RWANDA DEMOGRAPHIC AND HEALTH 2019/2020

Water, Sanitation and Hygiene WASH

RWANDA DEMOGRAPHIC AND HEALTH SURVEY

2019/2020

Water, Sanitation and Hygiene

WASH

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Thank you

Murangwa Yusuf

Director General, NISR

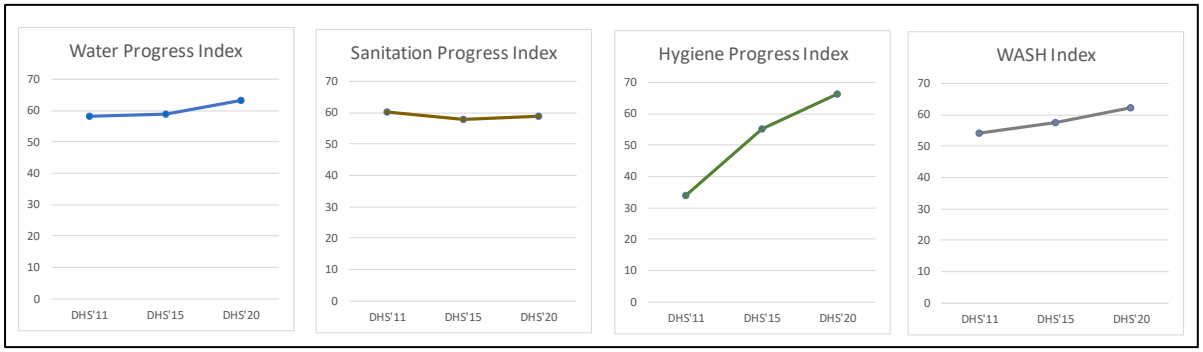
Executive Summary

This report defines and computes indexes of progress in water provision, sanitation services, and hygiene for Rwanda, as well as an overall WASH index. The raw data come from DHS, EICV, and MIS surveys, from 2010 through 2020.

The purpose of the indexes is to provide a clear picture of the extent to which improvements are occurring in the WASH (water, sanitation, and hygiene) areas. The indexes are straightforward to calculate, and should be especially helpful for those who are not necessarily experts in the subject, but need to get a quick grasp of trends and patterns in the sector.

In response to surveys, households provide information on where they get their water, what sanitation services they use, and the extent to which they have handwashing facilities. This information can be mapped into "ladders", starting with no service, and moving through unimproved service, limited service, basic service, and safe provision. The indexes create a weighted average of the proportions of households at each rung of these ladders. As of 2020, both the water and sanitation progress indexes are close to 65%; one interpretation is that Rwanda is 65% of the way toward providing safe water and sanitation for all. The data, and associated indexes, need to be handled carefully, because there can be differences over time in the questions asked, and in the protocols used to verify the data that are collected.

The indexes are graphed here, based on DHS data. We find that there is **steady, if fairly slow, progress in providing better water supplies**. The data also show **little or no progress in expanding the coverage of sanitation services**, which is at odds with the substantial resources that have gone into this sector in recent years. However, as measured by access to handwashing facilities, **hygiene has improved markedly** in recent years, although the underlying data are not yet very robust. The result is that the overall WASH index, which is a weighted average of the water, sanitation, and hygiene indexes, has risen over the past decade.



It is straightforward to break down the water progress index (WPI), and sanitation progress index (SPI), by region, urban or rural area, consumption quintile, and gender. In the report. we do this visually, because this shows the patterns most clearly.

The proposed WASH-related indexes help start conversations and analysis, and that is their main function. They invite the reader, researcher, or policy-maker to dig deeper, without losing sight of the larger context.

Contents

Chapter 1: Introduction

Of the 17 sustainable development goals (SDGs), number six calls for universal clean water and sanitation by 2030. There are two specific targets for Water, Sanitation, and Hygiene (WASH):

6.1 Achieve universal and equitable access to safe and affordable drinking water for all.

6.2 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.

There is evident popular demand for clean water, and it is often seen as a basic right. Better and more convenient water is associated with better health (Pickering and David 2012). And in countries such as Rwanda, a great deal of time and effort is spent fetching water: the average household in Rwanda spends over 200 hours annually fetching water, equivalent to a month of full-time work; nationally, the time spent fetching water is equivalent to the time spent working at 248,000 jobs.

Likewise, improved sanitation appears to improve health (Gross and Günther 2014), although the size of this effect is unclear. Households do want sanitation facilities that are secure, protected from animals, and clean, as evidenced by their willingness to pay for these features (Tidwell et al. 2019; Bin Seraj 2008).

Better hygiene, often measured as access to handwashing facilities, may also contribute to improved health.

It is not easy to judge the extent to which countries are progressing toward achieving the WASH targets. In part this is because there is so much detailed information from household surveys that it can be difficult to see the underlying trends.

To cut through the clutter, we suggest that would be helpful to create WASH indexes – one for water, one for sanitation, and perhaps one that combines these with an index for hygiene.

In what follows, we first review what information is publicly available on WASH. Then we set out the methodology for constructing the WASH indexes. That is followed by a discussion of the data sources. We then compute the indexes and use them to review progress towards the WASH targets in Rwanda since 2010, including some international comparisons.

After showing the WASH indexes at work, we return to the question of whether the indexes are useful. And in the final section we make some recommendations.

The United Nations SDG Indicators Database presents four graphs that summarize progress on WASH, and these are reproduced in Figure 1. Showing information from 2000 through 2020, these show a steadily rising proportion of the population with at least “basic” access to drinking water, and sanitation; a small but rising proportion of the population with

handwashing services at home; and a small and falling proportion of the population practicing open defecation.

These graphs are based on fitting a line to data from a number of surveys, and interpolating for the years for which data are not available. They show progress, but do not provide much context, they are sometimes out of date, they gloss over issues of data quality, and they overlook some of the more interesting developments – for instance, potential convergence between the WASH experience in rural and urban areas.

The Joint Monitoring Program (JMP) of UNICEF and the World Health Organization (WHO) is the custodial agency for data related to the sixth sustainable development goal. It has created an extensive database of information, compiled mainly from household surveys, for 244 countries and territories, running from 2000 through 2020. The JMP site (https://washdata.org/data/household#!/dashboard/new) allows the user to generate colorful graphs, such as those shown in Figure 2, and to download all the data for each country.

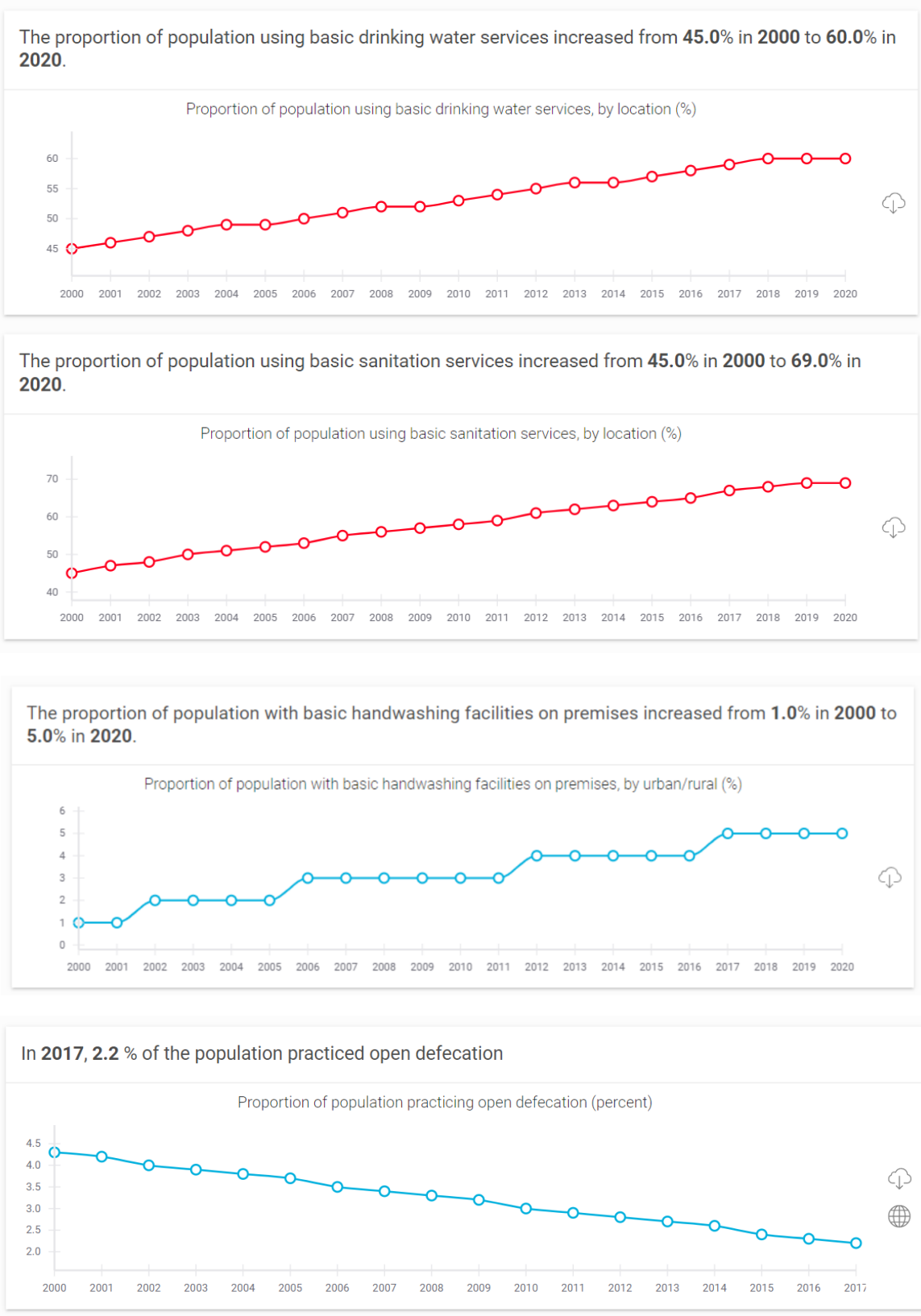
The JMP organizes data on water, sanitation, and hygiene into "ladders", using a consistent set of definitions. For example, in Figure 2, the left bar refers to water, and there are five rungs on the latter, ranging from best ("safely managed") in blue at the bottom to worst ("surface water") in orange at the top.

The JMP website also allows one to make comparisons, such as the one presented in Figure 3, which shows the proportion of the population with access to at least basic drinking water facilities in 2020, for the least-developed countries. By this measure Rwanda, marked with an arrow, fares slightly better than Uganda, but slightly worse than Burundi and Tanzania, and falls well behind Senegal or Mali.

It is also possible to graph the trends in water or sanitation services. An example, for water in Rwanda, is shown in Figure 4, and paints a picture of steady, if fairly slow, improvement. These trends should be of real interest to policymakers.

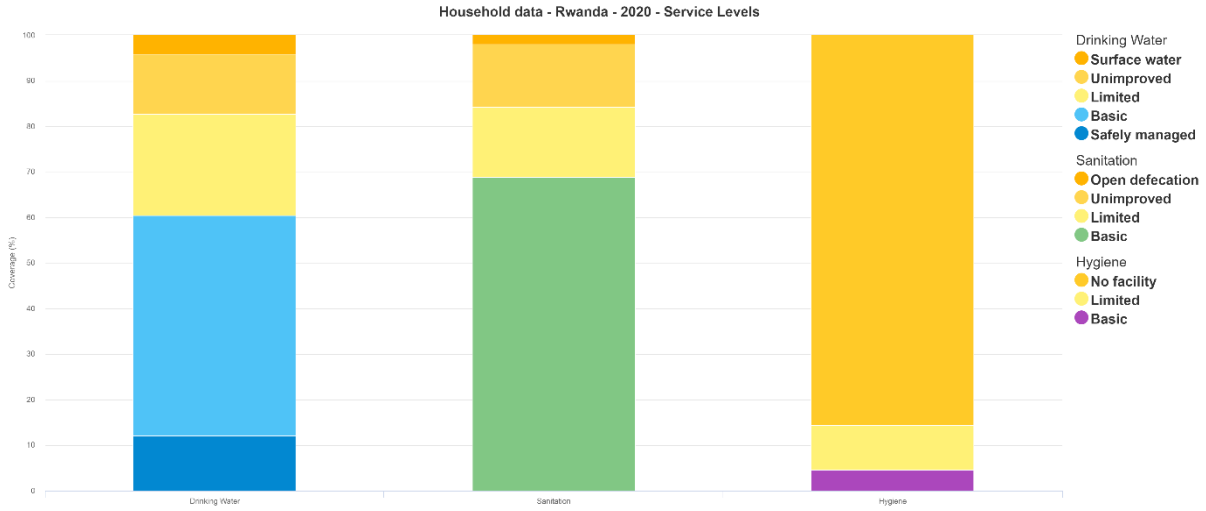
Despite these extensive resources, there is a strong case for using summary measures of access to water, and use of sanitation, for reasons set out in more detail below; and, moving forward, for a similar summary measure for hygiene, and an overall WASH index.

Figure 1. WASH indicators for Rwanda, as reported by the United Nations SDG Indicators Website



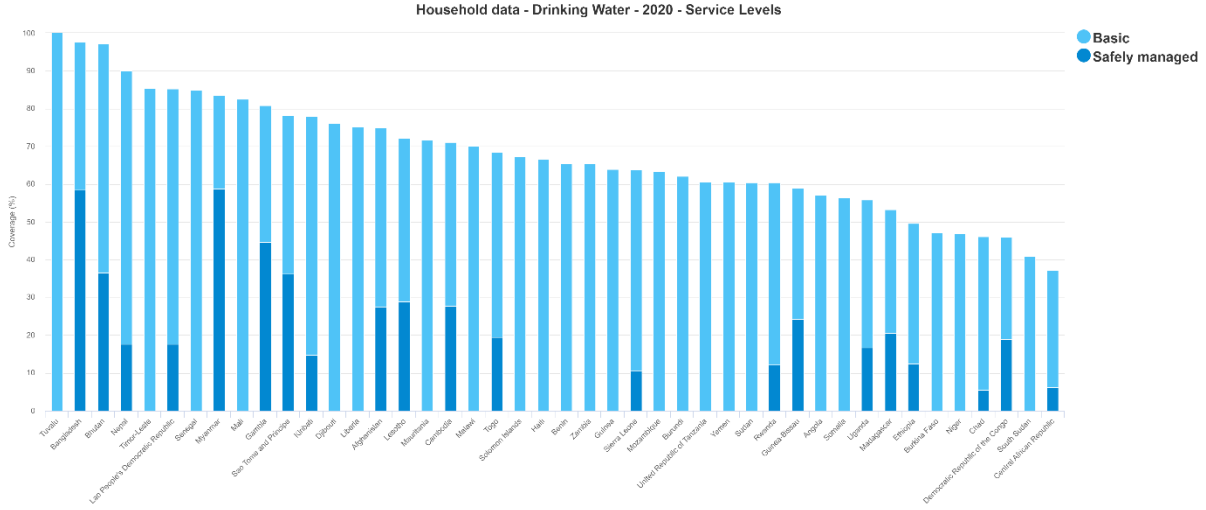
Source: https://unstats.un.org/sdgs/dataportal/countryprofiles/RWA#goal-6 [Accessed June 13, 2022 (for bottom panel) and March 13, 2023 (for other panels)]

Figure 2. Ladders for Water, Sanitation, and Hygiene for Rwanda for 2020, as reported by the JMG of UNICEF/WHO



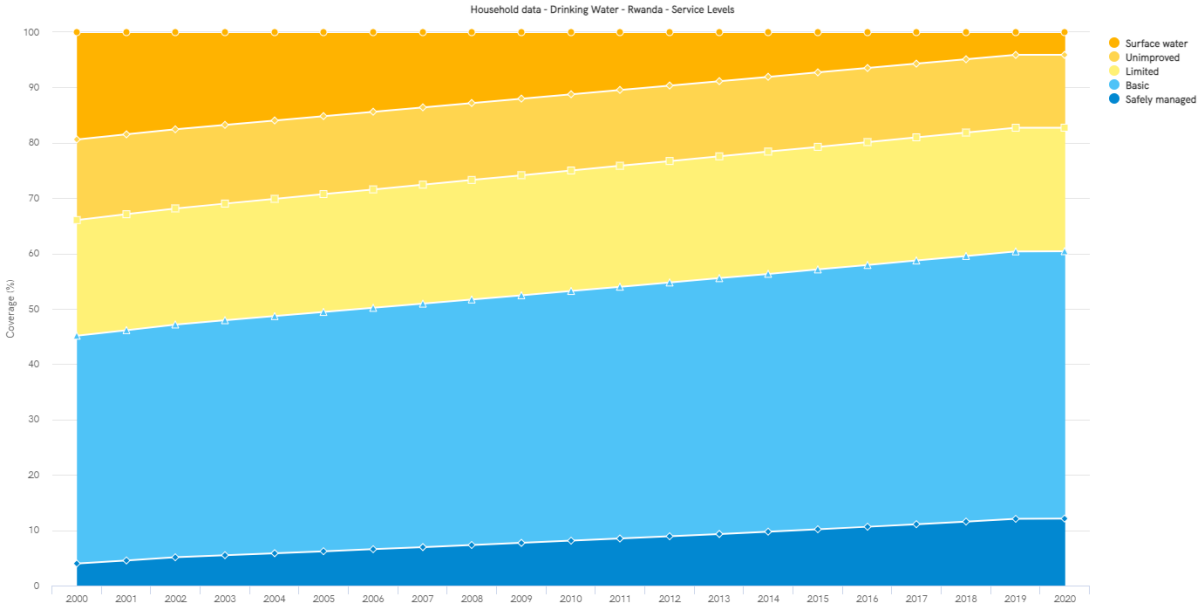
Source: https://washdata.org/data/household#!/dashboard/new

Figure 3. Comparison of Drinking Water Service Levels in 2020, Least-Developed Countries



Source: https://washdata.org/data/household#!/dashboard/new

Figure 4. Evolution of Drinking Water Services in Rwanda, 2000-2020.



Source: https://washdata.org/data/household#!/dashboard/new

Chapter 2: Methodology

2.1. Constructing a Water Progress Index

The idea behind a Water Progress Index (WPI) is to create a weighted average of the proportion of individuals whose water comes from the sources at different points of the JMP ladder of service.

We start with the five service levels of water provision, as set out in Table 1. When water is collected from a lake or river, the household is considered to have "no service", and if the water comes from an unprotected will or spring, the water source is deemed to be "unimproved". On the other hand, water from a protected well or spring, or a pipe, or delivered by a truck or in bottled form, is "improved". When it takes more than half an hour to fetch improved water – round-trip, including waiting in the queue – the water service is "limited", but if the water takes less than half an hour to fetch (and is not piped directly to the premises) the service is counted as "basic". The terminology may seem a bit odd, but basic service is considered to be relatively satisfactory, and certainly more so than limited service.

Table 1. JMP ladder for household drinking water services

Service level	Definition	Weights?
Safely managed	Drinking water from an improved water source which is located on premises, available when needed and free of fecal and prior chemical contamination.	1.0
Basic	Drinking water from an improved source, provided collection time is not more than 30 minutes for a roundtrip, including queuing.	0.8
Limited	Drinking water from an improved source where collection time exceeds 30 minutes for a roundtrip to collect water, including queuing.	0.6
Unimproved	Drinking water from an unprotected dug well or unprotected spring.	0.1
No service	Drinking water collected directly from a river, dam, lake, pond, stream, canal or irrigation channel.	0.0

Source: WHO/UNICEF JMP, 2018.

Once we know the proportion of people in each service category, we can apply weights. There is no consensus on what weights to use, but those used by Land (2018), based on earlier work

by Kempster and Hueso (2018), are shown in the right-hand column of Table 1. We will return to a discussion of the appropriate weights, below.

In order to construct the ladder of service, it is necessary to map the answers to questions about water sources and availability from household survey data to the service categories in Table 1. In Table 2 we present a sampling of the sort of raw results that we obtain from the 2019-20 Rwandan Demographic and Health Survey (DHS'20). Each row indicates the source of drinking water, and the "over30" variable equals 1 if it takes more than 30 minutes to fetch drinking water. The 1,548 households with water piped into their dwelling or yard are considered to have safely managed water.

Table 2. Sources of household water, Rwanda, 2019-20

source of drinking water	over30 0	over30 1	Total
piped into dwelling	87	0	87
piped to yard/plot	1,461	0	1,461
piped to neighbor	438	0	438
public tap/standpipe	2,961	813	3,774
tube well or borehole	76	90	166
protected well	202	155	357
unprotected well	98	99	197
protected spring	1,784	1,969	3,753
unprotected spring	712	757	1,469
river/dam/lake/ponds/	338	508	846
rainwater	54	4	58
tanker truck	0	3	3
cart with small tank	6	5	11
bottled water	301	14	315
other	10	4	14
Total	8,528	4,421	12,949

Source: Rwanda DHS survey of 2019-10.

To complete the mapping, we also need to determine which water sources are "improved". For this, we use the classification that JMP applies, reproduced here in Table 3. So, for instance, the 202 households who get water from a protected well are considered to have improved water, and because it takes no more than 30 minutes to fetch this water, they are classified as having basic water service.

2.2. Constructing a Sanitation Progress Index

We use a similar approach in order to construct a Sanitation Progress Index (SPI): Define the levels of the service ladder, and attach weights to each level. To do this, we map the raw survey data to the levels of service.

Table 3. Classification of Drinking Water Technologies

First level classification	Second level classification	Improved	Unimproved
Tap water	Piped water into dwelling	X	
	Piped water to yard/plot	X	
	Public tap, standpipe	X	
	Other	X	
Ground water	Tubewell, borehole	X	
	Protected well	X	
	Protected spring	X	
	Unprotected well		X
	Unprotected spring		X
Rainwater	Covered cistern/tank	X	
	Uncovered cistern/tank	X	
Packaged water*	Bottled water	X	
	Sachet water	X	
Delivered water*	Cart with small tank/ drum	X	
	Tanker truck provided	X	
Surface water	River		X
	Lake		X
	Dam		X
	Pond		X
	Stream		X
	Irrigation channel		X
Other	Other improved	X	
	Other unimproved		X
DK/Missing			X

*Packaged and delivered water were previously categorised as unimproved for MDG monitoring

Source: WHO/UNICEF JMP, 2018

For the case of sanitation, the JMP service ladder is shown in Table 4, with the weights that we use to construct our index in the final column. Open defecation amounts to having no sanitation facilities, while a pit latrine without a slab is considered to be "unimproved". Latrines with a slab are considered to provide a limited service if they are shared with other households, and a "basic" (i.e., satisfactory) service if they are not shared. Safely managed facilities typically consist of flush toilets where the excreta are safely disposed of; if the excreta simply flow into a ditch, they are classified as unimproved.

The unfiltered data from the DHS'20 survey are of the form shown in Table 5. After mapping this to the service ladder in Table 4, and applying the weights, we obtain estimates of the sanitation progress index, reported in more detail below.

Table 4. JMP ladder for household sanitation

Service level	Definition	Weights?
Safely managed	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or removed and treated offsite.	1.0
Basic	Use of improved facilities which are not shared with other households.	0.8
Limited	Use of improved facilities shared between two or more households.	0.6
Unimproved	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines.	0.1
No service	Disposal of human feces in fields, forests, bushes, open bodies of water, beaches and other open spaces or with solid waste.	0.0

Source: WHO/UNICEF JMP, 2018. https://washdata.org/monitoring/sanitation

Table 5. Tabulated Data from Rwanda DHS survey of 2019-20.

type of toilet facility	share toilet with other households: no	yes	Total
flush to piped sewer	186	10	196
flush to septic tank	144	8	152
flush to pit latrine	89	16	105
flush to somewhere el	135	54	189
flush, don't know whe	10	1	11
ventilated improved p	526	125	651
pit latrine with slab	6,469	1,688	8,157
pit latrine without s	2,655	420	3,075
composting toilet	10	3	13
Total	10,224	2,325	12,549

Source: Rwanda DHS 2019-20

2.3. Constructing a Hygiene Progress Index

In the context of the SDGs, hygiene is measured by looking at whether households have a handwashing station, with available water and/or soap. As Table 6 shows, here there is a three-point ladder of service, where “basic” service consists of a handwashing facility on the premises with soap and water, and limited service has a handwashing facility that lacks soap and/or water. Here too, we can apply weights to create a Hygiene Progress Index (HPI): we map the raw survey data into the ladder, and apply the weights to compute the HPI.

An important practical difficulty is that there is very limited consistent information on handwashing facilities, so this index can only be constructed on the basis of somewhat fragile data. At this point, it is more experimental than tested.

Table 6. JMP ladder for hygiene

Service level	Definition	Weights?
Basic	Availability of a handwashing facility with soap and water at home	1
Limited	Availability of a handwashing facility lacking soap and/or water at home	0.6
No facility	No handwashing facility on premises	0.0

Source: WHO/UNICEF JMP, 2018. https://washdata.org/monitoring/hygiene

2.4. An overall WASH index

It is possible to construct an overall WASH index, as a weighted average of the water, sanitation, and hygiene indexes. One possibility would be:

WASH index = 0.4 WPI + 0.4 SPI + 0.2 HPI

This gives weights of 40% each to the water and sanitation progress indexes, and less weight to the hygiene progress index, in part because the available data on the latter are less robust and less detailed.

Chapter 3: Data Sources

At the household or individual level, we construct the service ladders, and associated indexes, from household survey data. Over the past decade in Rwanda, the main sources of survey data for WASH are:

- The DHS surveys of 2010-11, 2014-15, and 2019-20;
- The Malaria Indicator Surveys (MIS) of 2013 and 2017; and
- The EICV (Integrated living conditions surveys) of 2010-11, 2013-14, 2016-17, and the incomplete survey of 2019-20.

Table 7 lists these surveys, with the sample sizes and dates. It should be noted that the EICV'20 was due to run for a further eight months, but data collection ended prematurely in February 2020 with the onset of COVID-19; even so, we have included the results here, as a robustness check (as discussed further below). Additional data, not analyzed in this report, are available from the censuses, and the Labor Force Surveys.

Table 7. Sample size and timing of surveys on which Rwanda WASH indexes are based

	Households	Individuals	Started	Ended
Demographic and Health Survey				
DHS'11	12,540	55,600	09/2010	03/2011
DHS'15	12,699	54,017	11/2014	03/2015
DHS'20	12,949	55,209	11/2019	07/2020
Integrated Household Survey				
EICV'11 (EICV3)	14,308	68,398	11/2010	10/2011
EICV'14 (EICV4)	14,419	66,081	10/2013	10/2014
EICV'17 (EICV5)	14,580	64,314	10/2016	10/2017
EICV'20 (EICV6)	5,830	25,672	10/2019	02/2020
Malaria Indicator Survey				
MIS'13	4,766	20,633	02/2013	04/2013
MIS'17	5,041	19,872	10/2017	12/2017

The DHS surveys asked the same questions in all three years, and are believed to have used a consistent survey protocol. In principle this should yield results that may be compared over time.

The two MIS surveys asked the same questions as the DHS surveys, but had smaller samples. The mean household size in MIS'17 was 3.97, compared to 4.29 in MIS'13 (which in turn is close to the mean household size in most of the other surveys), which casts some doubt about the reliability of MIS'17, and hence of its comparability to MIS'13.

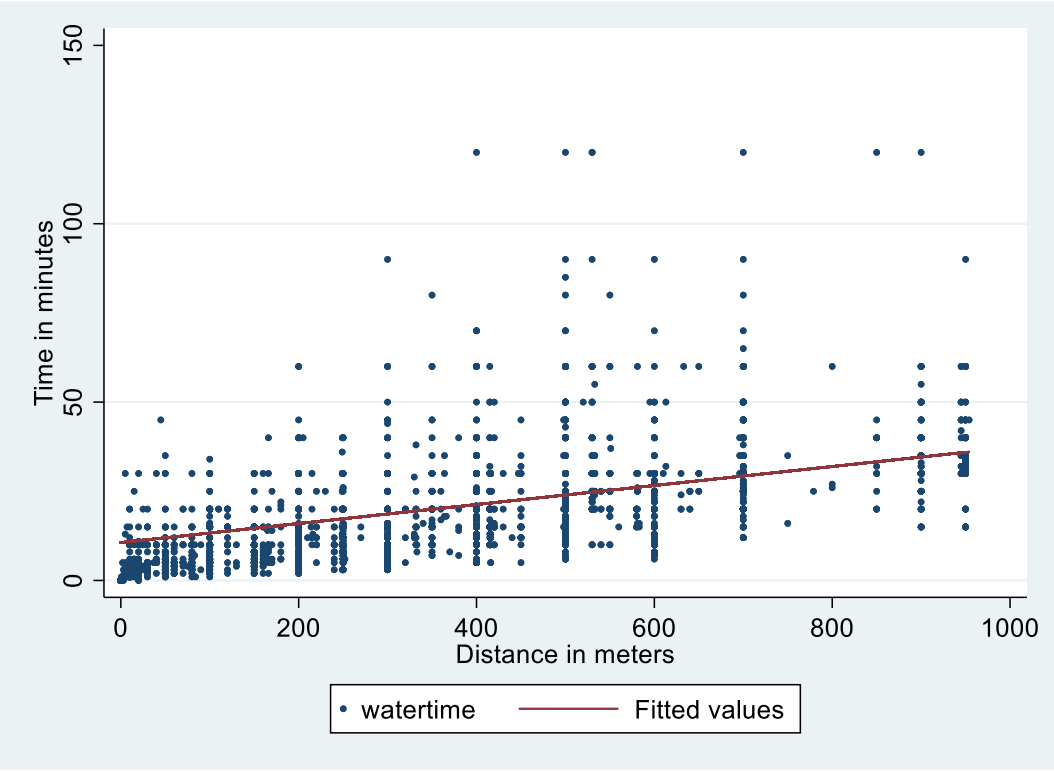
The EICV surveys of 2014 and 2017 (also known as EICV4 and EICV5) used identical questions related to water and sanitation, but EICV'11 had somewhat different sanitation questions. An important distinction between the EICV and DHS surveys is that the former asked about the distance required to fetch water, while the latter asked about the time required. The JMP ladders refer to time, not distance.

Usefully, EICV'20 asked about both the time and distance to collect water. We used data from that survey to regress time on distance, which yielded the following:

Time to fetch water (minutes) = 10.638 + 0.0266 Distance to fetch water (meters) $R^2 = 0.66$
p<0.000 p<0.000 N = 5,186

A graph of (most of) the observations, and the line fitted by this regression, are shown in Figure 4. About two-thirds of the variation in time to collect water is "explained" by the (one-way) distance: if water is about 40 yards further away, it takes about an additional minute round-trip, which is plausible. Based on this regression, if water is 727 meters away from the home, it takes 30 minutes round-trip to collect water. We have used this equivalence when using the EICV data to determine whether water supply is limited (i.e., improved and more than 30 minutes away) or basic (i.e., improved and no more than 30 minutes away), but it remains the case that the results based on the EICV surveys are only approximately comparable with those of the DHS and MIS surveys.

Figure 4. Regression model of time to collect water against distance



Source: EICV'20.

Chapter 4: Results

Based on these ladders, and the weights discussed above, we have computed the water progress index (WPI) for the DHS, MIS, and EICV surveys, and graphed them in Figure 5. Given the imperfect comparability between surveys, it is not entirely legitimate to present all these results on the same graph, but it is visually helpful. The WPI based on the DHS surveys are typically lower than for the EICV data. Taken at face value, the WPI appears to have risen by about 0.84 percentage points per year over the past decade.

If everyone had safely available water, the water progress index would be 100. It is currently close to 70. If progress in water provision continues to grow at 0.84 percentage points annually – which is the slope of the trend line in the top panel of Figure 5 – it will take over thirty years to provide everyone in Rwanda with safe water. On current trends, the WPI will be about 78 by 2030, falling short of the high aspirations of the sustainable development goals.

The bottom two panels in Figure 5 show the water progress index for rural and urban Rwanda. As measured by the index, progress is slightly slower in rural than in urban areas.

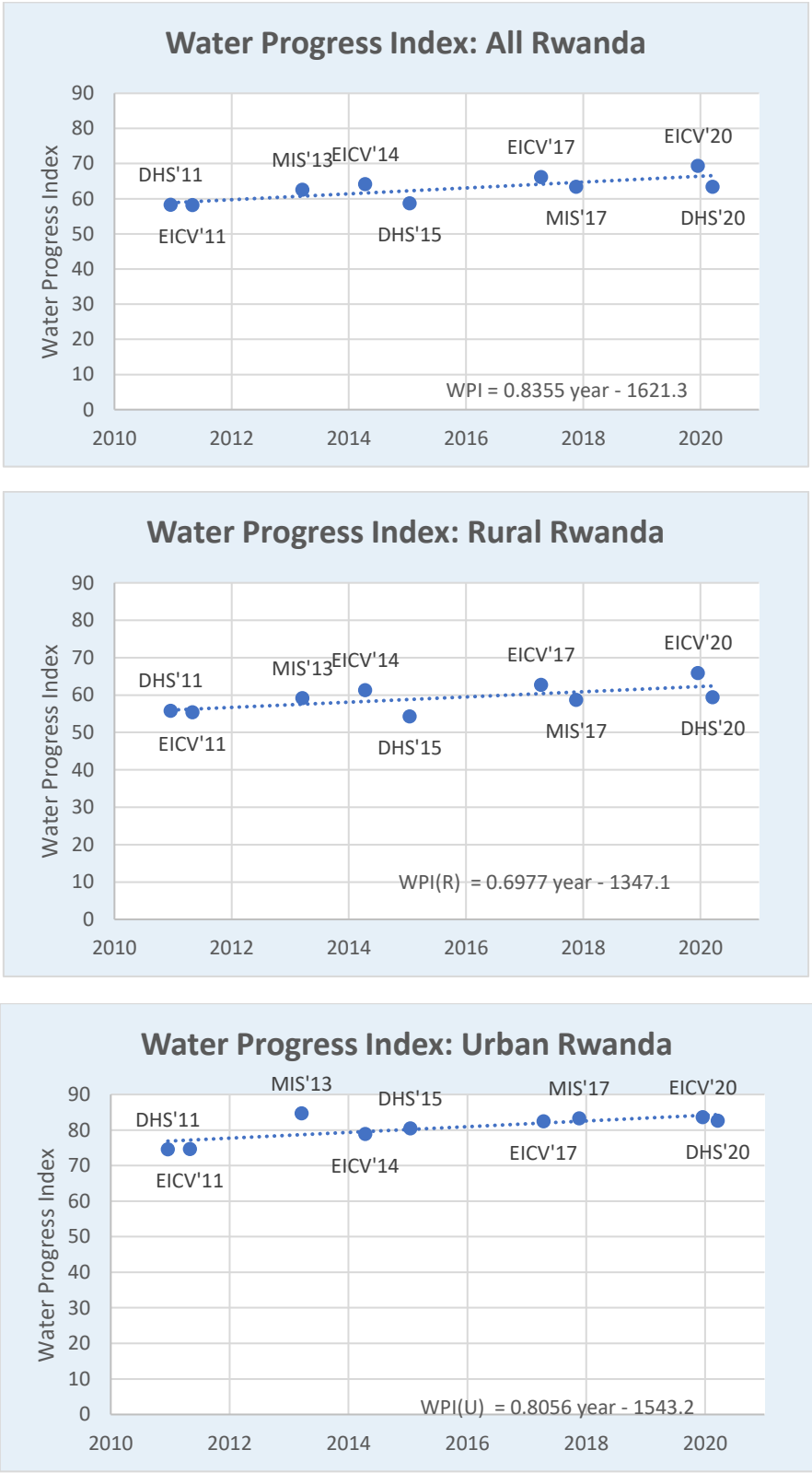
A similar exercise may be done for the Sanitation Progress Index, as Figure 6 shows. A line fitted to the observations shows gentle progress in sanitation services, especially in the first half of the decade. The EICV surveys, which (since 2014) are internally consistent, do show slower improvement. And the data from the DHS surveys – which are, in principle, consistent over time – show no improvement over time. The EICV'11 survey is omitted from Figure 9 because there was no question related to sharing sanitation facilities, and therefore it is not possible to distinguish between "limited" and "basic" sanitation services in that case.

There is a puzzle here: Reported investment in improving sanitation is apparently substantial, which is at odds with the story of limited change over the past several years.

It is worth noting that the SPI based on DHS'20 pre-COVID was just 57.8 (observed from November 2019 through March 2020), but was 61.5 post-COVID (June-July, 2020). This is an implausibly large jump over a short period, and it is reasonable to conjecture that the surveying may not have been as consistent as would be desirable.

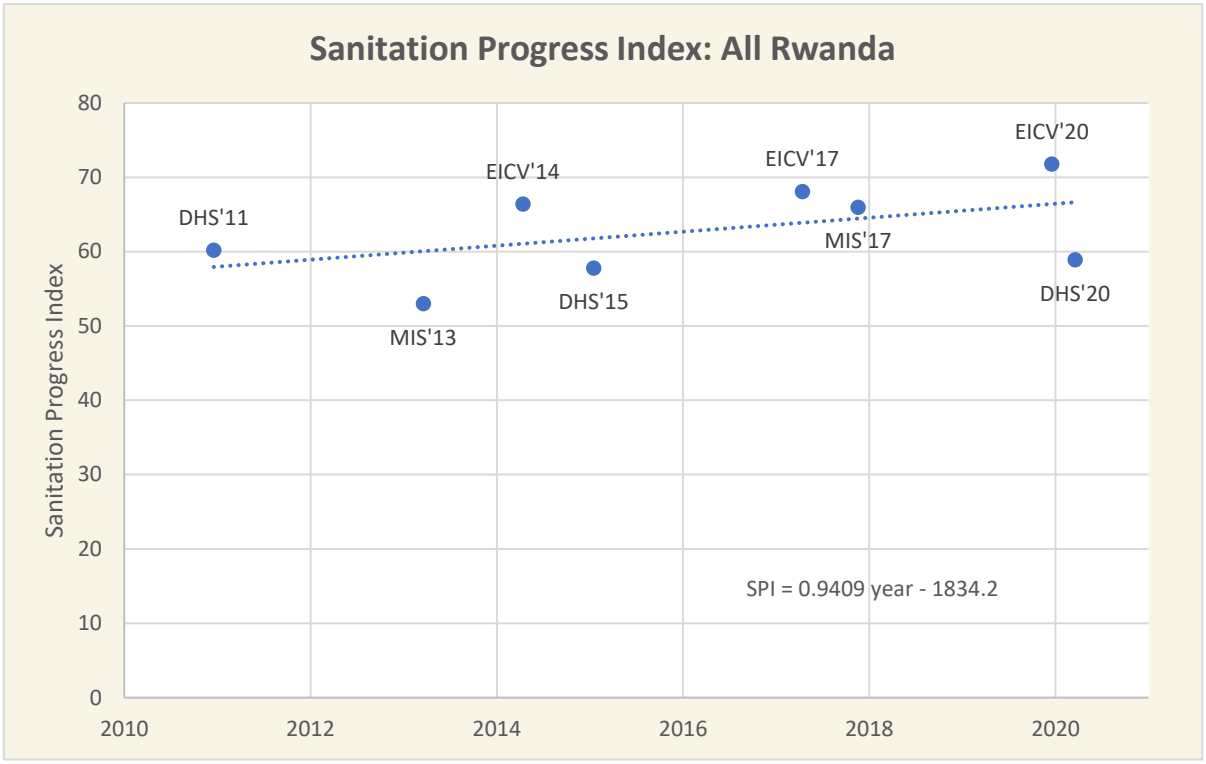
In Figure 7, we present the Hygiene Progress Index, and the overall WASH Index. Only the DHS surveys collected information on handwashing facilities, so our understanding relies entirely on this source of data. There were also some changes in the wording of the question related to handwashing, over time, so that the numbers may not be entirely comparable from one year to the next. However, it does appear that hygiene, as measured here, has improved over time, and that this trend began well before the COVID-19 pandemic. Driven in large part by the improvement in hygiene, the overall WASH index has risen substantially over the past decade.

Figure 5. Water Progress Indexes, Rwanda, 2010-2020



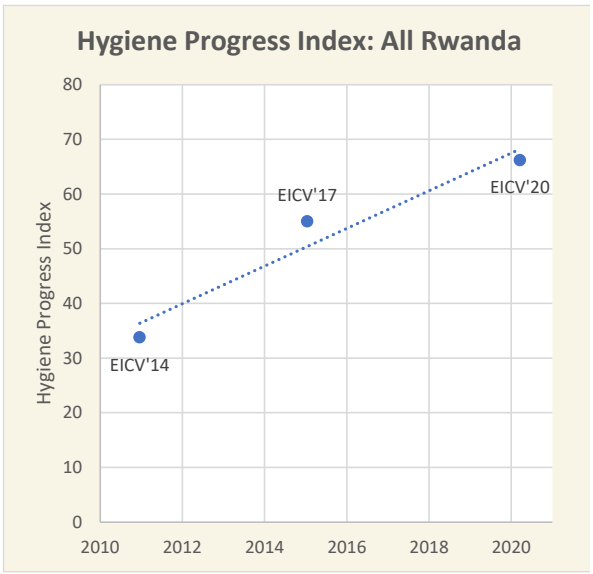
Sources: DHS, MIS, and EICV surveys

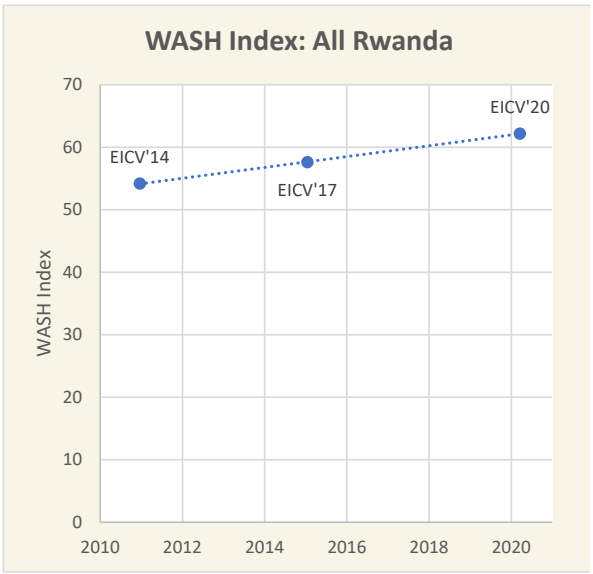
Figure 6. Sanitation Progress Index, Rwanda, 2011-2020



Sources: DHS, MIS, and EICV surveys

Figure 7. Hygiene Progress Index and WASH Index, Rwanda, 2010-2020





Source: DHS surveys

Chapter 5: Putting the indexes to work

What can we learn from the water and sanitation indexes that we might have overlooked otherwise? On the next two pages we present four sets of graphs, all based on the DHS surveys (of 2011, 2015, and 2020), that contribute to our understanding of the WASH sector.

The top panel in Figure 8a shows the indexes for water, sanitation, and hygiene, along with the WASH index, for the three DHS surveys. As we have noted above, there is evidence of some improvement in water services, stagnation in sanitation, and a rapid rise in hygiene.

The bottom panel distinguishes rural (light color) from urban (darker color) indexes. Water supply is substantially better in urban than rural areas, while the difference in more modest in sanitation. This is because the JMP counts shared facilities as "limited" rather than "basic", and sharing is relatively more common in dense urban areas.

The top panel of Figure 8b breaks down the indexes by "wealth quintile". Each DHS survey creates an index of wealth, which is a weighted average – based on a factor analysis – of the assets reported by households, such as furniture, electronics, bicycles, and the like. Individuals are then assigned to quintiles based on the wealth index. It is clear that water services are markedly better in the top quintile than in all other quintiles. On the other hand, sanitation services are far worse in the lowest quintile than in any of the others. There is an element of circularity here, as the DHS measures of "wealth" reflect, to some degree, the household's water and sanitation services, leading to an overstatement of the disparity in water and sanitation coverage across wealth quintiles. In most, but not all, cases, the recalculation of wealth quintiles, excluding water and sanitation variables, makes only a modest difference to the observed relationship between "wealth" and water or sanitation (Martel 2016).

The bottom panel of Figure 8b breaks out the indexes for 2020 by region. In both water and sanitation, Kigali fares better than the rest of the country. The two provinces that do best with the water progress index (North, and South) are the ones that do least well in the sanitation progress index.

Figure 8a. Water, Sanitation, Hygiene and WASH indexes for Rwanda, 2010-2020

Source: DHS surveys. In bottom panels, rural areas are shown in lighter color.

Figure 8b. Water, Sanitation, Hygiene and WASH indexes for Rwanda, 2010-2020

Source: DHS surveys. Top panel shows wealth quintiles (from poorest to richest); bottom panel shows regions.

Chapter 6: The Case for Water and Sanitation indexes

The indexes that we propose here – for water, sanitation, hygiene, and WASH – do not add hard information, but they do appear to be useful. There are three key arguments here.

Argument 1. The indexes cut through the clutter.

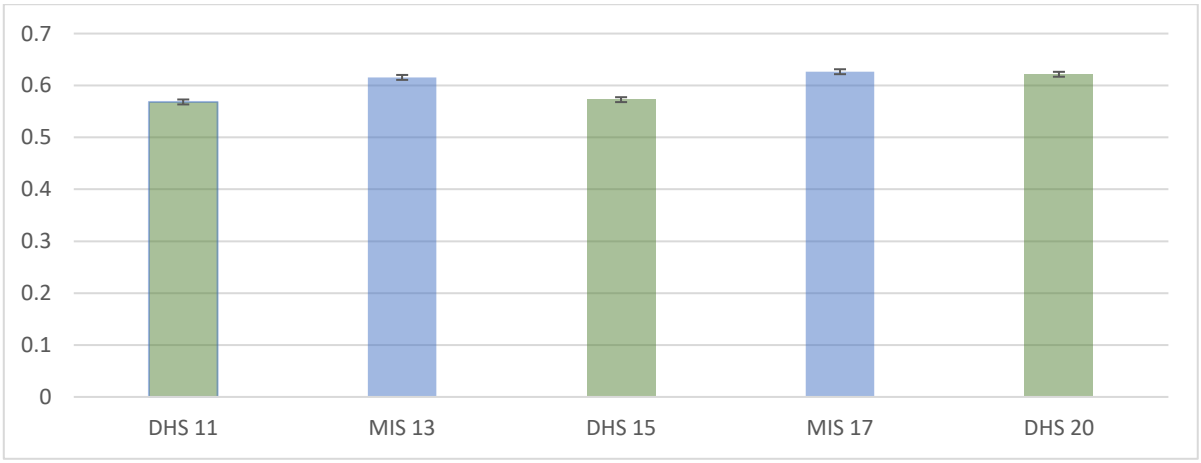
Table 8 shows some of the basic information on water supply from the DHS and MIS surveys of 2011 through 2020. It is very difficult to spot the trends. On the other hand, the water progress index – shown again (in slightly different format) in Figure 9 – clarifies the situation: there was some modest improvement in access to water services, whether one relies on the DHS data (green bars) or the MIS data (blue bars).

Table 8. Basic Information on Water Sources, Rwanda, 2010-2020

	surveyno					
watersource1	11	13	15	17	20	Total
Piped into dwelling/y	4.96	7.36	9.57	9.14	11.30	8.53
Piped to neighbor	25.54	25.51	26.48	2.05	3.14	17.46
Public tap/standpipe	0.00	0.00	0.00	28.67	29.89	10.84
Tube well or borehole	2.22	2.39	1.56	1.37	1.55	1.80
Protected dug well	2.39	1.77	1.94	2.08	2.43	2.19
Protected spring	37.99	41.39	32.03	32.88	28.52	33.71
Rainwater	0.36	0.92	0.80	1.41	0.46	0.66
Tanker truck/Cart wit	0.03	0.19	0.05	0.47	0.12	0.12
Bottled water	0.10	0.09	0.00	1.07	2.19	0.73
Unprotected dug well	1.89	1.33	1.73	0.88	1.52	1.59
Unprotected spring	14.48	11.01	13.90	14.09	11.11	13.04
Surface water	8.80	8.04	11.91	5.85	7.67	8.95
Other	1.17	0.00	0.04	0.04	0.10	0.36
99	0.06	0.00	0.00	0.00	0.00	0.02
Total	100.00	100.00	100.00	100.00	100.00	100.00

Sources: DHS and MIS surveys.

Figure 9. Water Progress Index, Rwanda, 2011-2020



Sources: DHS and MIS surveys.

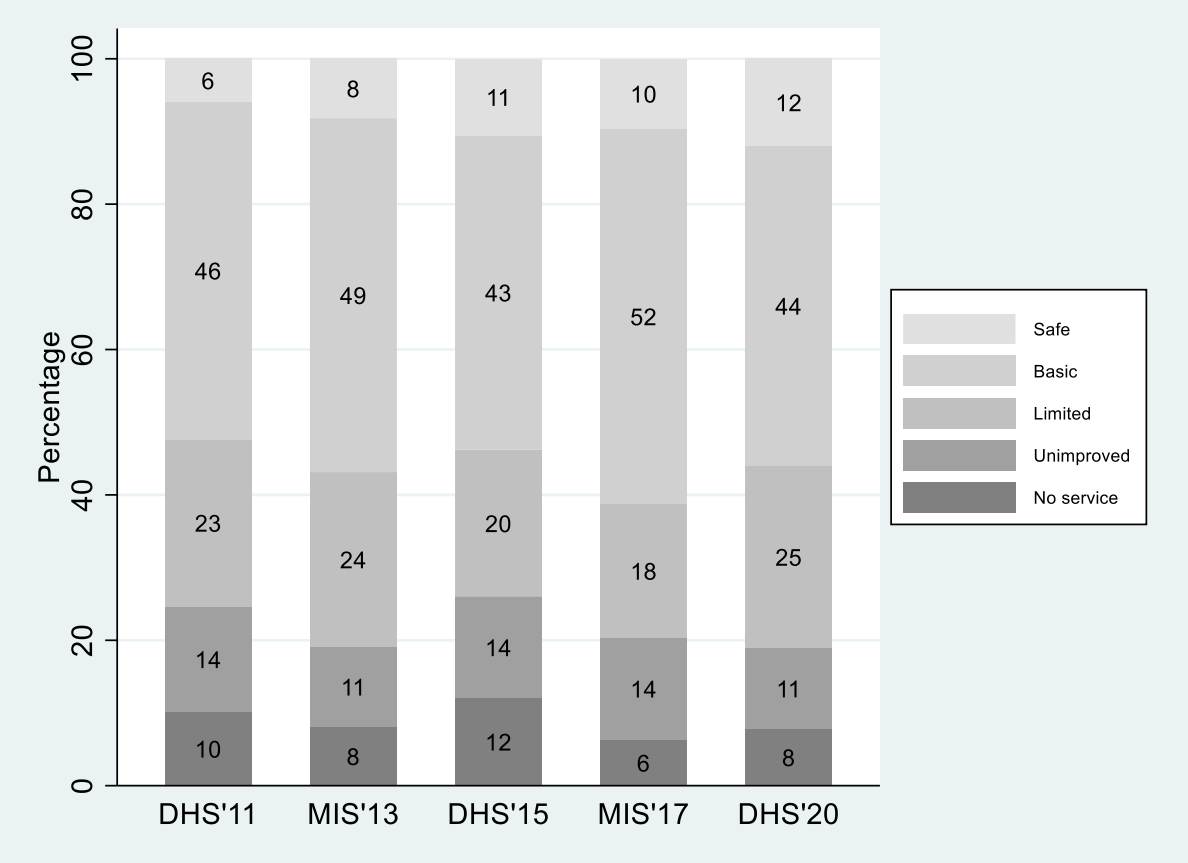
It is important to have a clear indicator, and a clear storyline, when introducing the subject to those who may not be immersed in the details. It helps set the agenda, and may drive future

actions, and in this sense is part of the "technology of governance" (Merry 2011). The previous section showed how we can begin to understand the WASH sector using these indexes.

We already use other summary measures in this way. The "poverty rate" summarizes what is really a complex issue, but the measure is easy to understand, and provides a basis for further discussion. The UNDP's Human Development Index is another example of a relatively simple measure that is designed to help drive the analysis of poverty and development.

When more detail is required, the "ladder diagram", in Figure 10, provides the next level of detail. Conceptually, these are like those used by JMP, but our preference is to show these in shades of grey, where each bar represents the results of a different DHS or MIS survey. Dark grey represents no service, and as we move up the bar, lighter grey shows better levels of water service and safety. There is a clear increase in the share of individuals with safely managed water, but the proportion of those with little or no service shows no evident trend.

Figure 10. Ladder of Water Service Categories, Rwanda, 2011-2020

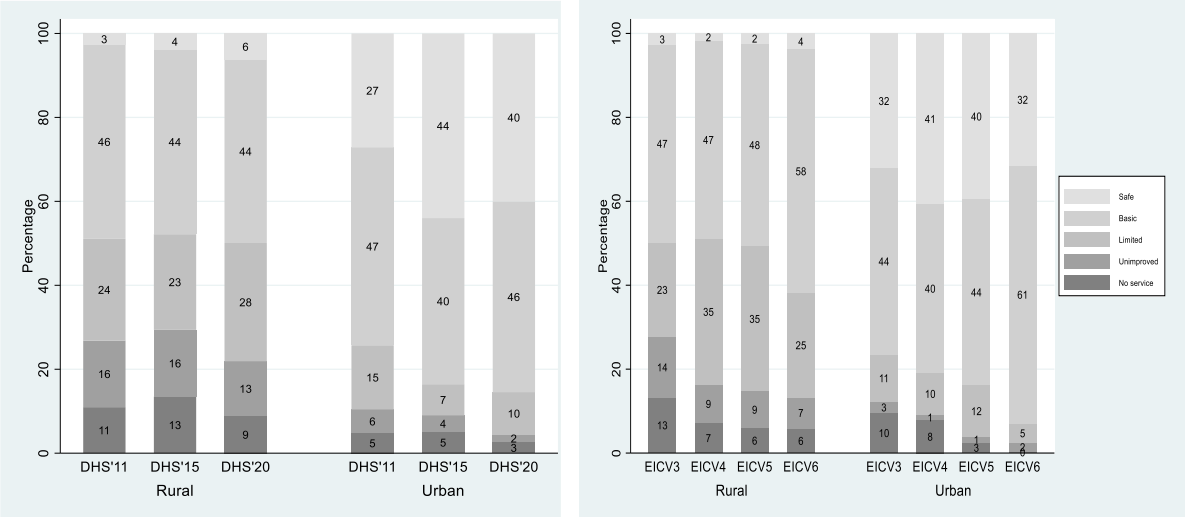


Sources: DHS for 2011, 2015, and 2020; MIS for 2013 and 2017.

In the same way as it is useful to disaggregate our indexes, it can be helpful to disaggregate the ladders, for instance by presenting ladders for water service separately for rural and urban areas, as done in Figure 11. The left-hand panel shows the DHS data, while the right-hand panel creates ladders using EICV data. It is clear that water quality is better in urban than rural areas. The DHS data show limited improvements in rural areas over time, unlike the EICV data,

which reflect evident progress, especially in the "basic" coverage. We should remember, however, that the two surveys do not collect strictly comparable information: The DHS survey asks about the time taken to fetch water, which is how basic and limited service are distinguished from one another, while the EICV asks about the distance required to fetch water.

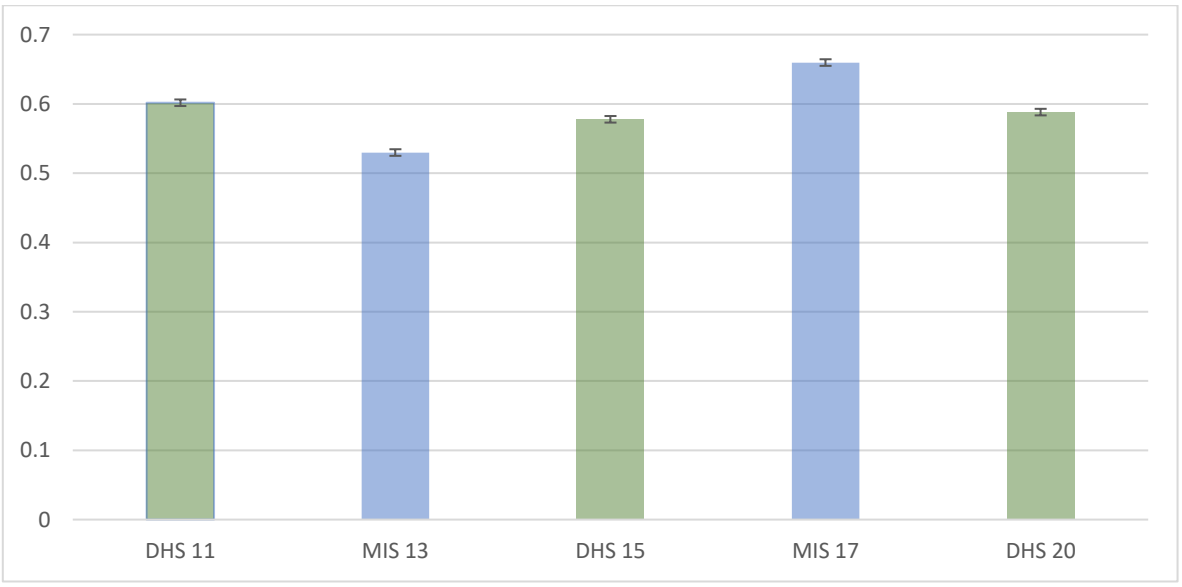
Figure 11. Ladder of Water Service Categories for Rural and Urban Rwanda, 2011-2020



Sources: DHS for the left panel, EICV for the right panel

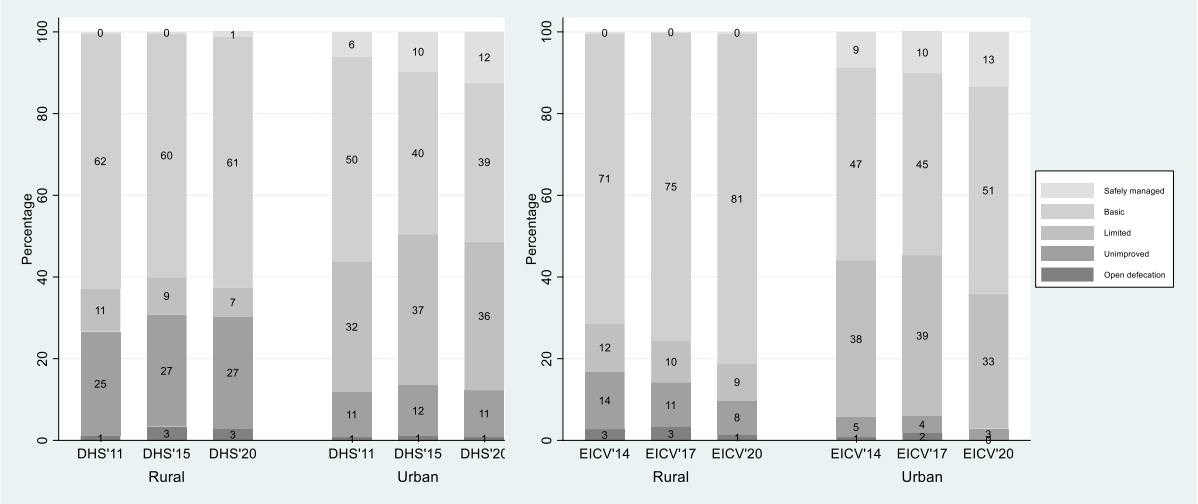
For completeness, we show the sanitation progress index, again in a slightly different form, in Figure 12. And Figure 13 shows a ladder for sanitation service categories, for rural and urban Rwanda, displaying separately the results of the DHS surveys and of the EICV surveys. The indexes keep us focused on the main trends; the more-detailed ladders help us understand what is going on, in more detail.

Figure 12. Sanitation Progress Index, Rwanda, 2011-2020



Sources: DHS and MIS surveys.

Figure 13. Ladder of Sanitation Service Categories for Rural and Urban Rwanda, 2011-2020

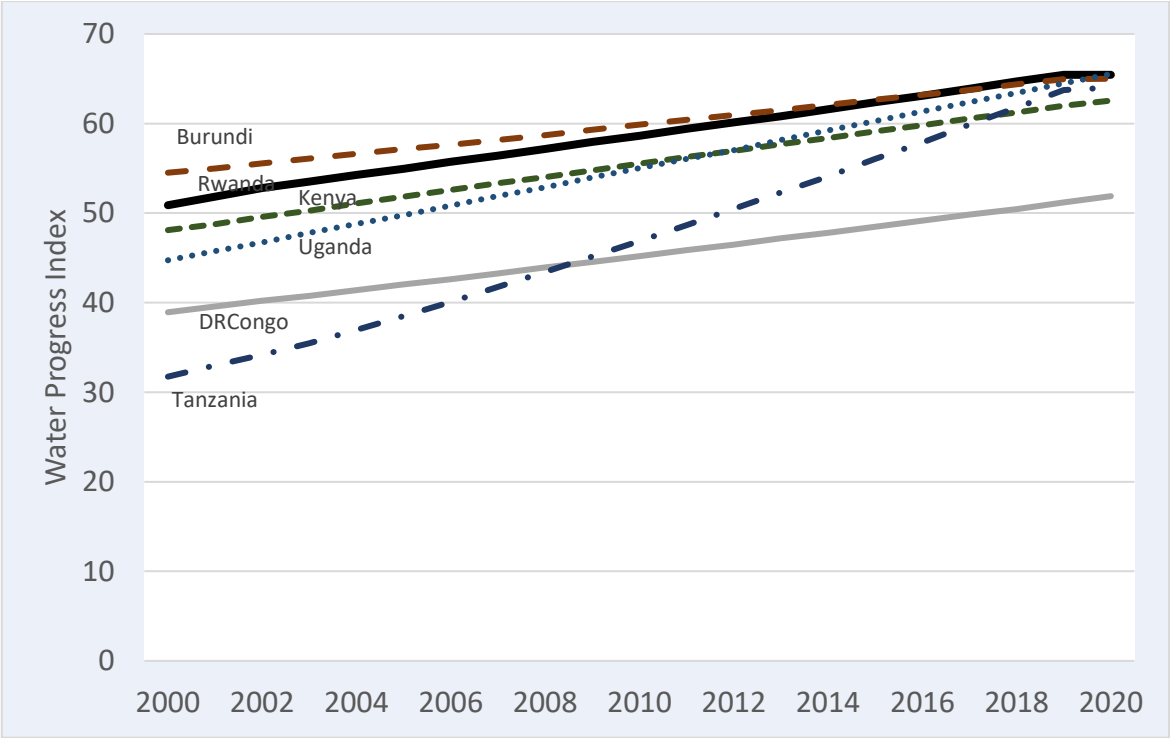


Sources: DHS for the left panel, EICV for the right panel

Argument 2. The indexes allow for international comparisons

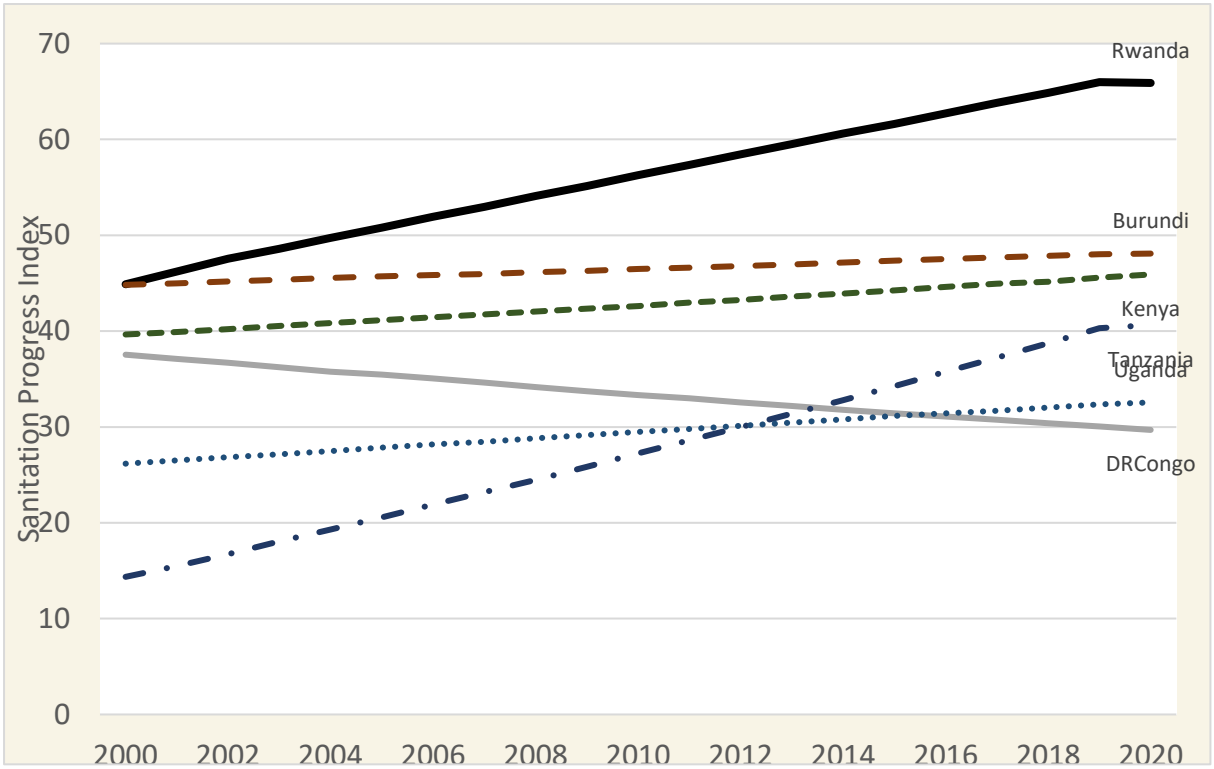
In Figure 14 we show water and sanitation progress indexes for Rwanda, and for its neighbors (plus Kenya). These have been computed based on the JMP data, which smooths the available survey data, and extrapolates to years for which survey data are not available. They show that Rwanda is among the regional leaders in providing water services, but most of its neighbors have essentially caught up with the Rwandan level.

Figure 14. Water Progress Index for Rwanda and Its Neighbors, 2000-2020



Source: JMP data.

Figure 15. Sanitation Progress Index for Rwanda and Its Neighbors, 2000-2020



Source: JMP data.

The sanitation progress index for Rwanda and its neighbors, presented in Figure 15, shows Rwanda to be well ahead of its neighbors, and to be advancing well. This picture of continued recent progress is not entirely consistent with the pattern of relative stagnation that we have found, based on our comparisons using similar surveys over time.

Argument 3. The indexes are better than other popular summary measures

The commonest summary measure of progress in water or sanitation used internationally is the proportion of households who have at least a basic (i.e., satisfactory) level of service. This proportion usually moves in tandem with the water or sanitation progress index, but this is not always the case. Consider Figure 16, which shows the sanitation progress index for urban residents, based on the JMP data. Also shown is the proportion of residents who have at least basic sanitation, meaning an improved source of sanitation that is not shared. The SPI shows a very slight upward trend, while the "Basic or better" share shows a deterioration in the situation. Which of these is correct?

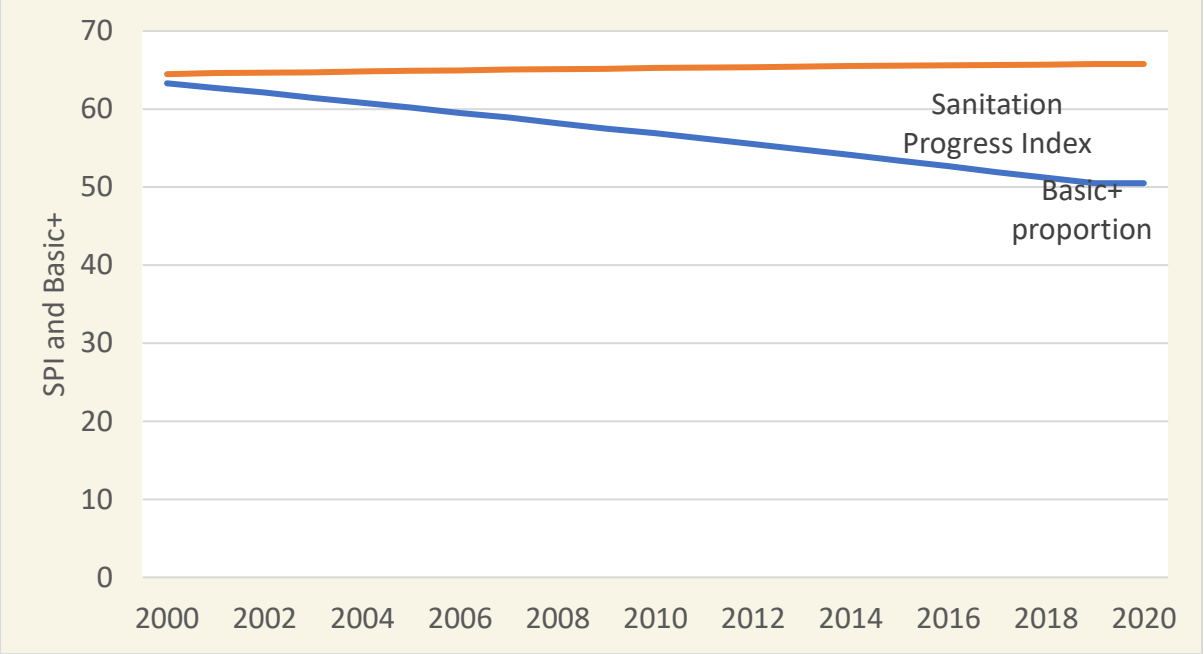
The issue may be resolved by examining the JMP data that underlie Figure 16, shown in Table 9. The proportion of urban residents with sanitation at a basic level or better did indeed decline between 2000 and 2020. However, the proportion of residents practicing open defecation, or using an unimproved facility, also declined. The result is that the proportion of those with "limited" sanitation, meaning an improved facility that is shared with other households, more than doubled over the twenty-year period. The sanitation progress index

picks up this shift from unimproved to limited sanitation, unlike the simple measure of those who have a "basic" service level or better.

The distinction matters. A country hoping to raise the proportion of households with basic sanitation or better might emphasize building more latrines so that fewer households have to share their facility with others. But a country aiming to raise the sanitation progress index might put more emphasis on replacing unimproved facilities with improved ones, even if they are shared. To the extent that simple indicators drive policy, the choice of a better indicator – such as the sanitation progress index – will in turn lead to better policy decisions.

In the Rwandan context, sharing sanitation facilities, provided the number of users is not excessive, may not be considered to be a heavy burden, especially as most people use other sanitary facilities – at work, at school, etc. – much of the time. A measure that reflects the proportion of urban households who have access to improved (as opposed to basic) sanitation would show a clear improvement between 2000 and 2020 – in this case, perhaps overstating the extent to which sanitation got better during this time.

Figure 16. Sanitation Progress Index vs. Households with At Least Basic Sanitation, Rwanda, 2000-2020



Source: JMP data.

Table 9. JMP Data on Sanitation Provision in Urban Rwanda, 2000-2020

Year	Basic+	Limited	Unimproved	Open defecation	SPI
2000	63.3	19.5	15.5	1.6	**64.5**
2001	62.7	20.5	15.2	1.6	**64.6**
2002	62.1	21.4	14.9	1.6	**64.7**
2003	61.4	22.4	14.6	1.6	**64.7**
2004	60.8	23.4	14.2	1.6	**64.8**
2005	60.2	24.3	13.9	1.6	**64.9**
2006	59.5	25.3	13.6	1.6	**64.9**
2007	58.9	26.3	13.3	1.6	**65.1**
2008	58.2	27.3	13	1.5	**65.1**
2009	57.5	28.3	12.7	1.5	**65.2**
2010	56.9	29.3	12.4	1.5	**65.3**
2011	56.2	30.3	12	1.5	**65.3**
2012	55.5	31.3	11.7	1.5	**65.4**
2013	54.8	32.3	11.4	1.5	**65.4**
2014	54.1	33.4	11.1	1.5	**65.5**
2015	53.4	34.4	10.8	1.5	**65.6**
2016	52.7	35.4	10.5	1.5	**65.6**
2017	51.9	36.5	10.1	1.4	**65.6**
2018	51.2	37.5	9.8	1.4	**65.7**
2019	50.5	38.6	9.5	1.4	**65.8**
2020	50.5	38.6	9.5	1.4	**65.8**
Source: JMP dataset.					

Chapter 7: Loose Ends

Including water and sanitation outside the home

One weakness of the indexes discussed here is that they only measure household use of home sanitation. Yet most individuals spend a good deal of time away from home: children go to school, most adults go to work, some people find themselves in hospital, others run errands, and so on. Ideally, an index of water or sanitation services would take into account the experience of the individual in all locations, rather than just the conditions in their dwelling.

In principle, more exhaustive indexes could be created. For instance, suppose a child spends 42 hours per week (i.e., 25% of their time) at school, and the other 126 hours at home. If sanitation at home is unimproved (weight 0.1), but sanitation at school is in an improved latrine (weight 0.6), then the *individual's* sanitation experience index would be 0.225 (= 0.25*0.6 + 0.75*0.1). An adjustment along these lines would be straightforward enough if information on the sanitation status of schools were available. It would be more difficult to incorporate information on the sanitation status of workplaces, but an additional question or two on a household survey could provide some information on this.

Robustness to weights

The water and sanitation indexes are weighted averages of the proportions of individuals at the different rungs of the JMP "ladders". The weights we have used are not unreasonable, and have been used by others (Lane 2018), but they are arbitrary. Ideally, the weights on different levels of service should reflect the importance that individuals and society put on each type of service (Kempster and Hueso 2018). In principle, one might ask for household willingness to pay for different levels of service, and also try to measure the effects of different service levels on outcomes such as heath. In reality, this is likely to be impractical.

This raises the issue of the extent to which the choice of weights matters. To explore this, we compared two sets of weights – our default weights, and equal-spaced weights – as follows:

Service level ladder	Default weight	Equally-spaced weight
Safe	1.0	1.0
Basic	0.8	0.75
Limited	0.6	0.5
Unimproved	0.1	0.25
No service	0.0	0.0

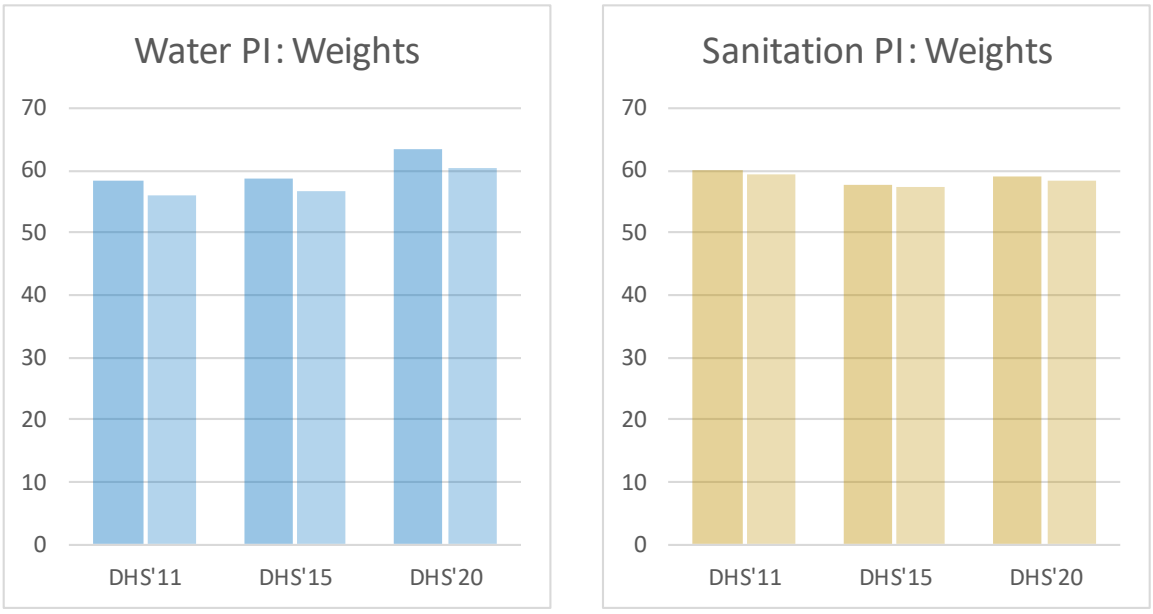
Source: Default weights follow Lane (2018). Equally-spaced weights are used in a sensitivity analysis by Kempster and Hueso (2018).

For each set of weights, we computed the water and sanitation progress indexes, with the results that are shown in Figure 17. The choice of weights leads to somewhat different levels

for the indexes, but the trends are the same, whether one uses our default weights, or equally-spaced weights. If the focus is on trends, the choice of index weights is not particularly important, within reasonable bounds.

If the indexes are interpreted as the distance that Rwanda has traveled towards safe water (or sanitation), then the choice of weights matters a bit more: according to the 2020 DHS, Rwanda was 63% of the way to safe water for all, using our default weights, but had covered only 60% of the distance if equally-spaced weights are used.

Figure 17. Water and Sanitation Indexes with Different Weights, Rwanda, 2010-2020



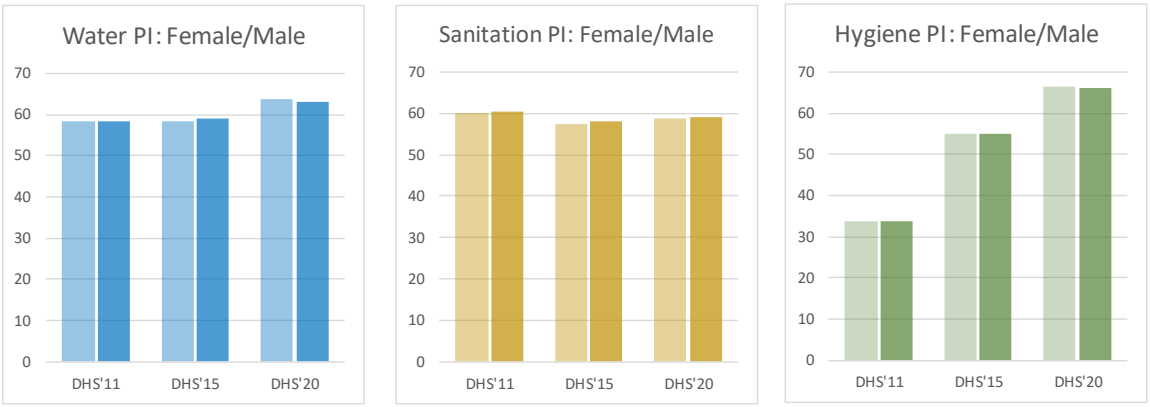
Notes: The left-hand columns apply our default weighting scheme: safe (1), basic (0.8), limited (0.6), unimproved (0.1), no service (0). The right-hand (lighter) columns use equally-spaced weights: 1, 0.75, 0.5, 0.25, and 0.

Gender

It would be useful to know whether the level of water or sanitation services received differs by gender. The difficulty here is that we have information at the household, rather than individual, level. However, households vary in the number of males and females, and so we may recompute the indexes using gender population weights. If households where most women live have relatively good sanitation, for instance, then the sanitation progress index will be higher for women than for men.

The key results are shown in Figure 18, and show essentially no differences between the service levels available to males and females, as measured by our indexes.

Figure 18. Water, Sanitation, and Hygiene Indexes for Females (left) and Males (right)



Source: DHS surveys of 2011, 2015, and 2020.

Association with poverty

One of the more important disaggregations of WASH data is by levels of wealth or poverty. The DHS surveys do not collect information on income or expenditure, but try to create a measure of wealth (or assets) that, it is hoped, roughly tracks levels of wellbeing. A sampling of this information was shown above in Figure 8b.

The EICV data do include enough information to measure consumption (per adult equivalent) and associated quintiles, as well as poverty rates, and the numbers are graphed in Figure 19. The pattern shows fewer discontinuities than the DHS data presented in Figure 8b, as Martel (2016) might have predicted.

It would be a nice exercise to relate expenditure per capita to measures of wealth, and apply this model to DHS data, as a way of testing how closely the DHS measure of wealth might track household consumption. It would also be useful to model the "determinants" of the water and sanitation progress indexes, possibly using regression techniques.

Figure 18. Water and Sanitation Indexes by Quintile and Poverty Status, 2017

Source: EICV'17. Quintiles show consumption per adult equivalent.

Chapter 8: The Status of WASH

In Section 1 we noted that the Sustainable Development Goals aim, by 2030, to:

- Achieve universal and equitable access to safe and affordable drinking water for all; and
- 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 water progress index (WPI) is designed to reach 100 when everyone has safe and accessible water. It currently stands at about 62, based on the 2019-20 DHS survey, up from 57 in 2010-11. If the trend continues, it could be expected to reach 70 by 2030, well short of universal access.

The 2019-2020 EICV survey shows a water progress index of 69, using a similar set of definitions to that of the DHS. It is not clear why the two surveys yield such different results, but if the EICV data are closer to the truth, then the improvements in water quality over the past decade have been substantial, and it would be plausible to reach a water progress index of about 80 by 2030.

The goal for the sanitation progress index is less clear, because "adequate" sanitation might simply be defined as limited or basic sanitation services, rather than ensuring a safe level of service for everyone. But whatever the goal might be, progress appears to be slow. According to the DHS data, the sanitation progress index (SPI) went from 60 in 2010-11 to 59 in 2019/20; the EICV data show a rise from 66 in 2013/14 to 72 in 2019/20, or by about one unit per year. If the pace continues at this latter rate, then one might reach an SPI of 80 or higher by 2030, which would be satisfactory if this mainly consists of eliminating open defecation and unimproved sanitation facilities.

The hygiene progress index shows a rapid rise, but caution is needed here, as the underlying data are rather fragile. We do not really know how COVID-19 has changed knowledge, attitudes, and practice towards handwashing, but it may well have led to its more widespread use. More data are needed before we can have confidence in this index.

The overall WASH index has shown substantial improvement, but as noted earlier, rests in part on the still-shaky information in the hygiene index. Looking ahead, as more-reliable and more-complete data become available, we will be able to have more confidence in the usefulness of the WASH index.

Recommendations

The analysis in this report leads to a number of recommendations.

1. The water and sanitation progress indexes, and to some extent the hygiene and WASH indexes, should be used routinely to summarize the progress that Rwanda is making in these areas.

The indexes are not a substitute for looking at the data in detail, but they are helpful in framing the discussion, and they can be disaggregated in order to show progress by area and by socio-economic group. They are likely to be most helpful when discussing progress on WASH matters with non-experts, who need a quick but tolerably accurate way to determine how well Rwanda is advancing.

2. There are significant issues of comparability across surveys, and these should be resolved to the extent possible.

The DHS surveys, traditionally the most-trusted source of information on water and sanitation, show no progress in sanitation, and very limited progress in water services, over the past decade. On the other hand, the EICV surveys, whose primary function has been on the measurement of poverty, show substantial improvements in water and sanitation over the same period. It is almost impossible to reconcile these two stories, but there needs to be a careful examination of the questions, and survey protocols, of these two series of surveys, in an effort to reconcile the two. This is a case where harmonization would be helpful.

One issue is that the questions may differ between surveys. For instance, until recently the EICV surveys asked about the distance to water, while the DHS and MIS surveys asked about the time required to fetch water. Fortunately, the EICV'20 survey asked about both, and going forward, there is likely to be greater comparability between these two important survey series.

A second issue is that the protocols for collecting data may differ across surveys. For instance, is the surveyor expected to verify personally the information on the nature of a latrine, or do they simply take the word of the interviewee? It would be desirable to discuss, and then share, the precise protocols that are used.

3. It would be helpful to be able to extend the indexes to cover access to water (and sanitation) outside the home.

In principle, it should be possible to match household survey data with information from other sources – for instance, administrative information on the quality of sanitation at schools, or data from a community survey that includes information on schools. Alternatively, it may be possible to collect usable data directly from households, albeit at the expense of making the questionnaires even longer. A decision would need to be made on whether the cost of collecting the additional data is worth the benefit, but it would help shed light on the apparent

disconnect between the substantial level of investment in sanitation, and the slow progress observed from household-level survey data.

4. More coordination on data issues would be desirable.

The Ministry of Infrastructure maintains a database related to WASH. In addition, NISR is the repository for EICV and census data. The DHS data are relatively accessible. Clearer arrangements for who maintains what data, and how those data may be accessed, by whom, and using what tools, would be helpful.

5. Additional data are needed

Although we have information on the average amount of time taken to fetch water, we do not know how frequently households fetch water, so we cannot accurately compute the time burden required for fetching water. Nor do we know who in the household bears the most burden of fetching water. And there is little information on how pure the water is, and hence how much treatment would be desirable. This additional information would help drive priorities for improving water supply, and would help us understand who the beneficiaries of such efforts would be.

There are some issues that call for a careful research effort. It is an article of faith that better sanitation leads to better health. Yet we do not know whether this is really true, and if it is, which improvements in sanitation are the most effective at creating better health outcomes. The same issue arises with water, where there is very little information on the quality of water, or the value of treating water, and their links to health. There may be some scope here for randomized controlled trials to get answers to questions like these.

6. What motivates households to invest in sanitation

Most, but certainly not all, households now have an improved sanitation facility. What is not clear is what steps are needed to ensure that all households have improved sanitation. Does it call for more subsidies to households? The provision of slabs? Help with digging latrines? A public campaign? Gross and Günther (2014) have examined this issue in the case of Benin, but a better understanding of how and when households invest in sanitation would be useful as Rwanda reaches out to the "holdout" households whose sanitation is not yet adequate.

7. Government and its partners still play an essential role

It is too soon for Rwanda to declare victory, and leave the responsibility for sanitation and water to the private sector and to households. If the JMP data are to be believed, Rwanda has fared well relative to its neighbors on sanitation, although it is likely that this progress is overstated. Most of the neighbors have now reached a comparable level of provision of water services. Clearly, there is much work to be done.

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