum. 2. Do not sample near the edge or bank. Reach as far as you comfortably can toward the middle of the water surface to collect the sample. 3. Face the open beaker in the direction of the current. If water is not flowing, tilt the bottle slightly to allow it to fill slowly. Do not rinse. 4. Fill the beaker entirely under water.
Rain water or water truck	1. Only in these particular cases, the sample can be taken from containers, packages, or temporary storage. If the water is accessible via a tap from the storage container, use the tap to collect water. If not, ask the household to pour water from these storage containers slowly into the Whirl-Pak directly. Do not insert the beaker into the storage container; this may contaminate the household's source of water.
Bottled/packaged water	1. Uncap the water bottle 2. Prepare the Whirl-Pak bags as described in the instructions. 3. Pour the water from the water bottle into the Whirl-Pak bag without touching the sample.

Source: World Bank team.

To verify the practice of these aseptic techniques, a blank test was conducted at the beginning of each week of fieldwork. Every seven days, the team leader performed each parameter test on a bottle of purified water. This test was conducted near the field team's support vehicle where it was parked. The results of this test were recorded in a separate questionnaire, developed solely for the purposes of verifying the field procedures. If the MUG broth used to detect the presence/absence of *E. coli* changed in color, even slightly, the team leader was to report the result to the regional supervisor and reread the entire water quality manual to refresh his/her knowledge of proper testing procedures.

Limitations

The length of the two-month study, compounded by the lack of laboratory facilities and technologies in rural areas, were quite restricting in the type of water quality testing that could be performed. These limitations greatly encouraged the use of straightforward testing instruments and procedures that required minimum analytical experience. The lack of a constant supply of electricity also required creativity in using an alternating battery system to ensure an uninterrupted incubation period of 24 hours. Complications with equipment delivery, including an incomplete shipment of resources, reduced the number of expected samples. Corrective sampling measures were taken to ensure that the data remained statistically representative.

Parameters

The parameters of interest in this study were pH, total dissolved solids (TDS), free chlorine, total chlorine, nitrate levels, and the presence or absence of *Escherichia coli* (*E. coli*). Each of these microbiological, physical, and chemical parameters provide evidence-based insights into the quality of drinking water across Tajikistan.

- **pH:** pH values are indicators of the concentration [mol/L] of active hydrogen (H^+) ions in a solution. Accepted values for pH range from 0 to 14. According to the World Health Organization (WHO), the pH of drinking water should be kept between 6.5 and 8.5 as an optimal operating range (WHO 2017a). A Pocket Pal™ pH tester from Hach Company was used to collect all pH measurements in the field. The instrument consists of an electrode system, composed of a reference half-cell and a glass sensing half-cell. Prior to fieldwork, this instrument was calibrated against buffer solutions to standardize the pH readings. These calibrations were conducted by the same individual in a constant environment, ensuring limited variability between the baseline settings. Although pH interpretations are dependent on temperature, Hach's instrumentation designs minimize temperature effects in pH probe measurements. This maximizes comparability between data values collected at different temperatures.

- **Total dissolved solids:** Total dissolved solids (TDS) refer to any inorganic salts and select amounts of organic matter that are dissolved in water. A Pocket PalTM TDS tester from Hach Company was used to collect field measurements of water conductivity. Conductivity is defined as a solution's ability to transport electric charge. It is important to note that conductivity is only an indicator of the TDS levels in water because the exact relationship between these two parameters is dependent on the type of water as well as the nature of the dissolved negatively charged anions and positively charged cations (WHO 1996, 2017a).

- **Chlorine:** Chlorine is often used as a disinfecting agent when treating drinking water. Total chlorine is the remaining chlorine concentration after the initial binding of chlorine to organic materials and metals in the water. Total chlorine is further classified into combined chlorine and free (residual) chlorine. In this study, n, n-diethyl-p-phenylenediamine (DPD) was used as a chemical reagent to measure the concentration of free and total chlorine in drinking water. In the presence of chlorine, DPD undergoes an oxidoreduction reaction to produce a magenta color. The intensity of the magenta color is directly correlated with the amount of chlorine present in the sample. The DPD Free Chlorine Reagent Powder Pillow from Hach Company was added to a test tube filled with sampled drinking water. A second, control test tube was filled with sampled drinking water, without the DPD and buffer. The test tube containing the DPD was agitated for thirty seconds, permitted to react for one minute, and compared to the control test tube using a color comparator box to determine the concentration of free chlorine in the sample. A similar procedure was followed to determine the concentration of total chlorine. However, the DPD Total Chlorine Reagent Power Pillow from Hach was used instead. This reagent contained potassium iodide, in addition to the DPD and buffer. Two new sample test tubes were used to measure the concentration of total chlorine in drinking water. In this second test, the test tube containing the DPD was agitated for one minute, permitted to react for three minutes, and compared to the control test tube using the same color comparator box.

- **Nitrate:** The Nitrate Test Kit from Hach Company was utilized in measuring the concentrations of nitrates in drinking water. This method is a modification of the more commonly known Cadmium Reduction Method. NitraVer 5 Nitrate Reagent Powder Pillows, consisting of cadmium metal, sulfanilic acid, gentisic acid, and other necessary

reagents, were used to facilitate a series of chemical reactions between the reagent contents and the nitrates (NO3-) present in the water sample. The completion of this sequence of chemical reactions ultimately led to an amber-colored product. The intensity of the solution was directly indicative of the concentration of nitrates present in the drinking water sample. The reagent pillow was added to a test tube filled with sampled drinking water. A second, control test tube was filled only with sampled drinking water. The test tube containing the chemical reagents was agitated for one minute, permitted to react for five minutes, and compared to the control test tube using a color comparator box to determine the concentration of nitrates in the sample. Three separate readings were recorded, each taken one minute after the previous measurement.

- ***E. coli:*** Testing for *E. coli* is one of the most important practices in determining the presence of fecal contamination and/or other parasites, viruses, and harmful microorganisms. The WHO guidelines for drinking water stipulate that "*E. coli* must not be detectable in any 100-milliliter sample" (WHO 2017a). Within the practices of this study, the presence or absence of *E. coli* was determined using a presence/absence (P/A) Broth with MUG from Hach Company. The broth contained a beta-glucuronidase chemical substrate called beta-methylumbelliferyl beta-D-glucuoronide (MUG) that fluoresces upon reacting with *E. coli* if the bacteria is present. This fluorescent dye was observed using an ultraviolet (UV) lamp. Since this procedure required a sample incubation period of 24 hours at 35°C, the samples of drinking water were transported using Whirl-Pak bags containing sterilized sodium thiosulfate. Sodium thiosulfate is a dechlorinating agent, responsible for removing any residual chlorine present in the collected sample. Removing any residual chlorine was a critical step to preserving the integrity of the sample. Any traces of *E. coli* could be detected only in the absence of a disinfectant (residual chlorine). The Whirl-Pak bags were stored on ice packs in a cooler. Within 8 hours of sample collection, they were transferred to bottles containing the MUG broth for incubation. This transfer step was performed at the nearest chemical laboratory owned by the Sanitary Epidemiological Services (SES). Hach's 12V DC Portable Incubator was used to facilitate the 24-hour incubation period. To ensure a constant supply of electricity, the portable incubator was connected to a 75A battery. Concurrently, a second 75A battery was being charged by a 60A battery charger. The battery connected to the portable incubator was switched every 12 hours to support a constant incubation process.

Table E.3: Parameter Values for Water Quality Tests, by National and WHO Guidelines

Physical and chemical significance	Public health significance	Accepted levels in drinking water per national standards[a,b]	Accepted levels in drinking water per WHO guidelinesc
pH			
Mathematically, the pH scale follows a logarithmic model and is defined as the following, $pH = -log_{10}H^{+}$ Given its logarithmic nature, an increase in one pH unit is equivalent to a 10-fold increase in the concentration of H+ ions in solution. When the pH and pOH levels are equal (pH = pOH = 7), the solution is neutral. Solutions with pH values below 7 are classified as acidic while solutions with pH values above 7 are classified as basic.	Acidic effects • Corrosion of metallic pipes • Damage to system piping • Leaching of metal ions such as iron, manganese, copper, lead • Increased aquatic toxicity of drinking water • Metallic or sour taste in drinking water Basic effects • No significant health risks • “Chalky” taste • Formation of precipitates on system piping, fixtures, and laundry basins • Decreased water pressures, interior pipe diameters, and efficiency of electric water heaters	**6–9**	No health-based guideline is proposed. Optimum pH required for operation: **6.5–8.5**

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Table E.3: Continued

Physical and chemical significance	Public health significance	Accepted levels in drinking water per national standards[a,b]	Accepted levels in drinking water per WHO guidelinesc
Total dissolved solids (TDS)			
Total dissolved solids (TDS) refer to any inorganic salts and select amounts of organic matter that are dissolved in water. Inorganic salts of particular interest include, but are not limited to: • Calcium • Magnesium • Potassium • Sodium • Bicarbonates • Hydrogencarbonate • Chlorides • Nitrates • Sulfates The accumulation of dissolved solids in water can be attributed to • Sewage • Agricultural run-off • Treatment chemicals • System piping • Plumbing fixtures • Natural environmental sources • Mineral springs • Carbonate deposits • Salt deposits • Sea water intrusion	High TDS levels do not necessarily directly pose serious health threats. However, elevated concentrations of dissolved solids increase the corrosive nature of drinking water. This can ultimately contribute to: • Aquatic toxicity • Compromised integrity of system piping and electric water heaters • Mineral deposition • Pipe diameter reduction. Such instances may also be responsible for the salty taste in brackish water	Maximum limit of **1000 mg/L.** In certain situations, the Sanitary-Epidemiology Services department can set a limit of up to 1500 mg/L depending on the specific characteristics of a water supply scheme, and sanitary-epidimiological conditions in the serviced area.	No health-based guideline value is proposed. The palatability of water with a total dissolved solids (TDS) level of less than about **600 mg/L** is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/L.

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Table E.3: Continued

Physical and chemical significance	Public health significance	Accepted levels in drinking water per national standards[a,b]	Accepted levels in drinking water per WHO guidelinesc
Total chlorine			
Chlorine is often used as a disinfecting agent when treating drinking water. The addition of chlorine to water ignites a number of different chemical reactions. When chlorine is initially added, it combines with organic materials and metals.[d] The removal of these substances improve the quality and palatability of drinking water, but also decrease the amount of available chlorine for further disinfection. The remaining concentration of chlorine present in the drinking water is known as the total chlorine concentration. Total chlorine is further classified into combined chlorine and free chlorine.	Elevated concentrations of chlorine produce a significant chlorine taste in drinking water.	Only limits for the Maximum Bound Residual Chlorine are set: **0.8–1.2 mg/L** Therefore, the total chlorine limits should correspond to **1.1–1.7 mg/L.**	No specific guideline values for total chlorine are specified. Guideline value for free chlorine in drinking water is **5 mg/L**. At 5 mg/L, most individuals are able to taste chlorine.
Free chlorine			
The addition of chlorine to water can reversibly produce hydrochloric acid (HCl) and hypochlorous acid (HOCl).[e] $Cl_2 + H_2O \rightarrow HOCl + HCl$ Hydrochloric acid (HCl) fully dissociates in water to produce hydrogen ions (H^+) and chloride ions (Cl^-). $HCl \rightarrow H^+ + Cl^-$ On the other hand, hypochlorous acid (HOCl) only partially dissociates into hydrogen ions (H^+) and hypochlorite ions (OCl^-). $HOCl \leftrightarrow H^+ + OCl^-$	Elevated concentrations of chlorine produce a significant chlorine taste in drinking water. Insufficient concentrations of chlorine increase the possibility of drinking water contamination after leaving the treatment plant.	**0.3–0.5** mg/L	**Minimum residual concentration of 0.2 mg/L** at point of delivery in normal circumstances. Minimum concentration of 0.5mg/L in high-risk circumstances. For effective disinfection, there should be a residual concentration of free chlorine >= 0.5 mg/L after at least 30 min contact time at pH < 8.0.

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Table E.3: Continued

Physical and chemical significance	Public health significance	Accepted levels in drinking water per national standards[a,b]	Accepted levels in drinking water per WHO guidelinesc
The undissociated hypochlorous acid (HOCl) is particularly important because of its ability to continuously disinfect drinking water after it has left the water treatment facilities. The rate of dissociation is dependent on the pH of the drinking water. At pH levels greater than 8, dissociation of HOCl is favorable and the dissociated hypochlorite ions dominate. At low pH levels, the dissociation of HOCl is chemically unfavorable and the undissociated hypochlorous acid dominates. The undissociated form of hypochlorous acid (HOCl) is known as residual or free chlorine, and can be thought of as the concentration of uncombined chlorine in drinking water.			
Nitrate			
Nitrogen is a chemical element essential to the survival of all living things. In the environment, it presents itself in different forms as it navigates through the Nitrogen Cycle. Bacteria present in soil facilitate the conversion of various forms of nitrogen-based compounds into nitrate ions (NO_3^- [1]). Given their natural tendency to percolate through soil profiles, nitrates are able to easily deposit in groundwater sources after heavy rainfall or over-irrigation. Nitrogen-based contaminants commonly originate from: • Sewage and wastewater disposal • Landfills • Food processing plants • Decaying plant and animal residues • Livestock facilities • Agricultural fertilizers	High concentrations of nitrate in drinking water pose particularly serious health effects to infants under 6 months old. Above the regulated threshold, infants become at risk of developing methemoglobinemia, a temporary blood disorder more commonly known as baby blue syndrome. This blood oxygen deficiency is reversible if addressed in time. Infants under 6 months of age, nursing mothers, pregnant women, and the elderly are particularly vulnerable to developing to the adverse effects of high nitrate levels in drinking water.	**Maximum of 45 mg/L**	**Maximum of 50 mg/L of NO3-**. 3 mg/L guideline value for nitrite. 0.2 mg/L provisional, long-term exposure value for nitrite.

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Table E.3: Continued

Physical and chemical significance	Public health significance	Accepted levels in drinking water per national standards[a,b]	Accepted levels in drinking water per WHO guidelinesc
E. coli			
E. coli is widely used as an indicator organism to signal the presence of fecal contamination. Primary sources of *E. coli* contamination include: • Human waste (feces), including sources from overflow from sewerage and wastewater treatment plants • Agricultural run-off • Livestock feedlots	Among other waterborne diseases, *E. coli* is most commonly known to cause: • Hemorrhagic diarrhea • Urinary tract infections • Bacteraemis • Meningitis	Maximum value: **0/100 mL**	Maximum value: **0 /100 mL**

Source: For national guidelines, GOST 2874-82; USSR 1982; SES 2007. For WHO guidelines, WHO 2017a. WHO = World Health Organization.
Note: a. USSR 1982. b. SSE 2007. c. WHO 2017a. d. "Hach Disinfection Series—Step 3." Hach. https://www.hach.com/disinfectionseries03 (accessed April 7, 2017). e. "Chlorination Concepts: Inactivation of Microbes by Chlorine." Fact Sheet 2.17. World Health Organization, Geneva. http://www.who.int/water_sanitation_health/hygiene/emergencies/fs2_17.pdf.
mg/L = milligrams per liter; mL = millileters.

Table E.4: Compliance of Household Water Quality Samples with National and WHO Guidelines, Urban Areas

Test	Number of samples	Mean parameter test value	Acceptable parameter range	Percentage of samples compliant with national guidelines	Percentage of samples compliant with WHO guidelines
pH					
Point of consumption	241	8.0 pH	6–9 (national), 6.5–8.5 (WHO)	100	89
Water source	118	8.1 pH		100	60
Total dissolved solids					
Point of consumption	241	387 mg/L	<1000 mg/L (national), <600 mg/L (WHO)	94	75
Water source	118	421 mg/L		99	79
Nitrate					
Point of consumption	241	12.3mg/L	<45 mg/L (national), <50 mg/L (WHO)	100	100
Water source	118	12.2 mg/L		99	99
Total chlorine					
Point of consumption	241	0 mg/L	1.1–1.7 mg/L (national), <5 mg/L (WHO)	0	n.a.
Water source	118	0 mg/L		0	n.a.
Free chlorine					
Point of consumption	241	0 mg/L	0.3–0.5 mg/L (national), 0.2–0.5 mg/L (WHO)	0	0
Water source	118	0 mg/L		0	0

Source: World Bank team.
Note: For national guidelines, GOST 2874-82; USSR 1982; SES 2007. For WHO guidelines, WHO 2017a. mg/L = milligrams per liter; n.a. = not applicable; WHO = World Health Organization.

Table E.5: Compliance of Household Water Quality Samples with National and WHO Guidelines, Rural Areas

Test	Number of samples	Mean parameter test value	Acceptable parameter range	Percentage of samples compliant with national guidelines	Percentage of samples compliant with WHO guidelines
pH					
Point of consumption	759	8.1 pH	6–9 (national), 6.5–8.5 (WHO)	100	79
Water source	377	8.2 pH		100	69
Total dissolved solids					
Point of consumption	759	505 mg/L	<1000 mg/L (national), <600 mg/L (WHO)	95	65
Water source	377	497 mg/L		95	66
Nitrate					
Point of consumption	759	14.6 mg/L	<45 mg/L (national), <50 mg/L (WHO)	99	99
Water source	379	14.9 mg/L		98	99
Total chlorine					

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Table E.5: Continued

Test	Number of samples	Mean parameter test value	Acceptable parameter range	Percentage of samples compliant with national guidelines	Percentage of samples compliant with WHO guidelines
Point of consumption	759	0 mg/L	1.1–1.7 mg/L (national), <5 mg/L (WHO)	0	n.a.
Water source	379	0 mg/L		0	n.a.
Free chlorine					
Point of consumption	759	0 mg/L	0.3–0.5 mg/L (national), 0.2–0.5 mg/L (WHO)	1.4	1.7
Water source	379	0 mg/L		1.2	1.2

Source: World Bank team.
Note: For national guidelines, GOST 2874-82; USSR 1982; SES 2007. For WHO guidelines, WHO 2017a. mg/L = milligrams per liter; n.a. = not applicable; WHO = World Health Organization.

Table E.6: Compliance of School Water Quality Samples with National and WHO Guidelines, Urban Areas

Test	Number of samples	Mean parameter test value	Acceptable parameter range	Percentage of samples compliant with national guidelines	Percentage of samples compliant with WHO guidelines
pH					
Point of consumption	78	7.9 pH	pH 6–9 (national), pH 6.5–8.5 (WHO)	100	88
Total dissolved solids					
Point of consumption	78	457 mg/L	<1000 mg/L (national), <600 mg/L (WHO)	94	80
Nitrate					
Point of consumption	78	13.6 mg/L	<45 mg/L (national), <50 mg/L (WHO)	99	99
Total chlorine					
Point of consumption	78	0 mg/L	1.1-1.7 mg/L (national), <5 mg/L (WHO)	0	n.a.
Free chlorine					
Point of consumption	78	0 mg/L	0.3–0.5 mg/L (national), 0.2–0.5 mg/L (WHO)	0	0

Source: World Bank team calculations based on water quality data in School WASH Survey 2016.
Note: For national guidelines, GOST 2874-82; USSR 1982; SES 2007. For WHO guidelines, WHO 2017a. mg/L = milligrams per liter; n.a. = not applicable; WHO = World Health Organization.

Table E.7: Compliance of School Water Quality Samples with National and WHO Guidelines, Rural Areas

Test	Number of samples	Mean parameter test value	Acceptable parameter range	Percentage of samples compliant with national guidelines	Percentage of samples compliant with WHO guidelines
pH					
Point of consumption	211	8.1 pH	pH 6-9 (national), pH 6.5–8.5 (WHO)	100	87
Total dissolved solids					
Point of consumption	211	497 mg/L	<1000 mg/L (national), <600 mg/L (WHO)	93	69
Nitrate					
Point of consumption	211	11.7 mg/L	<45 mg/L (national), <50 mg/L (WHO)	100	100
Total chlorine					
Point of consumption	211	0 mg/L	1.1–1.7 mg/L (national), <5 mg/L (WHO)	0	n.a.
Free chlorine					
Point of consumption	211	0 mg/L	0.3–0.5 mg/L (national), 0.2–0.5 mg/L (WHO)	0	1.7

Source: World Bank team calculations based on water quality data in School WASH Survey 2016.
Note: For national guidelines, GOST 2874-82; USSR 1982; SES 2007. For WHO guidelines, WHO 2017a. mg/L = milligrams per liter; WHO = World Health Organization; n.a. = not applicable.

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Located on the western tip of the Himalayas, Tajikistan has abundant fresh water resources in its rivers, lakes, and glaciers. Yet, access to improved drinking water, and to sanitation connected to a functioning sewerage system, are among the most severe and unequally distributed services in the country. Unsafe water, sanitation, and hygiene (WASH) conditions have significant adverse effects on well-being, particularly for rural residents, the poor, and children.

Glass Half Full: Poverty Diagnostic of Water Supply, Sanitation, and Hygiene Conditions in Tajikistan documents the realities, characteristics, and priorities of Tajikistan's WASH-deprived population. It presents new, comprehensive evidence on the coverage and quality of WASH service conditions, along with their diverse well-being impacts. It also identifies institutional gaps and service delivery models that can inform future policies and investments in the WASH sector. The findings communicate a sense of urgency that should inspire the government, civil society, and the international community to accelerate their actions toward addressing WASH deprivation in Tajikistan.

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