Asian Water Development Outlook

KD1 Rural Household Water Security

FINAL REPORT

International WaterCentre

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Executive Summary

In AWDO 2020, KD1 has been redefined from 2016, where it considered household water security to now consider only Rural Household Water Security (RHWS). Specifying rural areas meant that the KD needed a new definition. For the purposes of KD1, RHWS has been defined as (underlining added for emphasis): "*The provisions of sufficient, safe, physically accessible and affordable water, and sanitation services for health and livelihoods, coupled with an acceptable level of water-related risk, in rural households.*"

Typically, rural households are poorer and more disenfranchised than their urban neighbours. Urban households usually have higher disposable incomes and better access to service *provision* than rural areas (WWAP 2019). Further, water and sanitation for households is generally less attractive to funding organisations compared to water for economic uses like agriculture, as the direct return on investment is lower and indirect (UN-Water 2017). It could be argued that rural households are the most *vulnerable* to water related *risks* and when combined with lower service *provision,* they constitute the least water secure communities.

A key element emphasised by the Sustainable Development Goals (SDGs) is that no-one is left behind. In the AWDO, rural households, along with those living in urban informal settlements (considered as part of KD3), are the most vulnerable. Thus, KD1 is most closely aligned with SDG 6 and provision of clean water as a basic human need, particularly with targets 6.1 and 6.2, of all the KDs. Further, investment in WASH has shown to have a very high indirect return on investment, through health, education and other benefits (WWAP 2019).

This dimension cannot only consider rural households' impact on water security regarding the volume of water used. Through AWDO, particularly KD1, governments and donors must recognise that improving the water security of rural households has its own intrinsic value, which is inherently linked to a holistic definition of water security.

Method

Four sub-indicators and a risk framework have been developed to create the overall KD1 score, including four sub-indicators. Figure 1 shows a summary of the KD1 method. In plain English, each sub-indicator is attempting to measure:

- sub-indicator 1 – access to water supply: *a score that considers how many rural people have access to different levels of water supply*
- sub-indicator 2 – access to sanitation: *a score that considers how many rural people have access to different levels of sanitation services*
- sub-indicator 3 – health impacts: *the health impacts, measured in Disability Adjusted Life Years (DALYs), of inadequate water supply, sanitation, and hygiene service*
- sub-indicator 4 – affordability: *the percentage of household consumption needed in order for rural households to afford safely managed water supply, sanitation, and hygiene services.*

Sub-indicators 1 and 2 used the Joint Monitoring Program (JMP) service ladders to find a raw score, which was then banded to find the sub-indicator scores. Prior to the raw score an Open Defecation (OD) threshold was applied to sub-indicator 2, resulting in countries with higher levels of OD not being able to receive high sub-indicator 2 scores. To find a raw score out of three:

- the proportions of the rural population with an at least basic service was multiplied by three
- the proportions of the rural population with an improved service was multiplied by two

- the proportions of the rural population with an unimproved service was multiplied by one.

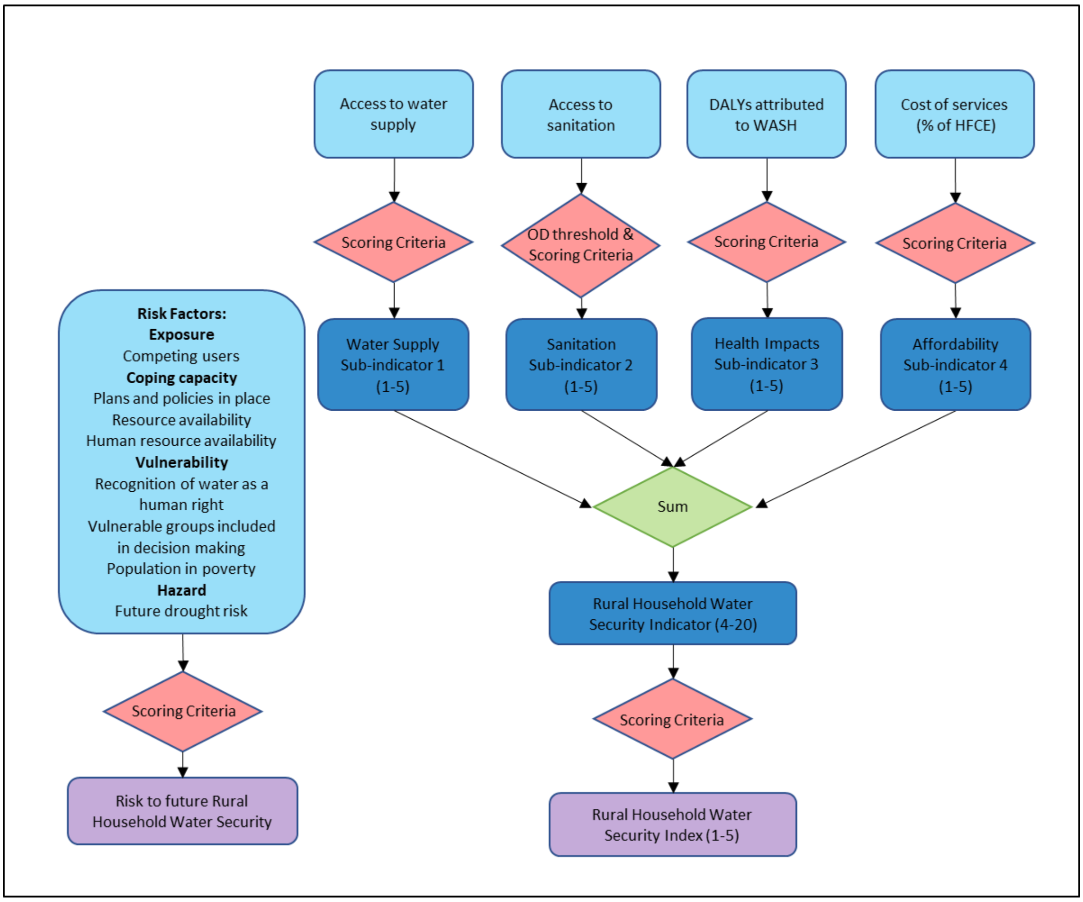

Figure 1. Summary of the KD1 sub-indicators and method

Sub-indicator 3 used an existing dataset that showed each ADB countries' WASH attributable diseases burden measured in Disability Adjusted Life Years (DALYs).

Sub-indicator 4 used a Water and Sanitation Program and World Bank database that had estimated the costs of safely managed water services in ADB countries. This cost had CPI and currency exchange factors applied to find these costs in 2018 National Currency. Household consumption was found by divided total household consumption by population. Affordability was then calculated as the percentage that costs of water services would be of household consumption.

With the raw scores determined, sub-indicators scores were found using the bandings shown in Table 1.

Table 1. Bandings for each of the sub-indicators

Sub-indicator score	SI 1 & 2 Raw score	WASH attributable DALYs per thousand people	Affordability (cost as a percentage of household consumption)
5	Equal to 3	Less than 1	Less than 2%
4	2.95 – 3	1 – 2	2% – 3%
3	2.75 – 2.95	2 – 5	3% – 4%
2	2.2 – 2.75	5 – 10	4% – 5%
1	Less than 2.2	More than 10	More than 5%

Results

Figure 2 shows the KD scores for each ADB country.

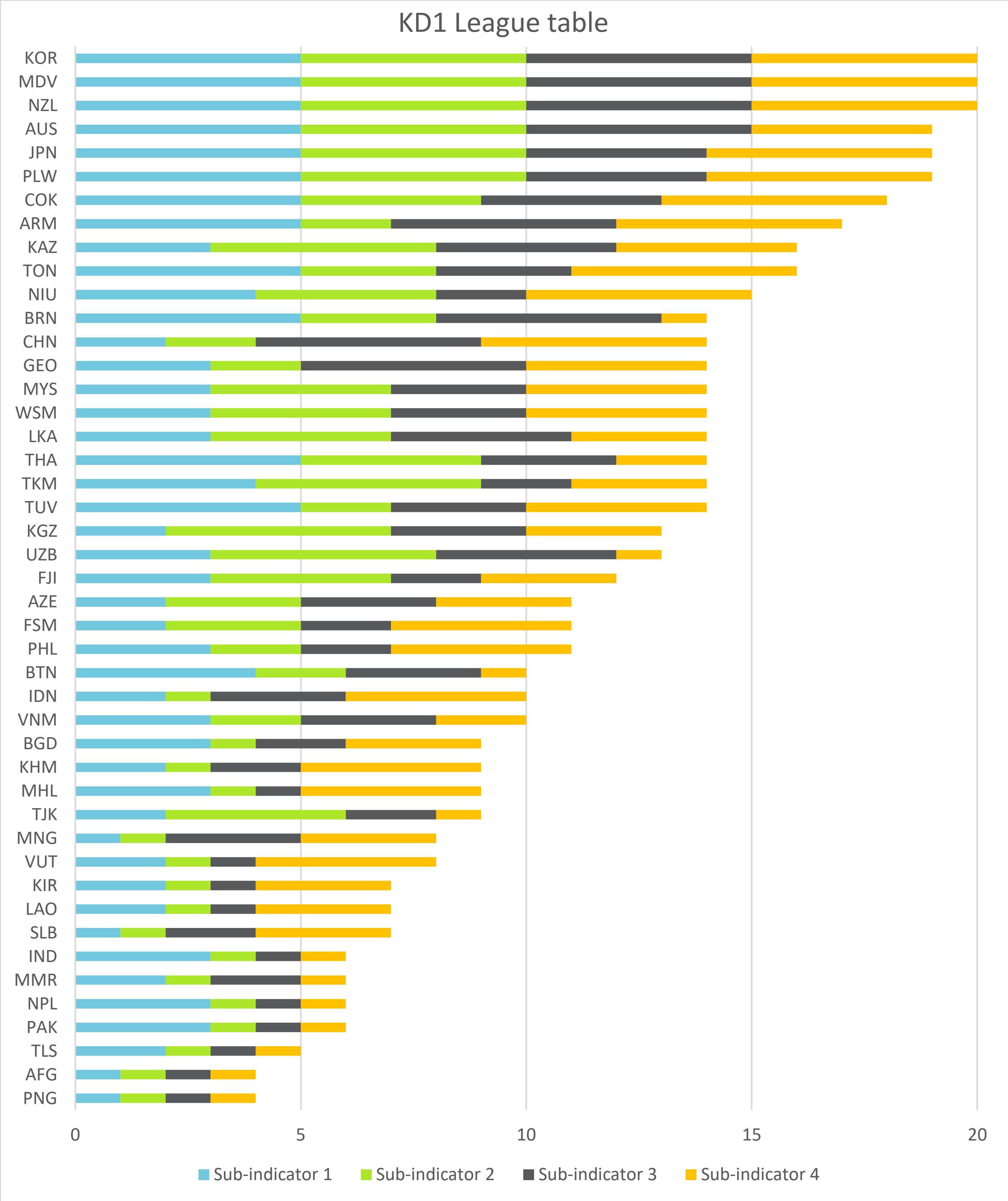

Figure 2. KD1 league table showing KD scores for all countries

Figure 3 shows the changes of KD1 through time by comparing 2020 scores with adjusted scores for 2013 and 2016.

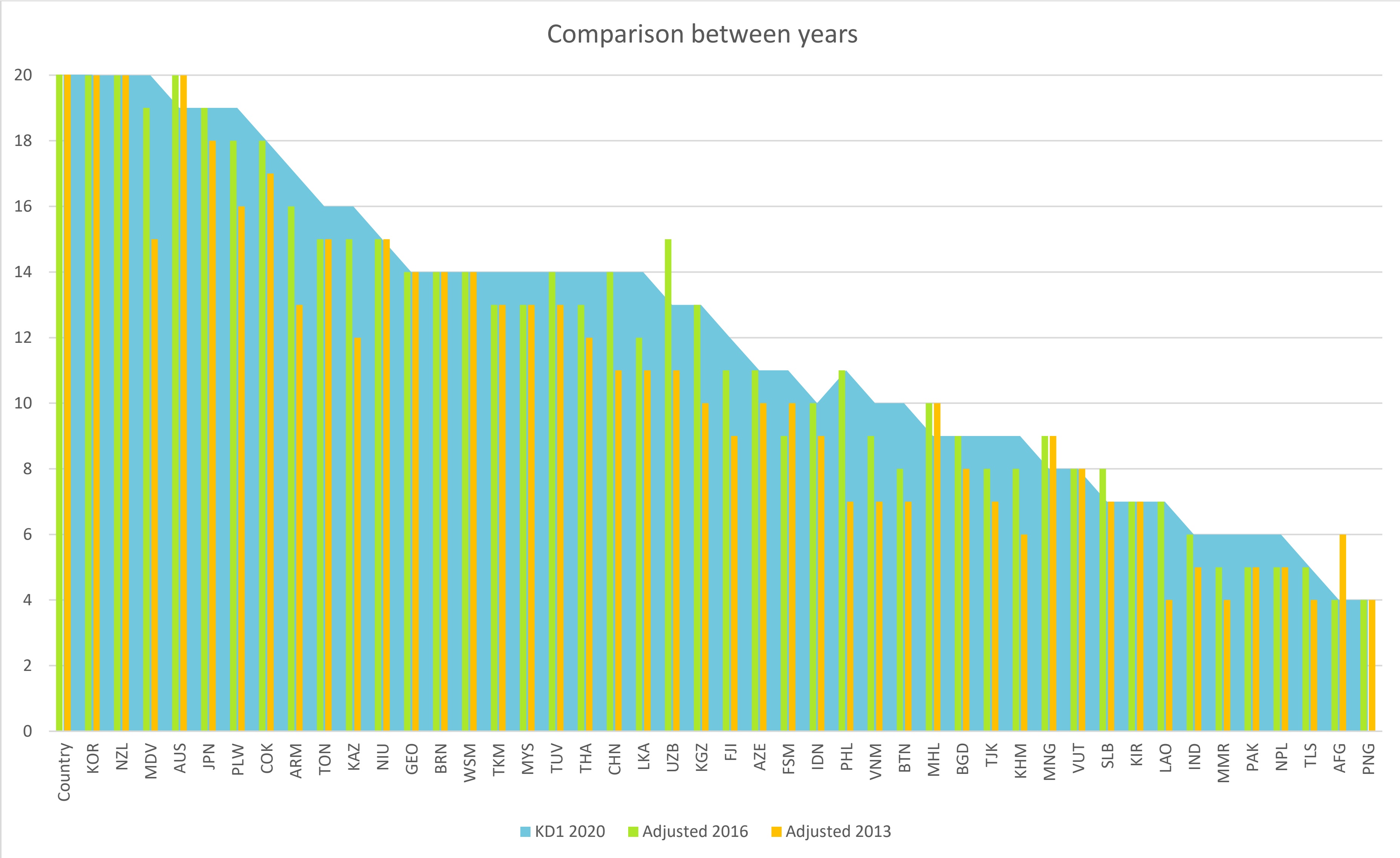

FIGURE 3. CHANGES BETWEEN THE 2020 AND ADJUSTED 2016 AND 2013 SCORES

Figure 3 shows that most countries have seen recordable improvement in this time period, with only 4 country scores worsening and all except for one for a specific reason regarding the affordability sub-indicator. Overall, it has been shown that RHWS in the Asia-Pacific is improving.

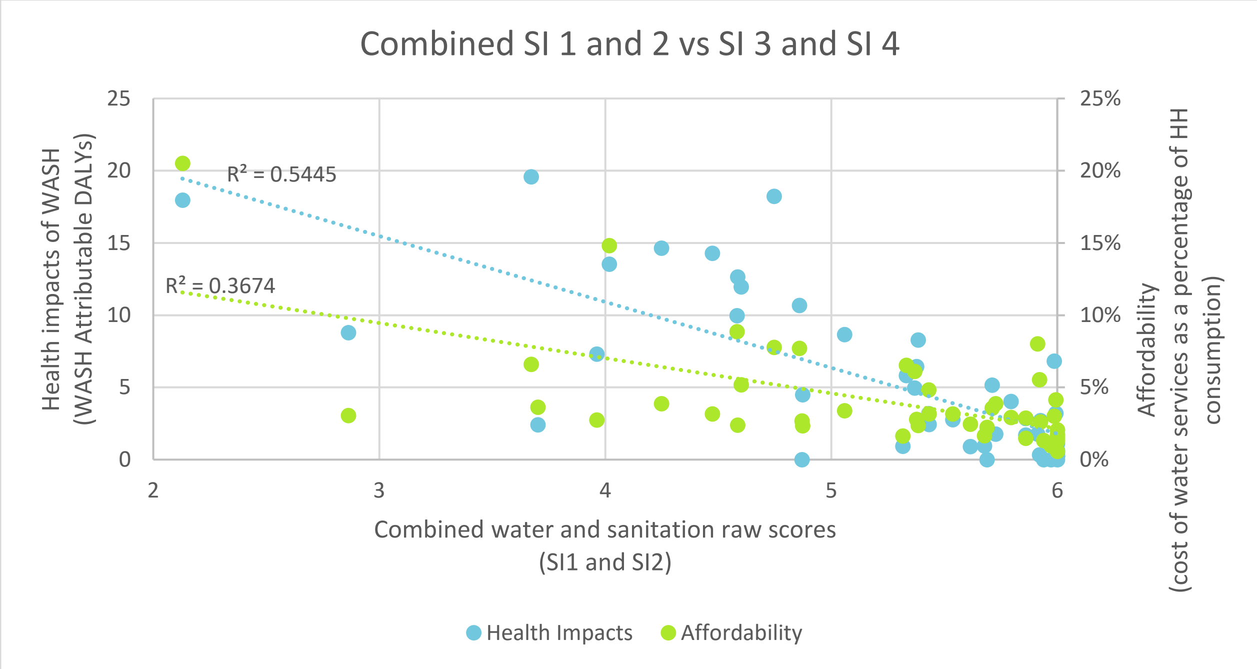

Figure 4. Correlation analysis between the sub-indicators

Figure 4 shows the correlation between access to water supply and sanitation and health impacts and affordability. There can be seen a clear positive correlation in both the plots. Therefore, it shows that more affordable water services improve water and sanitation access, which in turn improves health outcomes. However, the R values for both plots are relatively low, 0.5445 and 0.3674 for Affordability and Health Impacts respectively, suggesting that these are not the only factors.

Figure 5 shows the average KD1 scores from across the ADB regions. As expected, Advanced Economies were found to have the highest water security for rural households receiving very good scores for all sub-indicators, the highest of all regions in each sub-indicator except affordability, which was tied with East Asia. This shows that affordability is difficult for both advanced and developing economies to achieve. Central West Asia and the Pacific both performed well out of the other regions with similar scores across all sub-indicators. Central West Asia had poor affordability and the Pacific had poor health impacts. However, not using population weighted averages is somewhat misleading, particularly in the Pacific. East Asia received poor scores for water supply and sanitation but performed very well in health impacts and affordability, this region is the only region that does not reflect the correlation between sub-indicators, shown in Figure 4. South Asia is relatively strong in water supply, but weak in other areas. South East Asia performed relatively poorly across all the sub-indicators. Finally, the Pacific scored well in water supply and sanitation, in particular sanitation, while performing poorly for health impacts. This is likely because of some illnesses that were attributed to WASH, which can be exasperated by tropical climates. It was shown that more affordable water services improve water and sanitation access, which in turn improves health outcomes. Both showed linear correlations with low R scores, suggesting that these are not the only factors.

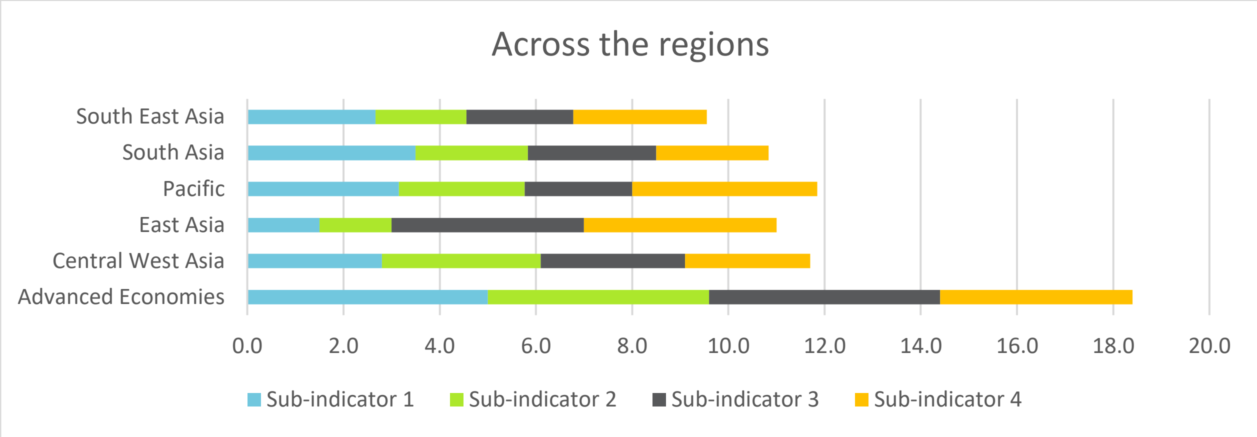

FIGURE 5. AVERAGE KD1 AND SUB-INDICATOR SCORES FOR EACH ADB REGION

Risks

The risk framework assed the risks in each of the countries using a framework like one that has been used in KD 5. The risk framework and the indicators that were considered are shown in Figure 6.

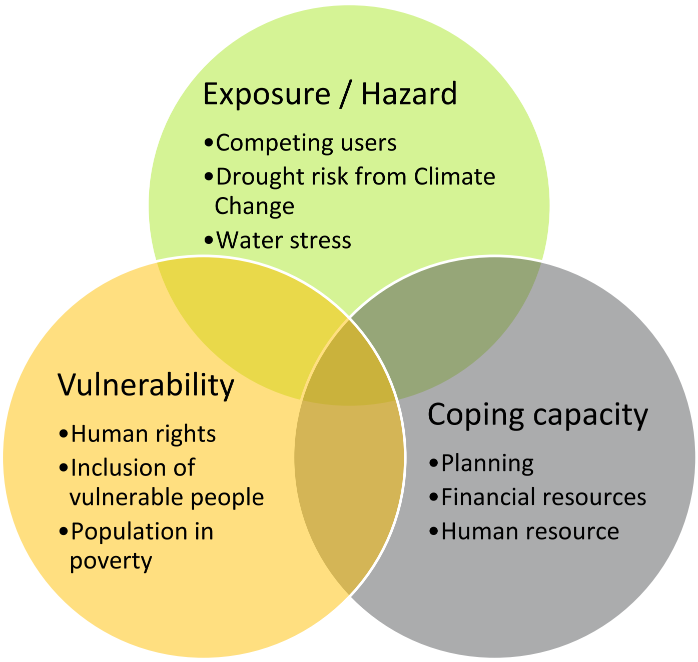

FIGURE 6. CONCEPTUAL REPRESENTATION OF RISK FRAMEWORK DEVELOPED BY KD5 AND RISK INDICATORS

A quick analysis of the risk indicators showed several indicators across regions, which point to future risks to rural water security. Below is a list of each of the key risks identified:

- there will be increased water stress in Central West Asia and East Asia
- there will be large populations of people in severe water scarcity in Central West and East Asia, India, Bangladesh, and Indonesia - this largely aligns with water stressed countries with high populations
- there is a lack of financial and human resources across all regions, this is particularly high risk in South East Asia

- poverty will be a big challenge in Central West Asia and the Pacific
- climate change is likely to impact RHWS in the region with Pacific countries being at the highest risk.

Sustainable Development Goals and gender

An analysis has shown that there are six SDG targets that closely align to KD1, with each sub-indicator most closely related to one target. Sub-indicators 1 and 2 are most closely related to SDG targets 6.1 and 6.2, respectively. Sub-indicator 3 is closely related to SDG target 3.9 and sub-indicator 4 is most closely related to target 1.4. However, each of the sub-indicators are also related to other targets as shown in Figure 7.

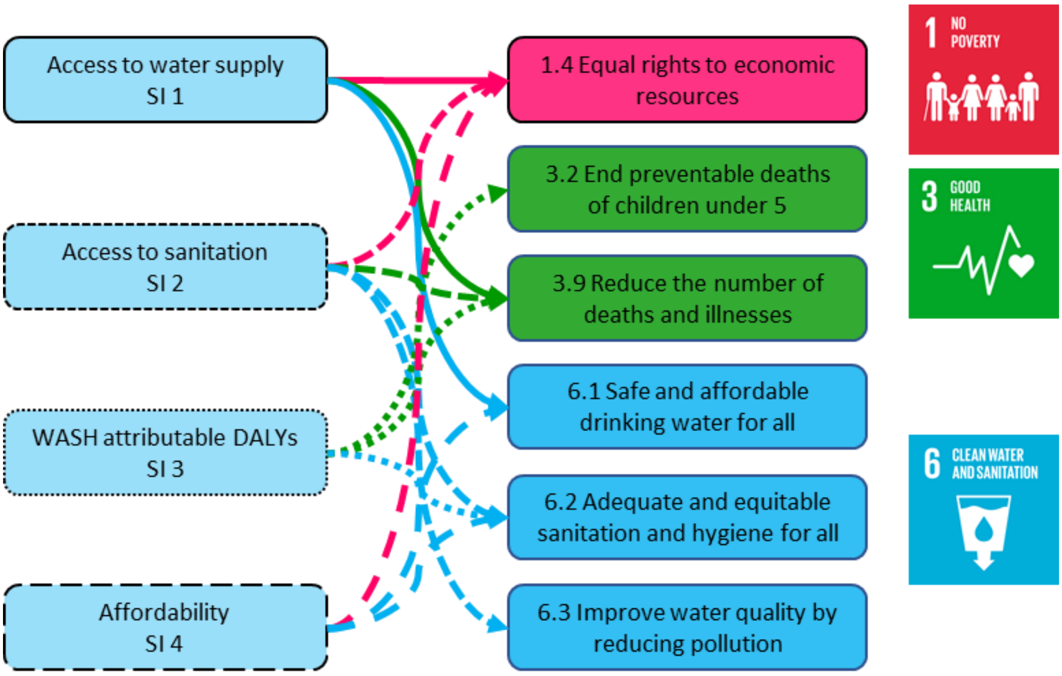

Figure 7. Interaction between KD1 sub-indicators and SDG targets

SDG 5 (gender equity) has not been included in this assessment, as none of the SDG 5 targets directly relate to or explicitly mention water and sanitation; however, there are multiple indirect or implicit linkages between. Improved RHWS would help to meet targets 5.1, 5.2, and 5.4, in particular the unpaid domestic work burden discussed in target 5.4, is specifically related to water fetching. Further, were target 5.5 to be met, it could be reasonably expected that RHWS would also improve as a result of better gender sensitive and more participative decision making, as discussed in section 5.6. It should also be noted that most databases are not disaggregated between men and women, making it difficult to understand the gender equity issues specific to each country.

Systems strengthening recommendations

Forward looking recommendations were developed inside the frame of a systems strengthening approach, so that no one is left behind. This process has resulted in four recommendations for government and ADB investment and advocacy priorities with respect to RHWS.

Improved data collection, monitoring and evaluation

Gaps in data sets have been a significant issue in KD1. Each of the sub-indicators has needed to be altered from what would be ideal because of the practicalities of what data exists. This has been most discussed in this report, regarding the absence of safely managed data for many countries, which has meant that sub-indicators 1 and 2 do not completely align with the SDGs. There have also been similar considerations made in the other sub-indicators and the risk framework.

Not only would better data assist in creating AWDO and similar research projects, but it is also vital for science-based decision making. A characteristic of a mature WASH sector is one where policies and plans are centred around reasoned, rational arguments, informed by data. Therefore, without accurate data, rational policy is difficult, if not impossible, to create. Improved monitoring and evaluation, in particular regarding safely managed water supply and sanitation and the health impacts of WASH, should be advocated for and invested in by governments in order to facilitate science-based decision making.

Targeting vulnerable people in decision making

Globally, vulnerable people have worse access to WASH services than nationally. Vulnerable people can include women, children, the elderly, the poor, those with a disability or any ethic or sexual minorities. In general, rural populations are more vulnerable and therefore it is important that KD1 offer recommendations regarding vulnerable people.

There is evidence that without targeting, vulnerable populations can miss out and be at a much higher risk of health impacts (World Bank 2017, WWAP 2019). Vulnerable populations and those in rural areas have less access to financing than in urban areas. This is even more prevalent when considering household water. With less access to funding or less ability to pay back loans, vulnerable people often are left with open defecation as their only option and paying more for water (Mitlin 2019) that water is often of a lower quality (JMP 2019), further driving their poverty and vulnerability.

To achieve better outcomes for vulnerable people, governments should invest more in engaging with vulnerable groups through targeted policies and empowering them to partake in decision making. Vulnerable groups are non-homogeneous, having a vast array of needs and desires and will respond to policies in different ways so a one-size-fits-all model will not work. Of the 23 countries that completed the appropriate part of the GLAAS survey, 19 have policies in place specifically to include vulnerable people in decision making. However, it is unknown how well funded the needs of vulnerable people are in these stretched WASH sectors.

Human resource capacity

Only two of 31 ADB countries reported that they have the human and financial resources necessary to implement their water and sanitation policies. Many ADB countries have shown considerable growth in RHWS, even in the face of increase water scarcity and stress. However, without the necessary resourcing and investment in human resources, this is likely to become a factor limiting growth, particularly in South East Asia. Governments throughout Asia and the Pacific should immediately begin to invest in the human resource gaps to be able to deliver water services of the future.

Locally appropriate solutions for Pacific nation

The population weighted average KD1 score for Pacific countries is very low. Further, as climate change will have a larger impact on these countries and these impacts will be exacerbated due to high levels of poverty. It is also possible that they will continue to stagnate, or even go backwards in the future. Research into Integrated Water Resource Management (IWRM) suggests that a holistic focus on a ridge-to-reef catchment planning could be a promising solution (Hadwen 2015).

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List of acronyms

Term	Extension
ADB	Asian Development Bank
APWF	Asia-Pacific Water Forum
AWDO	Asian Water Development Outlook
CPI	Consumer Price Index
DALY	Disability adjusted life year
GDP	Gross domestic product
HFC	Household Final Consumption
IWRM	Integrated Water Resource Management
JMP	Joint Monitoring Programme
KD	Key Dimension
KID	Key Indicator Database
NC	National Currency
OD	Open Defecation
PRC	People's Republic of China
RHWS	Rural Household Water Security
SDGs	Sustainable Development Goals
SI	Sub-Indicator
UN	United Nations
UN Water	United Nations Water
USD	US Dollar
WASH	Water Supply, Sanitation and Hygiene
WHO	World Health Organisation
WWAP	World Water Assessment Program

List of country and regional offices

Regional office or country	Acronym
Advanced Economies	AE
Central West Asia Regional Department	CWRD
East Asia Regional Department	EARD
Pacific Regional Department	PARD
South Asia Regional Department	SARD
South East Asia Regional Department	SERD
Afghanistan	AFG
Armenia	ARM
Australia	AUS
Azerbaijan	AZE
Bangladesh	BGD
Bhutan	BTN
Brunei Darussalam	BRN
Cambodia	KHM
China, People’s Republic of	CHN
Cook Islands	COK
Fiji	FJI
Georgia	GEO
Hongkong, China	HKG
India	IND
Indonesia	IDN
Japan	JPN
Kazakhstan	KAZ
Kiribati	KIR
Korea, Republic of	KOR
Kyrgyz Republic	KGZ
Lao People’s Democratic Republic	LAO
Malaysia	MYS
Maldives	MDV
Marshall Islands	MHL
Micronesia, Federated States of	FSM
Mongolia	MNG
Myanmar	MMR
Nauru	NRU
Nepal	NPL
New Zealand	NZL
Niue	NIU

Pakistan	PAK
Palau	PLW
Papua New Guinea	PNG
Philippines	PHL
Samoa	WSM
Singapore	SGP
Solomon Islands	SLB
Sri Lanka	LKA
Taipei, China	TPE
Tajikistan	TJK
Thailand	THA
Timor-Leste	TLS
Tonga	TON
Turkmenistan	TKM
Tuvalu	TUV
Uzbekistan	UZB
Vanuatu	VUT
Viet Nam	VNM

1 Background on AWDO

The Asian Water Development Outlook (AWDO) was initiated by the Asian Development Bank (ADB) and the Asia-Pacific Water Forum (APWF) to highlight important water management issues in the Asia- Pacific region. Three editions have been published so far: 2007, 2013 and 2016.

Working with ADB and the Australian Water Partnership, the International WaterCentre (IWC) has led the development of three Key Dimensions (KDs) of AWDO 2020: KD1 Rural Household Water Security, KD3 Urban Water Security, and KD4 Environmental Water Security. This report presents the revised method and results of KD1 for AWDO 2020. It presents the findings by sub-indicator, country, and region, and makes a number of recommendations to further improve KD1 methodology and rural household water security for rural people into the future.

1.1 Historical development of AWDO

AWDO 2013 was guided by a vision that *"societies can enjoy water security when they successfully manage their water resources and services to 1) satisfy household water and sanitation needs in all communities; 2) support productive economies in agriculture and industry; 3) develop vibrant, liveable cities and towns; 4) restore healthy rivers and ecosystems; and, 5) build resilient communities that can adapt to change*". AWDO 2013 was targeted to the countries' Ministers of Finance and Planning; AWDO 2013 recommended how to guide investments with better governance to increase water security in years to come.

AWDO 2016 refined the analytical framework and indicators, provided more detail, and created confidence that the 2013 methodology could be repeated. Importantly, this enabled preliminary comparisons of security changes through time. In doing so, it raised questions of "what shifted security?". I.e. was it changes in real on-ground management or infrastructure? Or were changes in security related to changes in methods or data?

In both AWDO 2013 and 2016, the importance of continual improvement and innovation was stressed, while balancing the need to enable comparisons through time.

1.2 Evolution of Key Dimension 1

The definition and measurement of KD1 was consistent in the 2013 and 2016 editions, with little change to the methodology applied. In the 2013 and 2016 versions of AWDO, KD1 measured household water security, which was defined as *"To what extent countries are satisfying their household water and sanitation needs and improving hygiene for public health".* Both the 2013 and 2016 indexes were composed of three sub-indicators: (1) access to piped water supply, (2) access to improved sanitation, and (3) a hygiene index measured in disability-adjusted life years (DALYs).

The 2020 version of AWDO marks a significant evolution in how KD1 has been defined and measured. In AWDO 2020, KD1 measures Rural Household Water Security (RHWS). The major difference being that urban households have been removed from KD1 and have been included as part of KD3, urban water security. This presents challenges of i) defining a new set of indicators and ii) developing a revised methodology for calculating RHWS that integrates social, equity and inclusion factors. It also raises the need to explore possible options for back forecasting to compare results of previous AWDO reports (i.e. 2013 and 2016).

1.3 The importance of water security to rural households

There are numerous reasons why RHWS is prominent in the AWDO and deserving of being the first KD. While rural households consume a relatively insignificant volume of water compared to the other KDs, they make up almost half of all households in Asia. And while their water consumption may be insignificant, the security of their water is critical to their livelihoods and well-being, and therefore central to any robust and holistic water security assessment.

Bradley and Bartram (2013) discuss the importance of disaggregated monitoring of water security outcomes with particular importance placed on rural/urban data disaggregation. Disaggregation of data can *"sharpen understanding of where the problems lie and to bring the datasets closer to the providers of water and sanitation services".* As well as the rural/urban disaggregation, the authors put forward disaggregation across wealth quartiles, gender and those with special needs.

Taking the concept of water related risk, a 2015 report from REACH conceptualises this further. *"Water-related risks…can be characterised as a function of hazard, exposure and vulnerability:*

- *hazard is a phenomenon with the potential to cause damage or harm*
- *exposure refers to the people, assets and livelihoods that could experience harm and loss due to the hazard*
- *vulnerability captures the propensity to experience harm as a dynamic function of the capacity to anticipate, cope with and recover from harmful events. Poor people have typically higher vulnerability due to lower capacity to anticipate and recover from water-related hazards."*

REACH further considers socio-economic factors and inequality as intrinsic to water related risk.

Typically, rural households are poorer and more disenfranchised than their urban neighbours. Globally, approximately 80% of people without improved water and 75% of people without improved sanitation live in rural areas (World Bank 2017). Urban households typically have a higher disposable income and live in closer proximity and therefore often have better access to centralised service provision than rural areas (WWAP 2019). Further, households in general are less attractive to funding organisations compared to water for economic uses, such as agriculture, as the direct return on investment is lower (UN-Water 2017). It could be argued that rural households are the least water secure segment of society along with urban informal settlements.

A key element emphasised by the Sustainable Development Goals (SDGs) is that no one is left behind. In AWDO, rural households along with those living in urban informal settlements (considered as part of KD3) are the most vulnerable and are the embodiment of this emphasis. Therefore, KD1 is most closely aligned with SDG 6, particularly with targets 6.1 and 6.2. Further, investment in WASH has shown to have a very high indirect return on investment, through economic development, health improvements, reduction of stunting (Kwami 2019), education, gender equity and other benefits.

This dimension cannot consider the water security implications of only the volume of water used by rural households. Through AWDO, particularly KD1, governments and donors must recognise that improving the water security of rural households is inherently linked to a holistic definition of water security.

1.4 Delineation between rural and urban

There is currently no universally accepted definition of urban and rural that is consistently used by ADB countries. Each country uses different definitions and this inconsistency flows through into KD1's main data source, the JMP. Consequently, there will be some ambiguity when delineating between KD1 and KD3 as it is inconsistent across countries and across datasets. The KD3 report includes a detailed discussion of the inconsistent delineations between urban and rural and therefore these inconsistencies will not be detailed in this report.

As defined by the JMP, three ADB countries do not have any rural residents: Singapore, Hong Kong, and Nauru. Therefore, these three countries will not be included in any KD1 analysis. Combining these three countries with Taipei, which has been removed due to data gaps, the total number of countries that have been assessed is reduced from 49 to 45.

2 Methodology and datasets

2.1 Definition of rural household water security

Previous editions of the AWDO have composed KD1 of water supply, sanitation, and hygiene (WASH) sub-indicators showing that there are clear linkages between household water security and WASH. However, there is currently no internationally accepted definition of RHWS. A working definition was developed by first investigating several related terms and considering their relevance to the water security of rural households.

The UN (UN 2013) defines water security as *“the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.”* This definition goes on to include elements of:

- good governance
- transboundary cooperation
- peace and political stability
- financing.

Across:

- drinking water and human well-being
- ecosystems
- water-related hazards and climate change
- economic activities and development.

There is strong alignment with the AWDO key dimensions and this definition of water security. Drinking water and human well-being are the focuses of KD1 and KD3, ecosystems are the focus of KD4 (environmental water security), water-related hazards and climate change are the focus of KD5 (risk to water-related disasters), and economic activities and development are the focus of KD2 (economic water security). Therefore, the definition of drinking water and human well-being as an element of water security is most relevant to KD1: *“populations have access to safe, sufficient and affordable water to meet basic needs for drinking, sanitation and hygiene, to safeguard health and well-being, and to fulfil basic human rights”* (UN 2013).

The UN definition considers and expands upon what is considered by the 2016 AWDO definition of KD1 with strong alignment between the two, but there are extra elements in the UN definition that were not considered in KD1. The UN emphasises that it is “basic” needs that must be met and includes the outcome of fulfilling human rights, something implicit in the human right to water (2002) as *"sufficient, safe, acceptable, physically accessible and affordable water".* Further, the UN definition also includes the elements of good governance, transboundary cooperation, peace and political stability, and financing, which are not considered in KD1. Both definitions require further separation from rural and urban to apply as a working definition for this study.

Another well cited definition of water security from Grey and Sadoff (2007) is "*the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies*". Following this definition, Grey went on to explain that it is the acceptability of risk that defines a water secure country (Grey, et al. 2013).

Bradley and Bartram (2013) argue that domestic water security should be defined according to *provision* and *risk*. The definition of KD1 in AWDO 2016 emphasises water provision and, as mentioned, Grey highlights the importance of risk. In fact, as pointed out by Bradley and Bartram, Grey's ealier definition includes both elements of provision and risk.

The human right to water and sanitation explicitly recognises the need to expand the right to include things beyond water supply. It should be noted that Grey defines *"water-related risk"* with room for the inclusion of sanitation and hygiene and to push the definition into the space of WASH (drinking water supply, sanitation, and hygiene). The logic is that no-one could be considered "water-secure" if they are ill or dying from inadequate sanitation or hygiene. For this reason, KD1 considers sanitation and hygiene and not just water supply.

There is a trend in WASH monitoring and reporting to consider communal spaces, evidenced by the recent JMP reports monitoring WASH in schools in 2018 and WASH health care facilties in 2019. This points to an understanding that while WASH at the household-level is important, public health benefits can only be enjoyed by the whole community when community facilities are also equipped with adquate WASH serviecs. While there have not been JMP reports highlighting the importance of them, other institutional and communal settings, such markets and prisons, are also receiving increasing scrutiny to ensure adequate WASH servies.

All of this leads us to the following academic definition of rural household water security (underlining added for emphasis): *the provision of sufficient, safe, acceptable, physically accessible and affordable water, sanitation, and hygiene services for health and livelihoods, coupled with an acceptable level of water-related risk, in rural communities.*

TABLE 2. DIFFERENT DEFINITIONS RELATED TO RURAL HOUSEHOLD WATER SECURITY

Term	Reference	Definition
Human right to water and sanitation	(UN General Assembly 2010)	The human right to water and sanitation...recognises the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights.
Human right to water	(UN Committee on Economic, Social and Cultural Rights 2002)	The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses.

Water security	(Grey and Sadoff 2007)	The availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems, and production, coupled with an acceptable level of water-related risks to people, environments, and economies.
Water security	(UN 2013)	The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.
Drinking water and human well-being	(UN 2013)	Populations have access to safe, sufficient, and affordable water to meet basic needs for drinking, sanitation and hygiene, to safeguard health and well-being, and to fulfil basic human rights.
Household water security	(ADB 2016)	To what extent countries are satisfying their household water and sanitation needs and improving hygiene for public health.

While there is value in this academic definition, we are unable to monitor or evaluate some elements and therefore propose a practical working definition for the purposes of measuring KD1 in the AWDO 2020. Given the practicalities of measuring and creating a rural household water security index, the goal of acceptable services, hygiene facilities and the consideration of the overall community context are impractical to measure due to data deficiencies. Therefore, they have been removed from the definition, leaving the practical working definition to be: *the provisions of sufficient, safe, physically accessible and affordable water, and sanitation services for health and livelihoods, coupled with an acceptable level of water-related risk, in rural households.*

The aspects that have been removed from the academic definition are addressed in the discussion section of the report, but not in the KD1 index. The way they will be addressed is outlined in Table 3.

TABLE 3. ELEMENTS OF RURAL HOUSEHOLD WATER SECURITY THAT ARE NOT ADDRESSED IN KD1

Aspect	Method of inclusion in KD1 report
Acceptable	To be included in the discussion around water's importance in water supply and sanitation.
Hygiene	Hygiene is recorded in the Joint Monitoring Program (JMP) as the presence of a handwashing facility with soap and water on premises, but its measurement is limited to only a few ADB countries. Hygiene is included in the affordability and health impacts sub-indicators.
Communities	WASH in schools and health care centres has a limited dataset in the JMP. This will be included in the discussion in the report.

2.2 Water security indicator framework

In order to create a coherent logic between sub-indicators, this study has developed a framework from which sub-indicators of water security can be categorised. The framework consists of three indicator categories:

- driver
- status
- outcome.

For example, if one were to have the sub-indicators of affordability, water supply, and health impacts (all crucial elements to RHWS), then one could say that:

***Affordable water** leads to **improved water supply**, which in turn leads to **improved health**.*

- Water affordability is a driver, which improves other elements of water security.
- Water supply is the physical status of water security that has a clear linkage with the definition of water security.
- Health impacts are an outcome caused by water security.

KD1 has four sub-indicators and a risk framework. These can be categorised into the framework as shown in Figure 8.

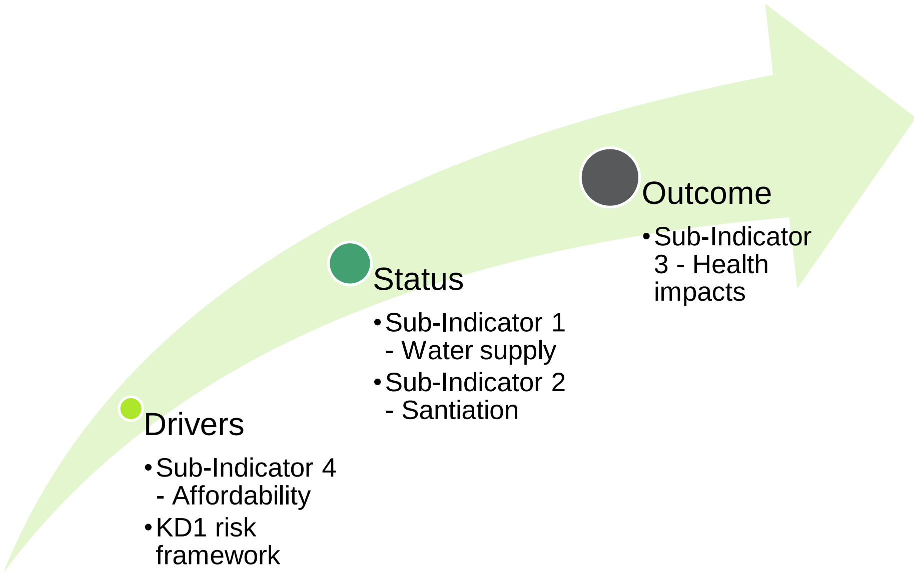

FIGURE 8. ELEMENTS OF KD 1 CATEGORISED ACCORDING TO THE INDICATOR FRAMEWORK

2.3 KD 1 method

As mentioned above, there are five elements in KD1:

Four sub-indicators, that after analysis will each be scored from 1 to 5 and will then be used to calculate the RHWS Index. The sub-indicators are:

1. access to water supply
2. access to sanitation
3. health impacts
4. affordability.

The risk framework for assessing future risks to RHWS has been incorporated into the discussion section of each region. Figure 9 shows the full KD1 method including all sub-indicators.

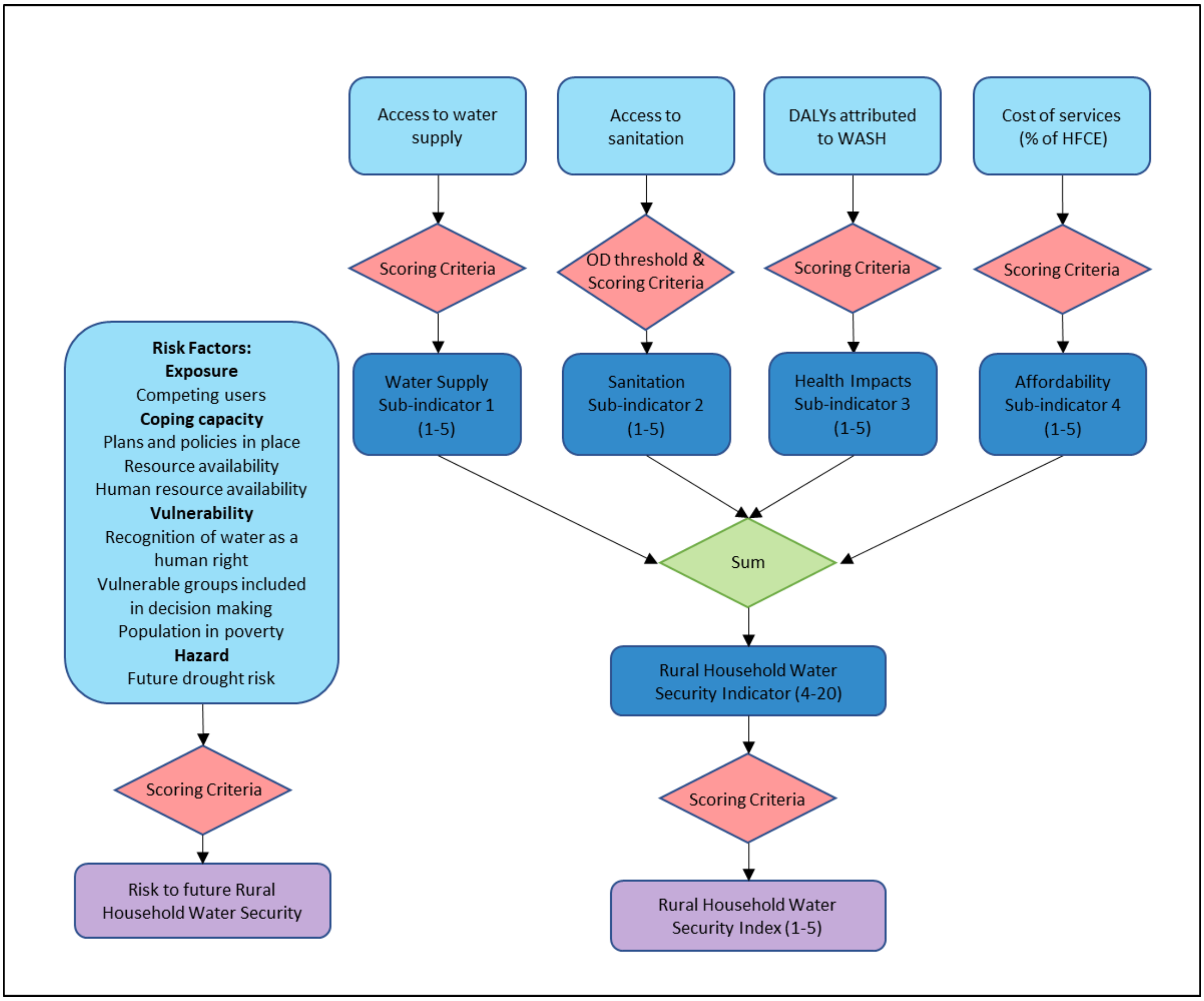

FIGURE 9. SUMMARY OF THE KD1 SUB-INDICATORS AND METHOD

When developing the method for each sub-indicator, issues caused by inadequate data were often encountered. During the investigation to develop sub-indicator 3, we were told that one potential method, while theoretically possible, would be heavily reliant on weak assumptions and that the method would "not be meaningful and even misleading" (Pruss-Ustun 2019). Therefore, throughout the development of the method, when gaps in datasets have been found, the need of creating best guess estimates has been balance with ensuring that the sub-indicators we use are still accurate and "meaningful".

For all sub-indicators it was not possible to either access data or calculate an estimate for Taipei. Therefore, Taipei was excluded from the analysis.

2.3.1 Changes to the 2016 method

As mentioned earlier, KD1 in AWDO 2016 investigated household water security for all contexts, not specified to rural households. Figure 10 shows the 2016 method used.

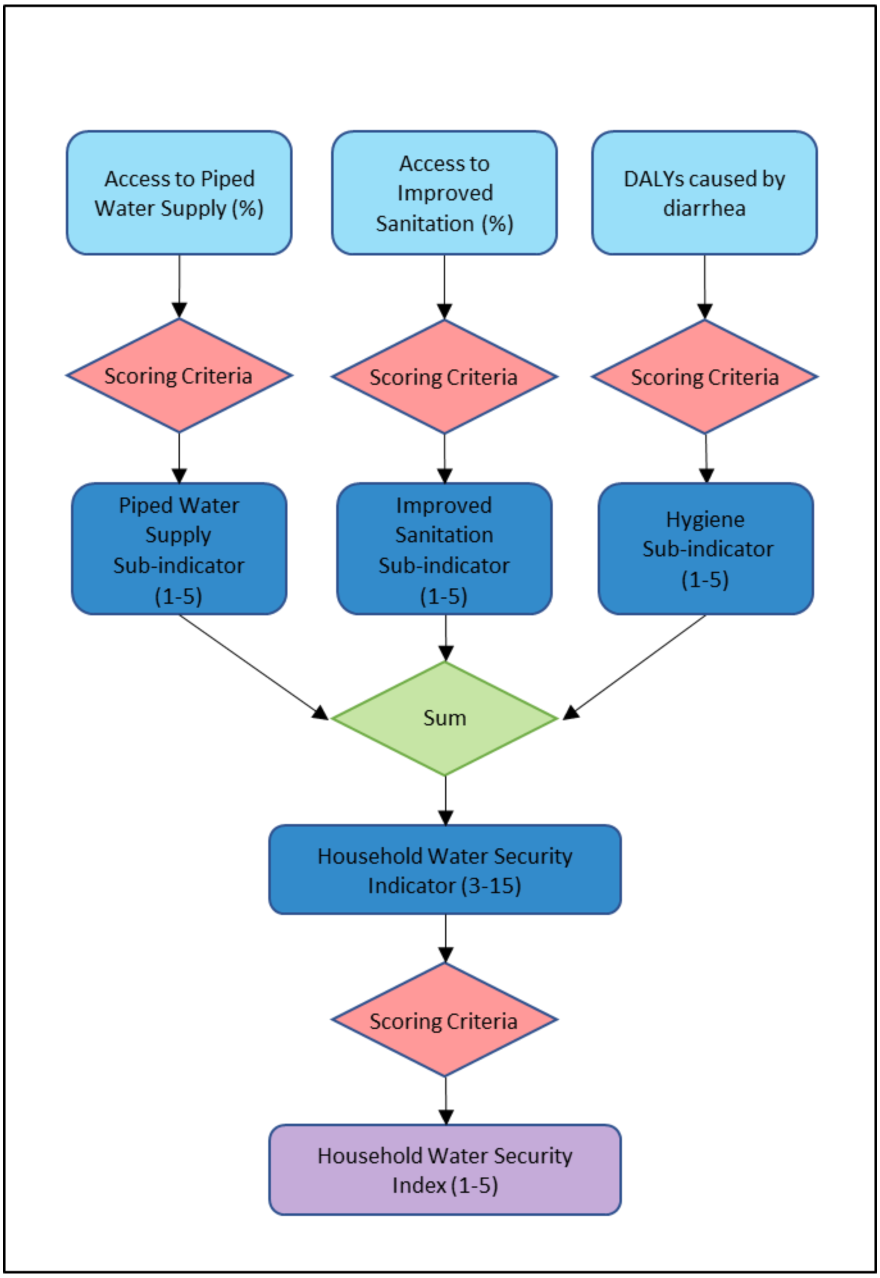

FIGURE 10. AWDO 2016 KD1 METHOD

The following changes have been made to each of the sub-indicators for AWDO KD1 method (as shown in Figure 9):

- sub-indicator 1 now targets rural households only and takes a more holistic perspective than solely piped water supply by considering multiple service levels
- sub-indicator 2 now targets rural households only and takes a more holistic perspective than solely improved sanitation by considering multiple service levels
- sub-indicator 3 has been refined to consider only the disease burden attributable to WASH
- sub-indicator 4 has been introduced to consider affordability, this includes an element of equality to KD1.

With these significant changes, it is impossible and would be misleading to complete a like-for-like comparison between the 2013, 2016 and 2020 results. Therefore, comparisons will only be made with data from 2013 and 2016 using the 2020 method, which will be named the adjusted 2013 and 2016 scores.

2.3.2 Sub-indicator 1 and 2: water supply and sanitation

Sub-indicators 1 and 2 use almost identical methods and therefore the method section for both has been combined.

Until the last decade or so, sanitation has been considered a lower priority to water supply. As a result, the provision of sanitation lags the provision of water supply globally. However, because sanitation and water supply sub-indicators used different targets in the methodology of KD1 AWDO 2016, the sub-indicator for water received a lower mean average score than the sub-indicator for sanitation. This would appear to be misleading, potentially leading to the false assumption that sanitation services are of higher quality than that of water supply. Therefore, it has been decided that the methodology used should be as similar as possible for both water supply and sanitation sub-indicators.

Plain English explanations of what we are trying to measure

Sub-indicator 1 – access to water supply: *a score that considers how many rural people have access to different levels of water supply.*

Sub-indicator 2 – access to sanitation: *a score that considers how many rural people have access to different levels of sanitation services.*

Methodology

The access to water supply and access to sanitation sub-indicators is calculated using the service ladders in the most recent JMP report (JMP 2019). The water supply service levels are surface water, unimproved, limited, basic, and safely managed. Levels of service for sanitation are open defecation, unimproved, limited, basic, and safely managed. In short, countries will be given higher scores for having more people with access to higher levels of service.

Targeting the *safely managed* service level for both water supply and sanitation is in-line with SDG 6 and current expectations of WASH practitioners. As defined by the JMP, safely managed water supply means *"an improved water source that is…accessible on premise…available when needed (and) …free from contamination"*. Therefore, a water supply must include the features of accessibility, timeliness, and quality, in line with SDG target 6.1, in order to be considered safely managed. Safely managed sanitation is defined as *"an improved type of sanitation facility that is not shared with other households and the excreta produced must either be safely treated in situ or transported and treated off-site. In practice, there are three possible pathways to safely managed services…wastewater treated offsite…excreta emptied and treated offsite (or)…excreta treated and disposed of in situ*". Therefore, a sanitation system must include both safe collection and safe treatment of waste in line with SDG target 6.2, in order to be considered safely managed.

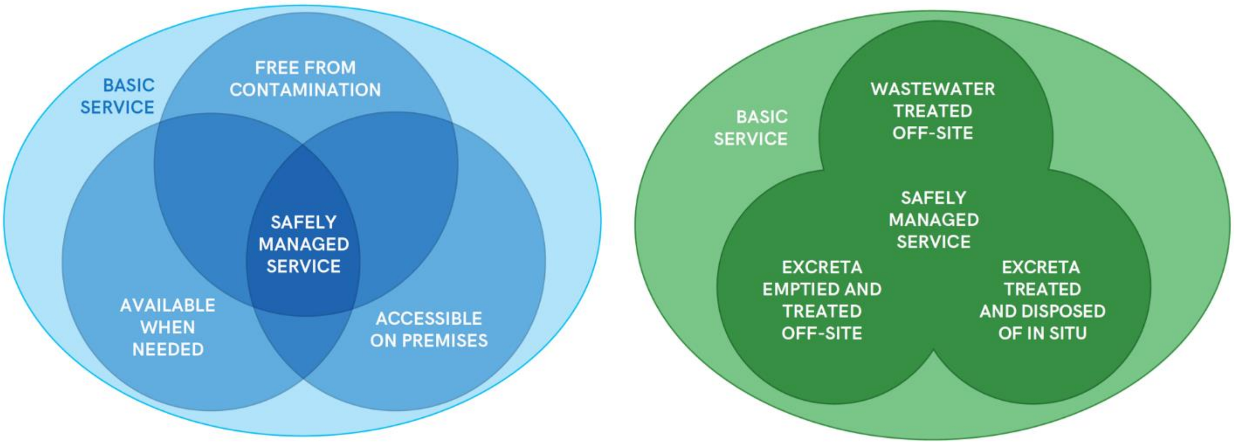

Figure 11. The relationship between basic and safely managed service levels for water supply (blue) and sanitation (green) (JMP 2019)

In an ideal situation, the *safely managed* service level should be the target for both water supply and sanitation; however, there are numerous gaps in the JMP dataset for safely managed, as numerous countries are only just beginning to adopt and measure safely managed service levels. In the JMP, there are 34 and 38 countries out of 45 without data for rural *safely managed* water supply and sanitation, respectively. However, if a country had national *safely managed* data showing that 95% or more of the country had access to a *safely managed* service, it has been assumed that there would also be a similar very high percentage for *safely managed* access in rural areas. Using this assumption reduces the number of data gaps. Finally, as potential back up options, it is of interest to know the number of data gaps if (a) we were to consider any national data figure as a best estimate proxy for rural data, or (b) we were to look at the *at least basic* service[1] level instead. This has led to the creation of Table 4.

Table 4. Gaps in JMP data set

Service	Service level	Gaps in rural data out of 45	Gaps in rural or national (when proportion is above 95%) out of 45	Gaps in rural or national data (any proportion) out of 45
Water supply	Safely managed	33	29	20
	At least basic	7	2	0
Sanitation	Safely managed	37	35	30
	At least basic	8	3	1

It is clear that there are too many gaps in the *safely managed* datasets (82% and 73% of countries did not have safely managed rural estimates for sanitation access and water supply respectively) for this to be a practical option when calculating the KD1 score. Therefore, we have decided that the *at least basic* service level will be used as the highest service for analysis. For KD1 to still strongly reflect that *safely managed* is the target for rural households in the Asia Pacific, *safely managed* will still be considered in this report in the following ways:

- sub-indicator 4 (affordability) is based safely managed

[1] An at least basic water service is defined as an improved water source that is less than 30 minutes round trip from the house. A basic sanitation service is defined as an improved sanitation facility, without safe excreta disposal that is not shared with other households.

- highlight boxes 1 and 2 discuss a safely managed service
- the recommendations of this report will include increasing resources for country monitoring systems to report safely managed rural access.

With the above-mentioned method, there are still the following gaps:

- Brunei sanitation
  - this gap is filled with Brunei sanitation from JMP from 2013
- Federated States of Micronesia both water and sanitation
  - this gap is filled with national estimates from JMP
- Kiribati both water and sanitation
  - this gap is filled with national estimates from JMP.

A relatively simple method has been used to calculate a raw score from the service levels. The scoring criteria will award more points to higher service levels. The points attributed to each service level are shown in Table 5.

TABLE 5. JMP LADDER LEVELS OF SERVICE AND POINTS ATTRIBUTED

Points	Water supply level	Sanitation level
3	At least basic	At least basic
2	Limited	Limited
1	Unimproved	Unimproved
0	Surface water	Open defecation

For example, using data from JMP 2019, Cambodia and Afghanistan would have their water supply raw and sanitation scores calculated as is shown in Table 6 and Table 7.

TABLE 6. CAMBODIAN WATER SUPPLY RAW SCORE CALCULATION

Water supply level	Percentage of rural population	Points available	Score
At least basic	73%	3	2.19
Limited	1%	2	0.02
Unimproved	13%	1	0.13
Surface water	14%	0	0
		Total	2.34

TABLE 7. AFGHAN SANITATION RAW SCORE CALCULATION

Sanitation level	Percentage of rural population	Points available	Score
At least basic	37%	3	1.11
Limited	6%	2	0.12
Unimproved	40%	1	0.40
Open defection	17%	0	0
		Total	1.63

Open Defecation threshold (SI 2 only)

Open Defecation (OD) is practiced where people do not have access to any sanitation facilities and is the lowest level of sanitation consider in the JMP. Levels of OD are higher in rural areas than they are in urban areas, the rates are higher still when considering vulnerable and poor groups (JMP 2019). Achieving an end to OD globally by 2030 is a key target set in SDG6. It should therefore be a priority that governments reduce the number of people that have no other option than to openly defecate. For these reasons OD has been included as an indicator in KD1. Two OD thresholds have been included, preceding the raw score calculation for SI 2:

- if a country has greater than 10% of their rural population openly defecating, they will automatically be scored a 1, and
- if a country has greater than 5% of their rural population openly defecating, they cannot be scored higher than a 2.

Banding

Once raw scores have been calculated for each country, they must be banded to give a score out of 5. In order to make bandings logical, trial and error was used with the following principles to develop the bandings shown in Table 8:

1. Countries should be spread evenly across bandings:
    - Bands were approximately even with the highest (band 5) having 21 countries and the lowest (band 3) having 16. It is because of this principle that the change in raw score is inconsistent between bands.
    - The raw score required to move between bands narrows significantly in higher bands, this reflects that the final few percent of rural households are the most vulnerable and hardest to reach. Therefore, as a country moves closer to full coverage, their access increased per year usually drops significantly.
2. Numbers will be rounded to nearest 0.05:
    - Numbers are rounded as shown.
3. Results should return a mean average of approximately 3:
    - The mean average is exactly 3 for water and sanitation combined.
4. Result return similar scores to AWDO 2016 for the adjusted 2016 calculation:
    - In AWDO 2016 KD1, water and sanitation indicators used 2014 JMP data and resulted in a mean average score of 2.8. Using this method and bandings, and 2014 JMP data also resulted in a mean average of 2.8.

TABLE 8. SUB-INDICATOR 1 AND 2 BANDINGS

Sub-indicator score	Raw score
5	Equal to 3
4	2.95 – 3
3	2.75 – 2.95
2	2.2 – 2.75
1	Less than 2.2

2.3.3 Sub-indicator 3: health impacts

Plain English explanation of what we are trying to measure

The health impacts, measured in Disability Adjusted Life Years (DALYs), of inadequate water supply, sanitation, and hygiene services.

Methodology

The 2016 KD1 method indicator was named hygiene and measured Disability Adjusted Life Years (DALYs) caused by diarrhea. However, this is both a misleading title and measure as diarrhea can be caused by many different illnesses, not only from pathogens resulting from inadequate water and sanitation services or hygiene behaviours and facilities.

The possibility of keeping a hygiene sub-indicator was investigated. The only dataset that could be found was again the JMP measurement of handwashing facilities in the household. However, only 23[2] out of 45 countries are included in the JMP hygiene dataset. This means that sufficient and accurate hygiene sub-indicator data is not available, so a sub-indicator using a similar DALYs measure was investigated.

Several datasets and methodologies were reviewed, the most notable being the World Health Organisation (WHO) disease burden database. A recent joint University of North Carolina and WHO study (Pruss-Ustun 2019) created a method to calculate the disease burden caused by inadequate WASH from multiple illnesses. The method uses comparative risk assessments to formulate WASH attribution factors for several of the illnesses in the WHO disease burden database, therefore developing a WASH attributable disease burden for an entire country. This dataset includes 40 of the 45 countries analysed in KD1. The illnesses included in this database are;

- Diarrhoeal diseases,
- Soil-transmitted helminth infections,
- Respiratory infections,
- Malnutrition (only Protein-energy malnutrition),
- Trachoma, and
- Schistosomiasis

Discussions with the authors of the study was undertaken to investigate whether it would possible to disaggregate this data by urban and rural. It was determined that it would be possible to create an estimated WASH attributable rural disease burden, but any estimate would be dependent on unreliable assumptions resulting in an estimate that would “not be meaningful and could even be misleading”[3]. Therefore, a national WASH attributable disease burden was used, with the discussion of this report stating that a rural estimate should be used if improved data becomes available.

The Pruss-Ustun dataset was used with minor calculations to determine the disease burden attributable to drinking water, sanitation, and hygiene[4] per thousand people.

This method resulted in the following gaps:

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[2] The 23 countries with hygiene data in JMP 2019 are Afghanistan, Armenia, Azerbaijan, Bangladesh, Cambodia, India, Indonesia, Kazakhstan, Kyrgyz Republic, Lao People’s Democratic Republic, Maldives, Marshall Islands, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Solomon Islands, Tajikistan, Thailand, Timor-Leste, Vanuatu, and Viet Nam.

[3] Correspondence with authors of previously mentioned publication (Pruss-Ustun 2019).

[4] DALYs attributed to water resource management were not considered in this report

- The Cook Islands, the Marshall Islands, Palau, and Tuvalu were not included in the Pruss-Ustun dataset:
    - these countries health impact scores were estimated as the same as the published 2016 KD1 sub-indicator 3 score
- Niue was not included in the Pruss-Ustun dataset:
    - as Niue was also not included in AWDO 2016, it was estimated as equal to the pacific average for sub-indicator 3.

Banding

Upon looking at the data, it was immediately apparent that there was an exponential distribution among countries as shown in Figure 12. Therefore, bands were selected exponentially, resulting in the bands shown in Table 9.

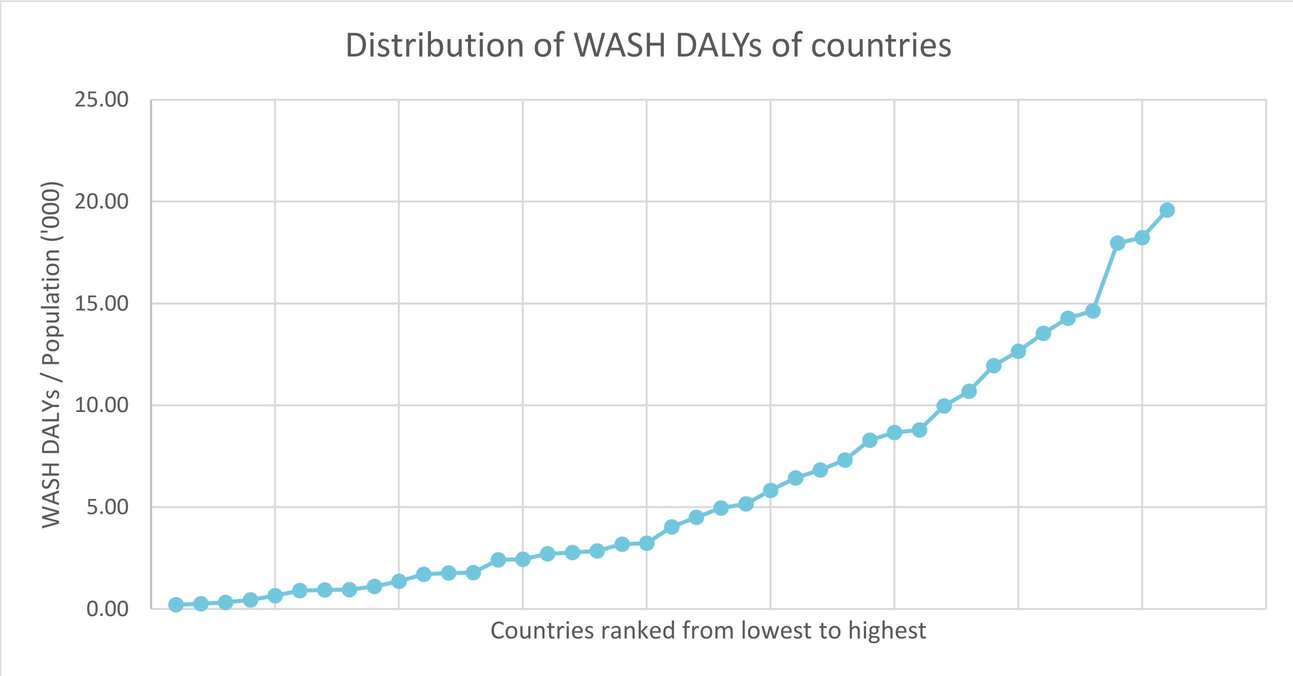

FIGURE 12. DISTRIBUTION OF COUNTRIES REGARDING WASH ATTRIBUTABLE DALYS

TABLE 9. SUB-INDICATOR 3 BANDINGS

Sub-Indicator score	WASH attributable DALYs per thousand people
5	Less than 1
4	1 – 2
3	2 – 5
2	5 – 10
1	More than 10

These bandings have resulted in the log scale distribution shown in Figure 13.

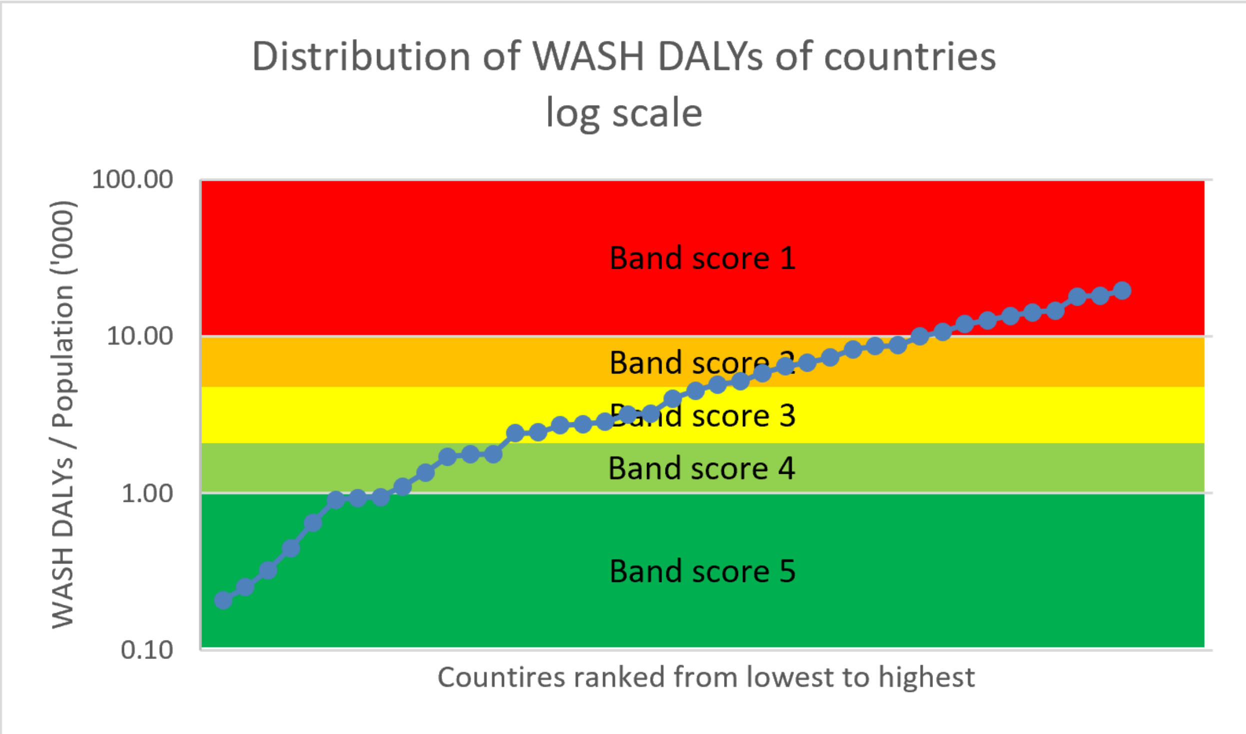

Figure 13. Logscale distribution of countries regarding WASH attributable DALYs

2.3.4 Sub-indicator 4: affordability

There is currently no universally accepted definition of affordability or method for monitoring and evaluating affordability (GLAAS 2019). The JMP has determined that *"the most valid indicator of affordability is one that includes the full costs for all households to achieve a commonly agreed minimum service level"* (JMP 2019). Further, JMP concludes that:

Measuring and monitoring WASH affordability requires an understanding of the interaction between:

1. *what the user pays for WASH services*
2. *the spending power of the user*
3. *what other essential goods and services the user pays for.*

This definition also includes capital costs associated with new infrastructure.

As discussed in the sections above, to be in line with the SDGs, the "minimum service level" that we aim to achieve should be the *safely managed* service level for both water supply, sanitation, and hygiene.

Plain English explanation of what we are trying to measure

The percentage of household consumption needed in order for rural households to afford safely managed water supply, sanitation, and hygiene services.

Methodology

In order to evaluate affordability according to the definition above, there need to be two key elements:

- the cost of service
- the household's ability or willingness to pay for the service.

A 2016 joint World Bank / Water and Sanitation Program study investigated how much it would cost per year for each country to meet the SDG 6.1 and 6.2 targets (Hutton and Varughese 2016). Among other things, this study used in-country experts to create ground-up modelled cost estimates for the provision of safely managed water supply, sanitation, and hygiene services in rural areas, creating a dataset that includes 40 of the 45 countries[5]. Multiple technologies were investigated; however, for the purposes of KD1, we have considered only the lowest cost technology. The estimates in this dataset are in 2015 prices in USD, therefore Consumer Price Index (CPI) and USD: National Currency (NC) exchange rate data from the ADB Key Indicator Database (KID) was used to turn these estimates into 2018 NC. The cost of service equation is shown in Equation 1.

$$\frac{Cost}{person}\ per\ year_{NC\ 2018} = \frac{Cost}{person}\ per\ year_{\$USD\ 2015} \times \frac{CPI_{2018}}{CPI_{2015}} \times \frac{NC_{2018}}{USD_{2018}}$$

EQUATION 1. COST OF SERVICE EQUATION

Household consumption was calculated using ADB KID datasets. As no reliable datasets were available to measure a household's ability or willingness to pay for a service, a proxy measure was selected. Total household consumption was decided as the best available proxy[6]. The total household final consumption (HFC) for a country in that countries NC divided by the country's population (both in 2018), to find the household consumption per person. This is shown in Equation 2.

$$Household\ consumption/person_{NC\ 2018} = \frac{Total\ HFC_{NC\ 2018}}{Total\ population_{2018}}$$

EQUATION 2. HOUSEHOLD CONSUMPTION EQUATION

Finally, affordability as a percentage of cost of service divided by household consumption can be calculated. This is shown in Equation 3

$$Affordability_{\ 2018} = \frac{\frac{Cost}{person} per\ year_{NC\ 2018}}{Household\ consumption/person_{NC\ 2018}}$$

EQUATION 3. AFFORDABILITY EQUATION

This method is summarised in Figure 14.

[5] Most gaps in this dataset were in advanced economies.

[6] This is a non-ideal proxy for the household's ability to pay for WASH services. It does not consider willingness to pay and by considering the mean average of all households in a country it does not consider discrepancies between income brackets within a country. These issues have been further discussed in section 7.1.

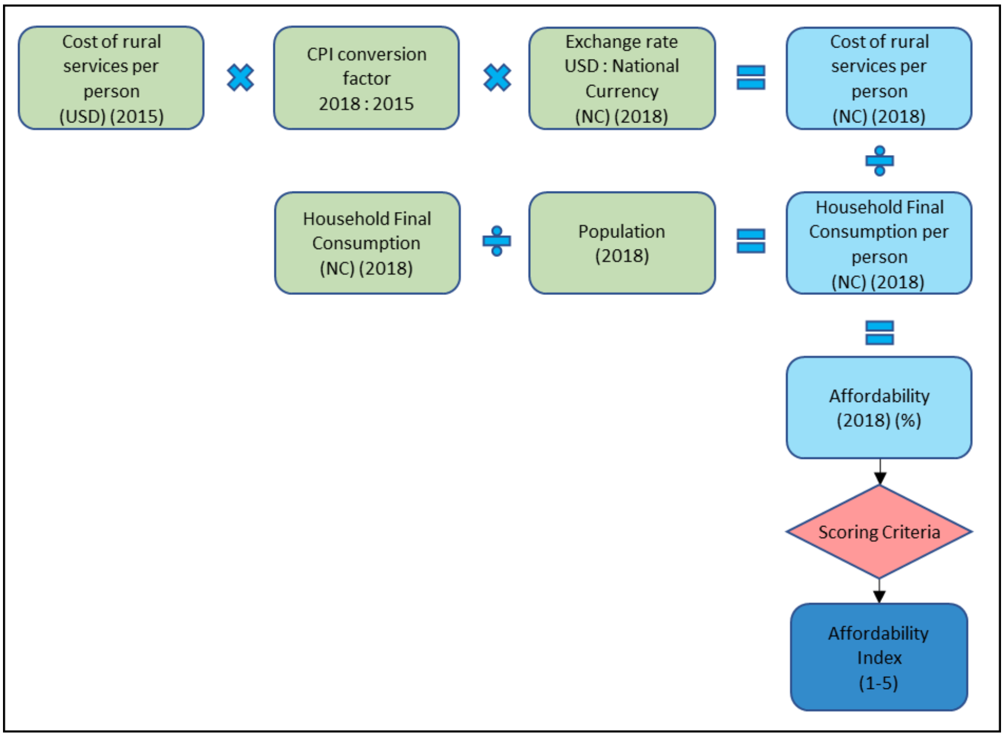

Figure 14. Sub-indicator 4: Affordability summary of method

This method resulted in the following gaps:

- Australia and the Republic of Korea had cost estimates calculated using the International Benchmarking Network for Water and Sanitation Utilities (IBNET) database
- Brunei Darussalam, Japan, and New Zealand had cost estimates calculated using regional averages
- Turkmenistan, the Cook Islands, Kiribati, the Marshall Islands, and the Solomon Islands had CPI figures estimated using regional averages
- Cambodia had CPI figures estimated using expert opinion provided by the ADB
- Turkmenistan, the Cook Islands, the Federated States of Micronesia, Kiribati, Niue, Tuvalu, Samoa, the Maldives, Lao People's Democratic Republic, and Myanmar had HFC estimated from GDP and a regional average for HFC as a percentage of GDP
- Papua New Guinea had HFC estimated using an HFC figure from 2005 with a CPI factor applied.

Banding

As there is no universally accepted method, there is also no universally accepted threshold for what constitutes 'affordable' water and sanitation. However, several relevant definitions have been found:

- Indonesia: 4% of regional minimum income for drinking-water (GLAAS 2019)
- Lao PDR: 3% of household income for urban drinking-water (GLAAS 2019)
- Lesotho: 5% of minimum salary for drinking-water (GLAAS 2019)
- Lithuania: 4% of average monthly family income drinking-water and sanitation (GLAAS 2019)
- OECD: 3.5% of household income (Mack and Wrase 2017)
- United Nations: water and sanitation services should not exceed 5% of a household's income (UN 2010)
- USA: 4.5% of income for combined water and wastewater services (Mack and Wrase 2017)

These data points were used to develop the bands shown in Table 10.

Table 10. Sub-indicator 4 bandings

Sub-Indicator score	Affordability (cost as a percentage of household consumption)
5	Less than 2%
4	2% – 3%
3	3% – 4%
2	4% – 5%
1	More than 5%

2.3.5 Weighting

The weighting applied to each of the sub-indicators is vital in order to ensure that the more important and relevant sub-indicators are emphasised. The sub-indicator framework outlines three different types of indicators, driver, status, and outcome. Given that status is the most closely linked to present water security, it is proposed that it be weighted twice as much as driver or outcome, with driver and outcome being weighted the same. This results in the weighting between driver: status: outcome as being 25%: 50%: 25%. Therefore, as there are two status sub-indicators, equally dividing the status portion between them results in equal weighting amongst all sub-indicators.

2.4 Data sets used

Database	Reference	Data year	Relevant sub-indicators	Comments	Countries included
Joint Monitoring Program	(JMP 2019)	2017	SI1 SI2	Data is disaggregated between urban and rural. Very good reference for WASH. No gender delineation.	45
Burden of disease from inadequate water, sanitation, and hygiene for selected adverse health outcomes	(Prüss-Ustün 2019)	2016	SI3	Uses disease burden and mortality estimates dataset as raw data (WHO 2018). No urban/rural delineation. Only has estimates for 2016.	40
Costs of meeting the 2030 SDG targets	(Hutton and Varughese 2016)	2015	SI4	Builds up an overall cost per person for both urban and rural of having access to *safely managed* WASH.	40
ADB Key Indicator Database	(ADB 2019)	2018	SI4	This database was used to source HFC, CPI, currency exchange rates and population.	45

3 Results

The results section is divided into four sections:

3.1. Results by sub-indicator
3.2. Results for the entire KD 1
3.3. Changes between adjusted 2013 and 2016, and 2020 results
3.4. Correlation between sub-indicators.

Sections 3.1 and 3.2 do not include any discussion, as these results are discussed by region in the discussion section. Sections 3.3 and 3.4 are discussed in their section.

3.1 Results by sub-indicator

Table 11. Sub-Indicator 1: Water Supply results

Grey cells indicator atypical calculation method used due to data gaps

Region	ABD country	Data				Calcs	
		At least basic	Limited	Unimproved	Surface water	Raw score	SI 1 score
Advanced Economies	AUS	99	1	1	1	3.00	5
	BRN	99	1	1	1	3.00	5
	JPN	99	1	1	1	3.00	5
	KOR	99	1	1	1	3.00	5
	NZL	99	1	1	1	3.00	5
Central West Asia	AFG	57	4	24	14	2.04	1
	ARM	99	1	1	1	3.00	5
	AZE	82	6	10	2	2.67	2
	GEO	96	1	4	1	2.94	3
	KAZ	92	1	6	1	2.86	3
	KGZ	82	2	3	13	2.54	2
	PAK	90	1	6	3	2.78	3
	TJK	76	3	3	19	2.36	2
	TKM	98	2	1	1	2.99	4
	UZB	96	1	1	4	2.91	3
East Asia	CHN	86	2	12	1	2.74	2
	MNG	56	3	19	21	1.94	1
Pacific	COK	99	1	1	1	3.00	5
	FJI	89	1	7	4	2.75	3
	FSM	79	1	21	0	2.59	2
	KIR	72	1	27	1	2.44	2
	MHL	94	5	1	1	2.95	3
	NIU	98	1	2	1	2.98	4
	PLW	99	1	1	1	3.00	5
	PNG	35	1	6	58	1.13	1
	SLB	61	6	18	15	2.13	1
	TON	99	1	1	1	3.00	5
	TUV	99	1	1	1	3.00	5
	VUT	88	1	1	10	2.69	2
	WSM	97	1	2	1	2.94	3
South Asia	BGD	97	2	1	1	2.95	3
	BTN	97	3	1	1	2.98	4
	IND	91	1	7	1	2.82	3
	LKA	88	4	7	2	2.77	3
	MDV	99	1	1	1	3.00	5
	NPL	89	3	6	2	2.78	3
South East Asia	IDN	82	2	13	3	2.63	2
	KHM	73	1	13	14	2.34	2
	LAO	76	1	19	4	2.48	2
	MMR	77	1	12	11	2.44	2
	MYS	89	1	10	0	2.80	3
	PHL	90	3	7	1	2.83	3
	THA	99	1	1	1	3.00	5
	TLS	70	3	21	6	2.36	2
	VNM	93	1	7	1	2.87	3

TABLE 12. SUB-INDICATOR 2: SANITATION RESULTS

GREY CELLS INDICATOR ATYPICAL CALCULATION METHOD USED DUE TO DATA GAPS

*COUNTRY HAD OVER 10% OF THEIR RURAL POPULATIONS OPENLY DEFECATING, THEREFORE AUTOMATICALLY SCORED 1 FOR SI 2

Region	ABD country	Data				Calcs	
		At least basic	Limited	Unimproved	Open defecation	Raw score	SI 2 score
Advanced Economies	AUS	99	1	1	1	3.00	5
	BRN	96	1	1	3	2.92	3
	JPN	99	1	1	1	3.00	5
	KOR	99	1	1	1	3.00	5
	NZL	99	1	1	1	3.00	5
Central West Asia	AFG	37	6	40	17	1.63	1
	ARM	83	1	15	1	2.68	2
	AZE	88	1	11	1	2.76	3
	GEO	83	1	17	1	2.67	2
	KAZ	99	1	1	1	3.00	5
	KGZ	99	1	1	1	3.00	5
	PAK	50	13	21	16	1.97	1
	TJK	98	2	1	1	2.97	4
	TKM	99	1	1	1	3.00	5
	UZB	99	1	1	1	3.00	5
East Asia	CHN	76	6	18	1	2.58	2
	MNG	42	24	5	30	1.76	1
Pacific	COK	98	1	2	1	2.97	4
	FJI	95	5	1	1	2.96	4
	FSM	88	1	12		2.79	3
	KIR	48	13	10	28	1.80	1
	MHL	59	7	3	32	1.92	1
	NIU	97	1	3	1	2.96	4
	PLW	99	1	1	1	3.00	5
	PNG	8	1	74	17	1.00	1
	SLB	20	2	9	69	0.73	1
	TON	92	1	6	1	2.86	3
	TUV	86	5	1	9	2.69	2
	VUT	29	32	39	1	1.90	1
	WSM	98	1	2	1	2.98	4
South Asia	BGD	47	18	36	1	2.11	1
	BTN	67	5	28	1	2.39	2
	IND	53	8	3	36	1.78	1
	LKA	96	3	1	1	2.96	4
	MDV	99	1	1	1	3.00	5
	NPL	61	11	3	25	2.08	1
South East Asia	IDN	65	12	7	17	2.25	1*
	KHM	48	7	3	41	1.63	1
	LAO	64	3	3	31	1.99	1
	MMR	59	8	19	13	2.14	1
	MYS	99	1	1	0	2.99	4
	PHL	75	13	5	7	2.56	2
	THA	98	2	1	1	2.99	4
	TLS	44	7	22	28	1.66	1
	VNM	78	4	14	4	2.56	2

TABLE 13. SUB-INDICATOR 3: HEALTH IMPACTS RESULTS
GREY CELLS INDICATOR ATYPICAL CALCULATION METHOD USED DUE TO DATA GAPS

Region	ABD country	Data	Calcs
		DALYs	SI 3 score
Advanced Economies	AUS	0.2	5
	BRN	0.3	5
	JPN	1.1	4
	KOR	0.4	5
	NZL	0.3	5
Central West Asia	AFG	19.6	1
	ARM	0.9	5
	AZE	2.4	3
	GEO	0.9	5
	KAZ	1.7	4
	KGZ	2.8	3
	PAK	18.2	1
	TJK	5.8	2
	TKM	6.8	2
	UZB	1.8	4
East Asia	CHN	0.9	5
	MNG	2.4	3
Pacific	COK		4
	FJI	5.2	2
	FSM	6.4	2
	KIR	14.6	1
	MHL		1
	NIU		2
	PLW		4
	PNG	18.0	1
	SLB	8.8	2
	TON	2.8	3
	TUV		3
	VUT	12.7	1
	WSM	2.7	3
South Asia	BGD	8.7	2
	BTN	5.0	3
	IND	12.0	1
	LKA	1.8	4
	MDV	0.7	5
	NPL	10.7	1
South East Asia	IDN	4.5	3
	KHM	7.3	2
	LAO	14.3	1
	MMR	10.0	2
	MYS	4.0	3
	PHL	8.3	2
	THA	3.2	3
	TLS	13.5	1
	VNM	3.2	3

Table 14. Sub-Indicator 4: Affordability results

Grey cells indicator atypical calculation method used due to data gaps

Region	ABD countries	Data					Calcs	
		Cost[7]	Exchange rate	CPI[8]	Population (Thousands)	HFC[9]	Raw Score	SI 4 score
Advanced Economies	AUS	$584.24	1.34	1.10	24993	1.04E+12	2.06%	4
	BRN	$334.53	1.35	0.99	442	3.58E+09	5.54%	1
	JPN	$334.53	110.40	1.01	126529	2.97E+14	1.59%	5
	KOR	$84.82	1100.56	1.05	51607	8.75E+14	0.58%	5
	NZL	$334.53	1.45	1.03	4886	1.69E+11	1.43%	5
Central West Asia	AFG	$31.80	72.08	1.12	30075	1.17E+12	6.60%	1
	ARM	$55.74	482.99	0.99	2971	4.76E+12	1.66%	5
	AZE	$80.55	1.70	0.98	9940	4.21E+10	3.18%	3
	GEO	$57.28	2.53	1.11	3727	2.44E+10	2.47%	4
	KAZ	$137.55	344.71	0.99	18276	3.00E+13	2.87%	4
	KGZ	$34.98	68.84	0.95	6257	4.55E+11	3.16%	3
	PAK	$76.12	121.82	1.11	212820	2.82E+13	7.78%	1
	TJK	$37.92	9.15	1.02	8837	4.77E+10	6.53%	1
	TKM	$122.43	3.50	1.04	5851	8.65E+10	3.02%	3
	UZB	$59.38	8069.61	1.11	32955	2.19E+14	8.03%	1
East Asia	CHN	$61.53	6.62	1.01	1395380	3.48E+13	1.64%	5
	MNG	$59.30	2472.48	1.17	3208	1.51E+13	3.63%	3
Pacific	COK	$133.46	1.45	1.02	19	3.74E+08	0.98%	5
	FJI	$115.41	2.09	1.07	885	6.42E+09	3.56%	3
	FSM	$68.60	1.00	0.99	103	2.51E+08	2.78%	4
	KIR	$42.05	1.34	1.02	113	1.67E+08	3.88%	3
	MHL	$71.53	1.00	1.02	54	1.48E+08	2.67%	4
	NIU	$150.82	1.45	1.06	2	3.01E+07	1.32%	5
	PLW	$163.63	1.00	0.84	18	1.89E+08	1.28%	5
	PNG	$81.71	3.28	1.12	9019	1.32E+10	20.51%	1
	SLB	$30.03	7.95	1.02	639	5.08E+09	3.07%	3
	TON	$77.00	2.24	0.92	100	1.06E+09	1.48%	5
	TUV	$52.81	1.34	1.08	12	3.96E+07	2.23%	4
	VUT	$43.43	108.78	1.04	278	5.74E+10	2.38%	4
	WSM	$73.38	2.59	1.07	198	1.54E+09	2.61%	4
South Asia	BGD	$33.29	83.47	1.18	164600	1.59E+13	3.39%	3
	BTN	$98.52	68.39	1.08	727	8.69E+10	6.11%	1
	IND	$59.26	68.39	1.08	1332000	1.13E+14	5.18%	1
	LKA	$98.88	162.46	1.12	21670	1.01E+13	3.87%	3
	MDV	$107.20	15.39	1.03	512	5.01E+10	1.74%	5
	NPL	$42.39	108.93	1.20	29102	2.09E+12	7.70%	1
South East Asia	IDN	$46.42	14236.94	1.11	265000	8.27E+15	2.35%	4
	KHM	$28.29	4051.17	1.05	15643	6.87E+13	2.74%	4
	LAO	$48.68	8489.24	1.05	6779	9.27E+13	3.16%	3
	MMR	$57.02	1429.81	1.12	53860	5.55E+13	8.85%	1
	MYS	$173.70	4.04	1.07	32400	8.30E+11	2.93%	4
	PHL	$49.45	52.66	1.10	106600	1.29E+13	2.37%	4
	THA	$144.33	32.31	1.02	67831	7.79E+12	4.14%	2
	TLS	$114.24	1.00	0.99	1296	9.90E+08	14.81%	1
	VNM	$76.60	22602.05	1.10	94700	3.75E+15	4.82%	2

[7] Per person per year (USD)

[8] Consumer Price Index ratio

[9] Household final consumption in national currency

3.2 Overall KD1 score

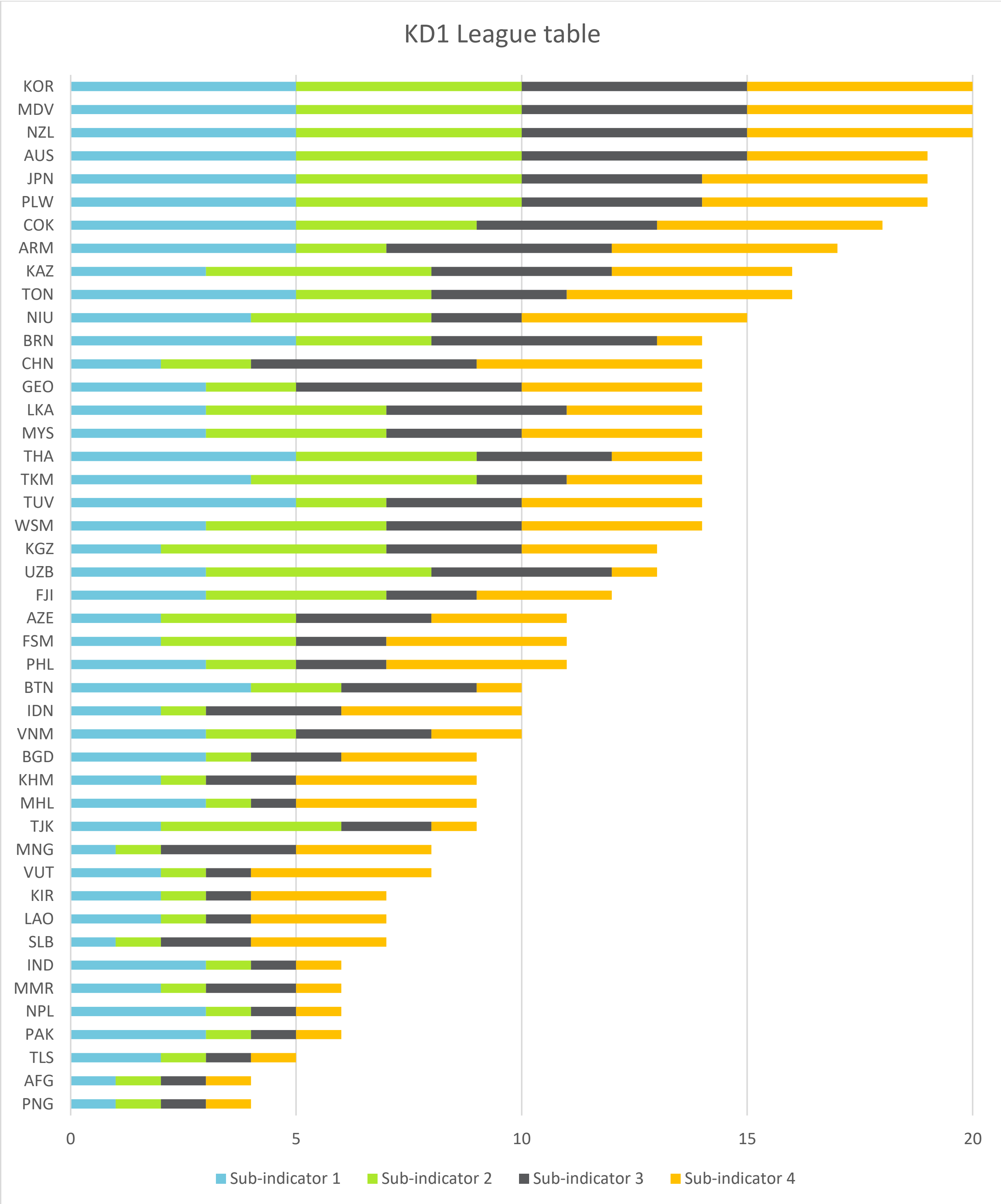

FIGURE 15. KD1 LEAGUE TABLE

3.3 Changes from 2016 to 2020

As mentioned in section 2.3.1, because of the changes to the methodology, comparisons between the 2020 scores and published 2016 and 2013 scores would be misleading. Therefore, comparisons will only be made with 2013 and 2016 data calculated using the 2020 method. As with any index, there is generally a lag between the year that the data is accurate and the index. For example, the KD1 2020 method used 2017 and 2018 data. Further, for the corresponding data years for the adjusted 2016 and 2013 scores, there are data gaps and some changes to the calculation and estimates were needed. These are listed below:

1. Sub-indicator 1: Access to water supply
   - 2020 method was used as is for adjusted 2013 and 2016 scores
   - adjusted 2016 scores used 2014 data in line with KD1 AWDO 2016
   - adjusted 2013 scores used 2010 data in line with KD1 AWDO 2013
2. Sub-indicator 2: Access to sanitation
   - 2020 method used as is for adjusted 2013 and 2016 scores
   - adjusted 2016 scores used 2014 data in line with KD1 AWDO 2016
   - adjusted 2013 scores used 2010 data in line with KD1 AWDO 2013
3. Sub-indicator 3: Health impacts
   - 2020 WASH attribution factors for six illnesses in each country that were used in the Prüss-Ustün (2019) study were used for adjusted 2016 and 2013 methods
   - adjusted 2016 scores used 2015 data from WHO disease burden and mortality estimates datebase (2018)
   - adjusted 2013 scores used 2010 data from WHO disease burden and mortality estimates datebase (2018)
4. Sub-indicator 4: Affordability
   - adjusted 2016 scores used 2015 data
   - adjusted 2013 scores used 2010 data
   - the following data was not available in the required year; therefore, it was estimated as the closest figure available on the ADB Key Indicator Database:
     - Niue population from 2015 and 2010
     - Myanmar and Tuvalu population from 2010
     - Myanmar USD: National Currency (Kyat) exchange rate from 2010.

3.3.1 Sub-indicator 1: Access to water supply

The changes between the adjusted 2016 and 2013 scores and the 2020 scores show how each country is progressing through time. Most countries have progressively improved their raw score from 2013 to 2016 and then to 2020, but this has not been reflected in all the sub-indicator scores. For example, Afghanistan has shown the second highest improvement between 2013 and 2020 regarding their raw score, but the improvements have not been enough to break the threshold and increase the sub-indicator score. The results show that there was more improvement between 2013 – 2016 than there was between 2016 – 2020. However, this reflects the data years considered with the 2013 – 2016 gap being larger (2010 – 2014 vs 2014 – 2017). With this in mind, the changes per year of both periods are approximately the same. Concerningly, four of the five countries that have had their water supply score decrease from 2013 – 2020 are small island nations in the Pacific.

Table 15. Comparison of water access sub-indicator 1 with adjusted 2013 and 2016 scores to 2020 scores

ABD Country	2020		2016 adjusted		2013 adjusted		2020 – 2016 comparison		2020 – 2013 comparison	
	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score
LAO	2.48	2	2.30	2	2.06	1	0.18	0	0.42	1
AFG	2.04	1	1.87	1	1.65	1	0.17	0	0.39	0
TJK	2.36	2	2.20	1	1.99	1	0.16	1	0.37	1
MNG	1.94	1	1.82	1	1.65	1	0.12	0	0.29	0
MMR	2.44	2	2.34	2	2.16	1	0.10	0	0.28	1
KHM	2.34	2	2.22	2	2.06	1	0.12	0	0.28	1
TLS	2.36	2	2.24	2	2.09	1	0.11	0	0.26	1
AZE	2.67	2	2.57	2	2.43	2	0.10	0	0.24	0
TKM	2.99	4	2.93	3	2.78	3	0.06	1	0.21	1
BTN	2.98	4	2.92	3	2.78	3	0.06	1	0.20	1
VNM	2.87	3	2.80	3	2.68	2	0.07	0	0.20	1
PLW	3.00	5	2.96	4	2.82	3	0.04	1	0.18	2
KIR	2.44	2	2.37	2	2.27	2	0.08	0	0.18	0
CHN	2.74	2	2.67	2	2.57	2	0.07	0	0.16	0
IDN	2.63	2	2.56	2	2.48	2	0.06	0	0.15	0
KAZ	2.86	3	2.80	3	2.72	2	0.06	0	0.14	1
IND	2.82	3	2.77	3	2.70	2	0.05	0	0.12	1
LKA	2.77	3	2.72	2	2.65	2	0.05	1	0.12	1
VUT	2.69	2	2.64	2	2.58	2	0.05	0	0.11	0
KGZ	2.54	2	2.50	2	2.43	2	0.04	0	0.11	0
PHL	2.83	3	2.78	3	2.72	2	0.04	0	0.10	1
GEO	2.94	3	2.92	3	2.84	3	0.03	0	0.10	0
NPL	2.78	3	2.74	2	2.68	2	0.04	1	0.10	1
UZB	2.91	3	2.89	3	2.83	3	0.02	0	0.08	0
PAK	2.78	3	2.75	2	2.71	2	0.03	1	0.07	1
ARM	3.00	5	3.00	5	2.93	3	0.00	0	0.07	2
THA	3.00	5	2.99	4	2.94	3	0.01	1	0.06	2
MDV	3.00	5	3.00	5	2.95	3	0.00	0	0.05	2
WSM	2.94	3	2.93	3	2.91	3	0.02	0	0.04	0
BGD	2.95	3	2.93	3	2.91	3	0.02	0	0.04	0
TUV	3.00	5	3.00	5	2.98	4	0.00	0	0.01	1
PNG	1.13	1	1.12	1	1.11	1	0.00	0	0.01	0
FSM	2.59	2	2.53	2	2.58	2	0.06	0	0.01	0
JPN	3.00	5	3.00	5	2.99	4	0.00	0	0.01	1
AUS	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
BRN	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
COK	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
KOR	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
NZL	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
TON	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
NIU	2.98	4	2.98	4	2.99	4	0.00	0	-0.01	0
FJI	2.75	3	2.76	3	2.77	3	-0.01	0	-0.02	0
MHL	2.95	3	2.96	4	2.98	4	-0.01	-1	-0.03	-1
MYS	2.80	3	2.82	3	2.84	3	-0.02	0	-0.04	0
SLB	2.13	1	2.22	2	2.34	2	-0.09	-1	-0.21	-1

Highlight box 1. Difference in results of different sub-indicator 1 methods

Difference in results of different sub-indicator 1 methods

The method for calculating sub-indicator 1 has changed substantially since AWDO 2016. The 2016 method looked solely at the percentage of the population with piped water, while the 2020 method considers multiple water supply service levels, calculating a score by giving more points to higher service levels. Further, due to many data gaps, the highest JMP service level, safely managed, is not included due to a lack of available data. This results in three different potential methods and this box shows the results of those different methods.

The 2020 and 2016 methods have been well explained in the method section of the report; however, the 'ideal' method, which includes safely managed, has not yet been fully developed. The simplest approach would be to amend the 2020 method to give countries four points for every percent of rural population with a safely managed supply, making the maximum score four. This method has been called the 'ideal' method.

Countries with enough data to calculate all three methods are shown in the table below. As this list is rather limited, comparisons have used the non-banded score (raw score for the 2020 and ideal methods and a percentage for 2016) with each country ranked from 1 – 11 accordingly. The noteworthy changes (+/– 4 or more) are highlighted. It should be noted that all methods have used the same 2017 JMP dataset.

Table in box 1. Comparison of different sub-indicator 1 methods

	Un-banded scores			Rank (1 – 11)			Change in rank		
Country	2016	2020	Ideal	2016	2020	Ideal	2016 – 2020	2020 – ideal	2016 – ideal
Bangladesh	3%	2.95	3.56	11	3	2	+8	+1	+9
Bhutan	99%	2.98	3.25	1	2	4	-1	-2	-3
Cambodia	11%	2.34	2.50	10	11	11	-1	0	-1
India	32%	2.82	3.38	8	6	3	+2	+3	+5
Kyrgyzstan	84%	2.54	3.08	2	9	8	-7	+1	-6
Lao PRD	32%	2.48	2.59	7	10	10	-3	0	-3
Nepal	46%	2.78	3.04	4	7	9	-3	-2	-5
Pakistan	15%	2.78	3.10	9	8	7	+1	+1	+2
Philippines	34%	2.83	3.16	6	5	6	+1	-1	0
Turkmenistan	35%	2.99	3.89	5	1	1	+4	0	+4
Uzbekistan	52%	2.91	3.22	3	4	5	-1	-1	-2

Results show that Bangladesh and Turkmenistan significantly improve their ranking by using the 2020 method, while the same change has seen a decrease in Kyrgyzstan's ranking. Bangladesh and Turkmenistan have relatively low piped water rates in rural areas but have very high rural populations supplied with at least basic water. In Bangladesh, this is because of a high number of protected wells. While Turkmenistan uses both protected wells and tanker water. A recent study found that up to 80% of piped water in Bangladesh is contaminated with e-coli, similar to the levels in surface water (World Bank 2017), further evidence that piped water is not a robust indicator of improved water supply. Water tankers are typically an expensive source of water; however, Turkmenistan is one of the wealthier countries in the region and can afford this system. On the other hand, rural Kyrgyzstan has a relatively high percentage of population supplied by piped water. However, it also has a high number of people collecting surface water, the second highest of these 11 countries. All three are excellent examples of why the 2020 is an improvement on the 2016 method, penalising countries for having large populations collecting untreated surface water and rewarded for providing a basic water supply, whether it is piped or not.

Comparing rural India with rural Nepal, fewer people have access to piped water, about the same have an at least basic service and many more people have safely managed access. This shows that if the 'ideal' method were to be adopted in the next iteration of AWDO countries, such as India, would be rewarded for ensuring their citizens receive not only a basic supply, but also one that is accessible on premises, available when needed, and free from contamination (i.e. safely managed).

3.3.2 Sub-indicator 2: Access to sanitation

Table 16. Comparison of basic sanitation access sub-indicator 2 with adjusted 2013 and 2016 scores to 2020 scores

***Country had over 10% of their rural populations openly defecating, therefore automatically scored 1 for SI 2**

ABD Country	2020		2016 adjusted		2013 adjusted		2020 – 2016 comparison		2020 – 2013 comparison	
	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score
IND	1.78	1	1.49	1	1.11	1	0.29	0	0.67	0
NPL	2.08	1	1.80	1	1.43	1	0.28	0	0.64	0
KHM	1.63	1	1.35	1	0.99	1	0.27	0	0.64	0
LAO	1.99	1	1.75	1	1.43	1	0.24	0	0.56	0
FSM	2.79	3	2.61	2	2.27	2	0.18	1	0.52	1
PAK	1.97	1	1.75	1	1.47	1	0.21	0	0.49	0
IDN	2.25	1*	2.05	1	1.78	1	0.20	1	0.46	1
VNM	2.56	2	2.41	2	2.20	1*	0.15	0	0.36	1
BGD	2.11	1	1.97	1	1.77	1	0.14	0	0.34	0
CHN	2.58	2	2.44	2	2.26	2	0.14	0	0.32	0
KIR	1.80	1	1.67	1	1.50	1	0.13	0	0.31	0
MDV	3.00	5	2.95	4	2.72	2	0.05	1	0.28	3
BTN	2.39	2	2.28	2	2.11	1	0.11	0	0.28	1
TLS	1.66	1	1.56	1	1.42	1	0.11	0	0.25	0
AZE	2.76	3	2.72	2	2.53	2	0.05	1	0.23	1
FJI	2.96	4	2.89	3	2.73	2	0.07	1	0.22	2
PHL	2.56	2	2.47	2	2.35	1*	0.09	0	0.21	1
AFG	1.63	1	1.54	1	1.42	1	0.09	0	0.21	0
MNG	1.76	1	1.71	1	1.61	1	0.05	0	0.16	0
LKA	2.96	4	2.90	3	2.83	3	0.06	1	0.12	1
TUV	2.69	2	2.69	2	2.61	2	0.00	0	0.08	0
TJK	2.97	4	2.94	3	2.89	3	0.04	1	0.08	1
SLB	0.73	1	0.70	1	0.66	1	0.03	0	0.07	0
TON	2.86	3	2.86	3	2.80	3	0.00	0	0.06	0
KGZ	3.00	5	3.00	5	2.95	3	0.00	0	0.05	2
MYS	2.99	4	2.99	4	2.95	4	0.00	0	0.04	0
ARM	2.68	2	2.66	2	2.64	2	0.02	0	0.04	0
THA	2.99	4	2.98	4	2.96	4	0.01	0	0.04	0
COK	2.97	4	2.97	4	2.94	3	0.00	0	0.04	1
TKM	3.00	5	2.99	4	2.96	4	0.01	1	0.04	1
UZB	3.00	5	3.00	5	2.97	4	0.00	0	0.03	1
KAZ	3.00	5	2.99	4	2.97	4	0.01	1	0.03	1
WSM	2.98	4	2.98	4	2.97	4	0.00	0	0.01	0
AUS	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
BRN	2.92	3	2.92	3	2.92	3	0.00	0	0.00	0
JPN	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
KOR	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
NZL	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
PLW	3.00	5	3.00	5	3.00	5	0.00	0	0.00	0
MHL	1.92	1	1.93	1	1.93	1	0.00	0	-0.01	0
NIU	2.96	4	2.96	4	2.98	4	0.00	0	-0.03	0
MMR	2.14	1	2.17	1	2.21	1*	-0.03	0	-0.07	0
PNG	1.00	1	1.05	1	1.10	1	-0.04	0	-0.10	0
GEO	2.67	2	2.72	2	2.78	3	-0.05	0	-0.11	-1
VUT	1.90	1	1.97	1	2.07	1	-0.07	0	-0.17	0

Like water supply, most countries saw an increase in raw scores from 2016 to 2020, without it translating into better sub-indicator scores, with only two of the top eleven countries increasing their sub-indicator score. Countries with the highest raw score improvements were those that received a one score in 2013 and despite significant improvements remained a score of one. Compared with water supply, there were more improvements in sanitation raw scores, particularly in South and South East Asia, with India being discussed in greater detail in Highlight box 5. This was expected and could be attributed to a lower starting point in 2013. Also, like water supply, the results show that there was more improvement between 2013 – 2016 than there was between 2016 – 2020. This is also a reflection that the gap in data years considered are 2010 – 2014 vs 2014 – 2017. With this in mind, the changes per year of both periods are approximately the same. Like sub-indicator 1, Pacific countries were most concerning, with four of the six countries with decreasing scores being Pacific countries.

The extent of OD practiced within a country is an important element of SI 2. The methodology used for sub-indicator 2 excludes countries with high OD from high scores and severely disadvantages countries with any rural open defecation. No country that received a SI 2 score of three or more had any more than 3% of their rural population openly defecating. Further, only one country, Indonesia, had over 10% of their population openly defecating would have scored more than 1 without the OD threshold. This shows that in most cases, low levels of OD were not concealed in other sanitation results.

HIGHLIGHT BOX 2. DIFFERENCE IN RESULTS OF DIFFERENT SUB-INDICATOR 2 METHODS

Difference in results of different sub-indicator 2 methods

The difference in calculating sub-indicator 2 in 2020 compared to 2016 is that the 2016 method used the percentage of the population with improved sanitation only, while the 2020 method considers multiple sanitation service levels. The 2020 method, calculates a score by giving more points to higher service levels. Further, due to data gaps, the highest JMP service level, safely managed, has not been included as it ideal would have been. This results in three different potential methods and in this box the impacts of using different the methods have been investigated.

The 2020 and 2016 methods have been well explained in the method section of the report, but the 'ideal' method, which includes safely managed, would expand on this. The simplest approach would be to amend the 2020 method to give countries an added four points for every percent of rural population that has access to safely managed sanitation, making the maximum score four. For the purposes of this analysis, this method has been called the 'ideal' method. The OD threshold has not been used in this analysis.

Seven countries that have enough data for calculations for all three methods are shown in the table below. As this list is rather limited, comparisons have used the non-banded score (a raw score for the 2020 and ideal methods and a percentage for 2016) with each country ranked from 1 – 7 according to their score. The noteworthy changes (+/– 2 or more) have been highlight. It should be noted that the years indicate the method with all using the same 2017 JMP dataset.

TABLE IN BOX 2. COMPARISON OF DIFFERENT SUB-INDICATOR 2 METHODS

Country	Un-banded scores			Rank (1 – 7)			Change in rank		
	2016	2020	Ideal	2016	2020	Ideal	2016 – 2020	2020 – ideal	2016 – ideal
Bangladesh	47%	2.11	2.44	7	5	6	+2	-1	+1
China	76%	2.58	3.14	3	3	2	0	+1	+1
India	53%	1.78	2.17	6	7	7	-1	0	-1
Lao PDR	64%	1.99	2.55	5	6	5	-1	+1	0
Philippines	75%	2.56	3.05	4	4	3	0	+1	+1
Samoa	98%	2.98	3.49	1	1	1	0	0	0
Tuvalu	86%	2.69	2.79	2	2	4	0	-2	-2

The change between the 2016 and 2020 methods resulted in Bangladesh leapfrogging both Lao PDR and India. This occurred because both Lao PDR and India have much higher percentages of rural populations practising open defecation and lacking sanitation access. These results indicate that the newer method is an improvement by better accounting for and penalising countries with large rural populations openly defecating.

Were the ideal method to be adopted, Tuvalu would have the most significant decrease of the countries above. While the country has rather high levels of rural people with a basic sanitation service, very few (only 10%) have a safely managed service. This has occurred because Tuvalu has relatively high numbers of sewer connections, but there is no sewerage treatment in the country. This method would therefore reward countries for ensuring that waste is safely treated in rural areas.

3.3.3 Sub-indicator 3: Health impacts

Similar to sub-indicator 2, most of the fastest improving countries kept their scores of one in 2020 despite their rapid improvement. There is a clear trend that the better performing countries in 2013 have improved slower than those with lower 2013 scores. In fact, all of the top ten improving countries were in the bottom ten of countries in 2013. Further, every country showed improvement except for the Advanced Economies, which also fits this trend, it is not known why the Advanced Economies have increased their DALYs

While Afghanistan has shown the most improvement, reducing their WASH attributable DALYs by almost double the next best country, they are still the lowest ranked of all 45 countries. Like sub-indicators 1 and 2, the years are somewhat misleading with 2020 using 2016 data, 2016 using 2015 data, and 2013 using 2010 data. Therefore, the gap between 2013 and 2016 is five years, with 2016 – 2020 only being a gap of one year.

Table 17. Comparisons of health impacts sub-indicator 3 with adjusted 2013 and 2016 scores to 2020 scores
Black cells indicate countries that had the same estimate used for all years

ABD Country	2020		2016 adjusted		2013 adjusted		2020 – 2016 comparison		2020 – 2013 comparison	
	DALYs	SI score	DALYs	SI score	DALYs	SI score	DALYs	SI score	DALYs	SI score
AFG	19.58	1	21.14	1	32.54	1	1.55	0	12.96	0
LAO	14.28	1	15.13	1	20.87	1	0.85	0	6.59	0
PAK	18.24	1	19.18	1	24.18	1	0.94	0	5.94	0
NPL	10.68	1	11.32	1	16.58	1	0.63	0	5.90	0
IND	11.95	1	12.59	1	17.52	1	0.64	0	5.57	0
TLS	13.54	1	14.44	1	18.92	1	0.90	0	5.38	0
PNG	17.96	1	19.75	1	23.14	1	1.79	0	5.18	0
BGD	8.67	2	9.24	2	13.64	1	0.57	0	4.97	1
KIR	14.64	1	15.73	1	19.11	1	1.09	0	4.47	0
MMR	9.97	2	10.54	1	14.37	1	0.57	1	4.40	1
KHM	7.31	2	7.72	2	11.65	1	0.41	0	4.34	1
TKM	6.83	2	7.27	2	9.07	2	0.44	0	2.24	0
TJK	5.83	2	6.16	2	8.06	2	0.33	0	2.23	0
SLB	8.79	2	9.17	2	10.74	1	0.38	0	1.95	1
BTN	4.96	3	5.17	2	6.89	2	0.22	1	1.93	1
PHL	8.29	2	8.56	2	10.11	1	0.27	0	1.82	1
VUT	12.66	1	13.02	1	14.25	1	0.36	0	1.59	0
VNM	3.18	3	3.38	3	4.77	3	0.20	0	1.59	0
FSM	6.44	2	6.64	2	7.93	2	0.20	0	1.49	0
IDN	4.50	3	4.65	3	5.80	2	0.15	0	1.29	1
KGZ	2.77	3	2.74	3	3.89	3	-0.03	0	1.12	0
UZB	1.78	4	1.91	4	2.88	3	0.13	0	1.11	1
MNG	2.42	3	2.58	3	3.41	3	0.16	0	0.99	0
KAZ	1.71	4	1.84	4	2.65	3	0.13	0	0.94	1
AZE	2.45	3	2.58	3	3.27	3	0.13	0	0.83	0
WSM	2.71	3	2.74	3	3.32	3	0.04	0	0.62	0
FJI	5.16	2	5.21	2	5.62	2	0.04	0	0.46	0
MDV	0.65	5	0.68	5	0.94	5	0.03	0	0.29	0
ARM	0.95	5	0.99	5	1.22	4	0.04	0	0.28	1
TON	2.85	3	2.91	3	3.11	3	0.06	0	0.26	0
CHN	0.93	5	0.96	5	1.16	4	0.03	0	0.22	1
LKA	1.77	4	1.78	4	1.89	4	0.01	0	0.12	0
GEO	0.91	5	0.92	5	1.02	4	0.01	0	0.11	1
MYS	4.03	3	4.01	3	4.08	3	-0.02	0	0.05	0
THA	3.22	3	3.25	3	3.25	3	0.02	0	0.03	0
COK		4		4		4				
MHL		1		1		1				
NIU		2		2		2				
PLW		4		4		4				
TUV		3		3		3				

BRN	0.32	5	0.35	5	0.31	5	0.03	0	-0.01	0
NZL	0.25	5	0.25	5	0.22	5	0.00	0	-0.03	0
AUS	0.21	5	0.21	5	0.18	5	0.00	0	-0.03	0
JPN	1.10	4	1.10	4	1.07	4	-0.01	0	-0.03	0
KOR	0.45	5	0.43	5	0.30	5	-0.02	0	-0.15	0

HIGHLIGHT BOX 3. LINKAGE BETWEEN RHWS, STUNTING, AND MALNUTRITION

Linkage between RHWS, stunting, and malnutrition

Globally 1 in 3 children under 5 years old have had their growth impeded by malnutrition. Often caused by poverty, poor nutrition at a young age can inhibit a child's growth, negatively impacting them for the rest of their lives and pushing them deeper into the poverty cycle. Malnutrition can lead to two conditions, stunting, defined by a child being short for their age, and wasting, defined as being thin for their height. Stunting is often a chronic condition while wasting can be more acute reflecting recent events. Globally, stunting is worse in the rural communities and wasting is most prevalent in Asia.

While stunting and wasting have not been directly included in the KD1 index, protein-energy malnutrition (PEM) is one of the illnesses considering in sub-indicator 3. While WASH is an important factor in malnutrition, it is only one of several environmental factors the contribute to malnutrition in children. WASH attribution factors for PEM were relatively low, ranging from 4% - 13 % resulting in malnutrition contributing a maximum of 4% of any countries total WASH attributable DALYs. However, even though there is a minimal contribution, there is a strong correlation between WASH attributable malnutrition DALYs and total WASH attributable DALYs (a linear line of best fit resulted in an R^2 value of 0.86). This is because many of the environmental factors that lead to malnutrition also lead to diarrheal illness, which makes up for most of the total WASH attributable DALYs.

While not being the same measurement, WASH attributable malnutrition DALYs and percentages of children under five suffering from stunting also shows a strong correlation (a second order polynomial line of best fit received an R^2 value of 0.69). The same could not be said for wasting which showed a low correlation with WASH attributable malnutrition DALYs.

In short, this analysis has shown that while stunting caused by malnutrition has only a small direct impact on WASH attributable health impacts, and therefore a small impact on RHWS, these two outcomes have a close correlation because they share similar causes. Any intervention that addressed these causes and improved health impacts attributable to WASH would very likely also improve stunting, and vice versa. However, the same cannot be said about wasting.

References

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3.3.4 Sub-indicator 4: Affordability

TABLE 18. COMPARISONS OF AFFORDABILITY SUB-INDICATOR 4 WITH ADJUSTED 2013 AND 2016 SCORES TO 2020 SCORES SUB-INDICATOR 4

ABD Country	2020		2016 adjusted		2013 adjusted		2020 – 2016 comparison		2020 – 2013 comparison	
	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score	Raw Score	SI score
LAO	3.16%	3	3.64%	3	6.06%	1	0.48%	0	2.90%	2
CHN	1.64%	5	1.98%	5	3.90%	3	0.34%	0	2.25%	2
KGZ	3.16%	3	3.46%	3	4.82%	2	0.31%	0	1.66%	1
TLS	14.81%	1	16.04%	1	15.95%	1	1.23%	0	1.14%	0
VNM	4.82%	2	5.35%	1	5.92%	1	0.53%	1	1.11%	1
KHM	2.74%	4	3.15%	3	3.71%	3	0.41%	1	0.98%	1
LKA	3.87%	3	3.82%	3	4.80%	2	-0.05%	0	0.94%	1
FJI	3.56%	3	3.85%	3	4.45%	2	0.28%	0	0.88%	1
BRN	5.54%	1	5.39%	1	6.41%	1	-0.15%	0	0.87%	0
THA	4.14%	2	4.84%	2	4.93%	2	0.70%	0	0.80%	0
PLW	1.28%	5	1.60%	5	2.04%	4	0.33%	0	0.77%	1
COK	0.98%	5	1.17%	5	1.67%	5	0.19%	0	0.69%	0
ARM	1.66%	5	2.04%	4	2.34%	4	0.38%	1	0.68%	1
MYS	2.93%	4	3.34%	3	3.59%	3	0.41%	1	0.66%	1
PHL	2.37%	4	2.33%	4	3.01%	3	-0.04%	0	0.65%	1
TON	1.48%	5	2.00%	4	2.11%	4	0.52%	1	0.63%	1
NIU	1.32%	5	1.58%	5	1.93%	5	0.25%	0	0.61%	0
SLB	3.07%	3	3.10%	3	3.65%	3	0.03%	0	0.58%	0
BGD	3.39%	3	3.76%	3	3.96%	3	0.36%	0	0.57%	0
KAZ	2.87%	4	2.49%	4	3.42%	3	-0.38%	0	0.55%	1
AZE	3.18%	3	2.60%	4	3.60%	3	-0.57%	-1	0.42%	0
IND	5.18%	1	6.00%	1	5.52%	1	0.82%	0	0.34%	0
NZL	1.43%	5	1.54%	5	1.62%	5	0.11%	0	0.19%	0
FSM	2.78%	4	3.21%	3	2.97%	4	0.42%	1	0.18%	0
WSM	2.61%	4	2.60%	4	2.79%	4	-0.01%	0	0.18%	0
TUV	2.23%	4	2.43%	4	2.40%	4	0.20%	0	0.17%	0
MDV	1.74%	5	1.76%	5	1.91%	5	0.02%	0	0.16%	0
MHL	2.67%	4	2.98%	4	2.82%	4	0.30%	0	0.15%	0
BTN	6.11%	1	6.21%	1	6.24%	1	0.10%	0	0.13%	0
KOR	0.58%	5	0.63%	5	0.68%	5	0.05%	0	0.10%	0
VUT	2.38%	4	2.39%	4	2.29%	4	0.00%	0	-0.09%	0
IDN	2.35%	4	2.45%	4	2.25%	4	0.10%	0	-0.10%	0
GEO	2.47%	4	2.31%	4	2.25%	4	-0.16%	0	-0.22%	0
TKM	3.02%	3	2.63%	4	2.78%	4	-0.39%	-1	-0.23%	-1
KIR	3.88%	3	3.90%	3	3.61%	3	0.02%	0	-0.27%	0
TJK	6.53%	1	4.95%	2	6.23%	1	-1.58%	-1	-0.30%	0
JPN	1.59%	5	1.76%	5	1.28%	5	0.16%	0	-0.31%	0
AUS	2.06%	4	1.99%	5	1.70%	5	-0.06%	-1	-0.35%	-1
MNG	3.63%	3	2.61%	4	2.62%	4	-1.02%	-1	-1.01%	-1
UZB	8.03%	1	3.75%	3	6.57%	1	-4.28%	-2	-1.45%	0
PAK	7.78%	1	6.85%	1	6.17%	1	-0.93%	0	-1.61%	0
NPL	7.70%	1	7.30%	1	5.83%	1	-0.41%	0	-1.87%	0
MMR	8.85%	1	7.93%	1	6.68%	1	-0.92%	0	-2.18%	0
AFG	6.60%	1	5.05%	1	3.61%	3	-1.56%	0	-2.99%	-2
PNG	20.51%	1	16.48%	1	13.88%	1	-4.04%	0	-6.63%	0

As the base cost of services has remained the same for each country across all years, this comparison has only measured economic changes. If affordability is changing, this is showing that household consumption relative to CPI in changing, which is not necessarily specific to water. However, some other findings can be drawn from the data. Overall water service affordability has remained stagnant with small improvements from 2013 to 2016, followed by a small decline from 2016 to 2020. However, what is most concerning is that the countries where water services are the most expensive are also the countries where the relative cost of water services is increasing fastest (with some outliers). This is inverse to the trend seen in the other sub-indicators.

3.3.5 Sub-indicators combined

Table 19 and Figure 16 show the changes between the 2020 and adjusted 2016 and 2013 scores. The table and the chart should be read together, as one provides detail for the other. Figure 16 shows the 2020 scores as the blue filled area, with the 2016 and 2013 adjusted scores shown by the green and orange bars respectively. This figure enables a reader to quickly see which countries have shown the most increases or decreases in scores through time. Table 19 shows the changes through time for each country's sub-indicators, also calculating the mean average score across all countries for each sub-indicator through time. This enables to a reader to quickly identify why country scores have changed.

Overall, there have been steady increases across the KD through time. Affordability is the highest scoring sub-indicator, but also the slowest to improve. Inversely, sanitation is the lowest scoring but fastest improving sub-indicator. This is in line with expectations and trends found earlier in this results section.

Several countries that have been highlighted for either their rapid improvement or any worsening of RHWS, with the reasons for their changes in score detailed below:

- The Maldives
  - The Maldives has improved their RHWS index score significantly since 2013 because they have consistently improved water supply and sanitation access even as they have reached closer to and achieved full basic coverage of water supply and sanitation.
- Armenia
  - Armenia has shown improvements in all sub-indicators except for access to sanitation. This is disappointing, as sanitation has been relatively stagnant with a large proportion of rural people still with access to only unimproved sanitation (15% in 2017 down from 19% in 2000) (JMP 2019).
- Uzbekistan
  - Affordability in 2016 is an outlier caused by economic growth resulting in the country score deceasing from 2016 to 2020. Other than this outlier, Uzbekistan has seen modest improvements in other sub-indicators.
- The Marshall Islands
  - The Marshall Islands saw a modest reduction in rural access to water supply. While it was a modest reduction, any reduction in this sub-indicator is a concern.
- Mongolia
  - Mongolia saw a decrease in affordability from 2016 to 2020, likely linked to a softening in economic growth after the 2013 – 2016 period.
- Afghanistan
  - Afghanistan saw a decrease in affordability from 2013 to 2016, this was caused by a poor exchange rate and reducing household consumption relative to CPI.

Table 19. Comparisons between 2020, adjusted 2016 and adjusted 2013 results for all sub-indicators

ABD Country	2020					2016					2013				
	SI 1	SI 2	SI 3	SI 4	Total	SI 1	SI 2	SI 3	SI 4	Total	SI 1	SI 2	SI 3	SI 4	Total
KOR	5	5	5	5	20	5	5	5	5	20	5	5	5	5	20
NZL	5	5	5	5	20	5	5	5	5	20	5	5	5	5	20
MDV	5	5	5	5	20	5	4	5	5	19	3	2	5	5	15
AUS	5	5	5	4	19	5	5	5	5	20	5	5	5	5	20
JPN	5	5	4	5	19	5	5	4	5	19	4	5	4	5	18
PLW	5	5	4	5	19	4	5	4	5	18	3	5	4	4	16
COK	5	4	4	5	18	5	4	4	5	18	5	3	4	5	17
ARM	5	2	5	5	17	5	2	5	4	16	3	2	4	4	13
TON	5	3	3	5	16	5	3	3	4	15	5	3	3	4	15
KAZ	3	5	4	4	16	3	4	4	4	15	2	4	3	3	12
NIU	4	4	2	5	15	4	4	2	5	15	4	4	2	5	15
GEO	3	2	5	4	14	3	2	5	4	14	3	3	4	4	14
BRN	5	3	5	1	14	5	3	5	1	14	5	3	5	1	14
WSM	3	4	3	4	14	3	4	3	4	14	3	4	3	4	14
TKM	4	5	2	3	14	3	4	2	4	13	3	4	2	4	13
MYS	3	4	3	4	14	3	4	3	3	13	3	4	3	3	13
TUV	5	2	3	4	14	5	2	3	4	14	4	2	3	4	13
THA	5	4	3	2	14	4	4	3	2	13	3	4	3	2	12
CHN	2	2	5	5	14	2	2	5	5	14	2	2	4	3	11
LKA	3	4	4	3	14	2	3	4	3	12	2	3	4	2	11
UZB	3	5	4	1	13	3	5	4	3	15	3	4	3	1	11
KGZ	2	5	3	3	13	2	5	3	3	13	2	3	3	2	10
FJI	3	4	2	3	12	3	3	2	3	11	3	2	2	2	9
AZE	2	3	3	3	11	2	2	3	4	11	2	2	3	3	10
FSM	2	3	2	4	11	2	2	2	3	9	2	2	2	4	10
IDN	2	2	3	4	11	2	1	3	4	10	2	1	2	4	9
PHL	3	2	2	4	11	3	2	2	4	11	2	2	1	3	8
VNM	3	2	3	2	10	3	2	3	1	9	2	2	3	1	8
BTN	4	2	3	1	10	3	2	2	1	8	3	1	2	1	7
MHL	3	1	1	4	9	4	1	1	4	10	4	1	1	4	10
BGD	3	1	2	3	9	3	1	2	3	9	3	1	1	3	8
TJK	2	4	2	1	9	1	3	2	2	8	1	3	2	1	7
KHM	2	1	2	4	9	2	1	2	3	8	1	1	1	3	6
MNG	1	1	3	3	8	1	1	3	4	9	1	1	3	4	9
VUT	2	1	1	4	8	2	1	1	4	8	2	1	1	4	8
SLB	1	1	2	3	7	2	1	2	3	8	2	1	1	3	7
KIR	2	1	1	3	7	2	1	1	3	7	2	1	1	3	7
LAO	2	1	1	3	7	2	1	1	3	7	1	1	1	1	4
IND	3	1	1	1	6	3	1	1	1	6	2	1	1	1	5
MMR	2	1	2	1	6	2	1	1	1	5	1	2	1	1	5
PAK	3	1	1	1	6	2	1	1	1	5	2	1	1	1	5
NPL	3	1	1	1	6	2	1	1	1	5	2	1	1	1	5
TLS	2	1	1	1	5	2	1	1	1	5	1	1	1	1	4
AFG	1	1	1	1	4	1	1	1	1	4	1	1	1	3	6
PNG	1	1	1	1	4	1	1	1	1	4	1	1	1	1	4
Averages	3.16	2.78	2.82	3.18	11.93	3.02	2.58	2.78	3.20	11.58	2.67	2.44	2.56	2.96	10.62

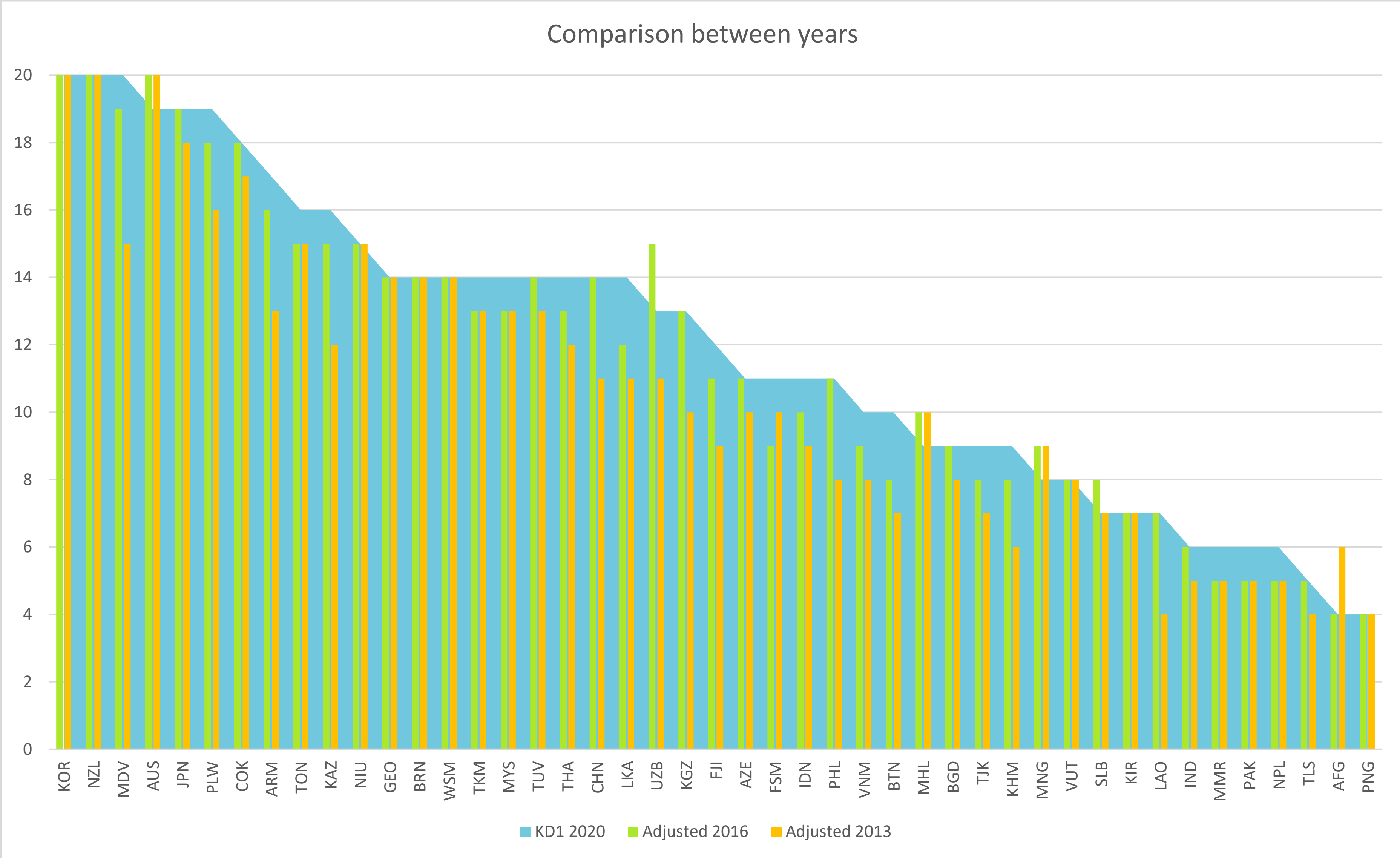

FIGURE 16. CHANGES BETWEEN THE 2020 AND ADJUSTED 2016 AND 2013 SCORES

3.4 Correlation between indicators

In section 2.2, a framework was introduced for how sub-indicators should related to one another. It was theorised that affordability should drive improved access to water supply and sanitation, which in turn would result in improved health outcomes. Therefore, there should be a correlation between SI1 and 2 combined and SI3 and SI4 separately. To show this, Figure 17 has plotted the combined SI1 and SI2 raw scores versus SI3 and SI4 raw scores on separate axes.

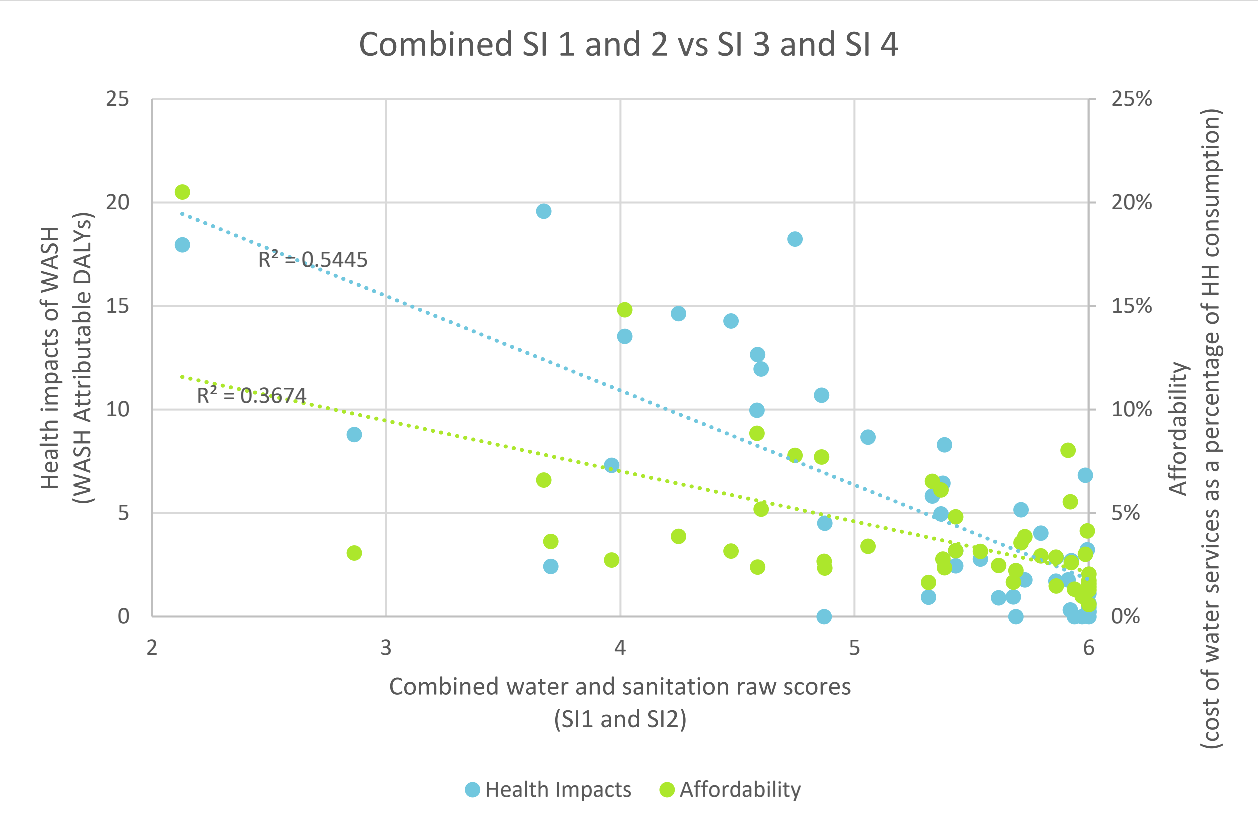

FIGURE 17. CORRELATION ANALYSIS BETWEEN THE SUB-INDICATORS

There can be seen a clear positive correlation in both the plots; however, correlation is not necessarily causation and therefore the theory that more affordable water services improve water and sanitation access, which in turn improves health outcomes, is supported but not proven. However, the R values for both plots are relatively low, 0.5445 and 0.3674 for Affordability and Health Impacts respectively, suggesting that these are not the only factors.

This is to be expected, as literature tells us that affordability is not the only factor in improved access (WWAP 2019) and is shown most clearly in the results by the Solomon Islands and Malaysia where they have similarly affordable water service, but Malaysia has much higher water supply and sanitation access.

This is also what is expected for the health impacts trend as there are many factors that can result in improved health, some are often unknown. For example, reductions in stunting and diarrheal disease have been linked to WASH interventions, hygiene programs in particular, but there are many other factors (Kwami 2019, World Bank 2017) .

4 Risk

4.1 Elements of risk

To develop a holistic and future looking understanding of RHWS, it is important understand the risks to future water security. In order to categorise and consider the water security risks faced by rural households, the risk framework developed by the KD5 team of AWDO 2020 has been applied to KD1. This framework is an expansion of the REACH (2015) risk framework. The framework features three elements that are each important to consider in risk and are shown below in Figure 18.

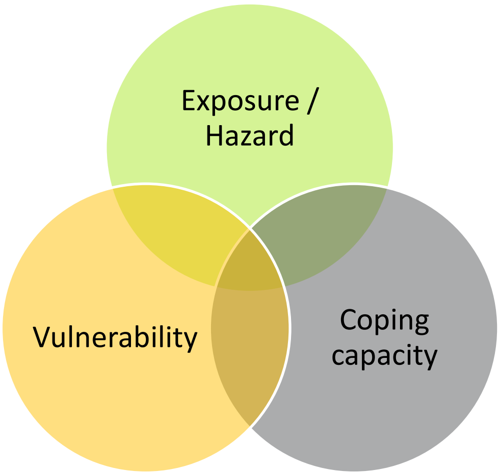

FIGURE 18. CONCEPTUAL REPRESENTATION OF RISK FRAMEWORK DEVELOPED BY KD5

In order to determine what factors should be considered in an assessment of risk, a literature review was conducted, reviewing 29 academic publications and practitioner reports relevant to risk to water security, rural water security and WASH.

Numerous risk factors were identified through the literature review, some of which were not relevant to RHWS as defined in section 2.1. Relevant factors have then been included in the risk framework in Table 20, as well as the rationale for their inclusion or exclusion from the RHWS risk framework, and what indicator would be used.

TABLE 20. POTENTIAL RHWS RISK FACTORS FOUND DURING LITERATURE SEARCH

Element	Factor	Rationale	Indicator
Factors included			
Exposure / hazard	Competing users	Increased water usage in other sectors can lead to a decrease in water available to Rural Households (Xiao, Li, Xiao, & Liu, 2008).	Predicted 2030 domestic BAU Water Stress from Aqueduct Water Risk Atlas (includes elements of competing users in modelling).
	Drought risk from climate change	Climate change will increase water shortages due to increased temperatures, reduced rainfall (Hall & Borgomeo, 2013), floods, water pollution and a deteriorated water environment (Xiao, Li, Xiao, & Liu, 2008).	Drought Risk from Aqueduct Water Risk Atlas.

	Water stress	Predicted increases in demand and reductions in supplies will result in more people experiencing water stress (Wiberg, et al. 2016).	Percentage of population in severe water stress by 2030 as predicted by Water Futures and Solutions.
Coping capacity	Planning	Lack of investment and planning can lead to water shortages (Feng, Zhang, & Luo, 2008). Water planning has been shown to improve water security in rural areas (Meng, Wu, & Zhang, 2013). Poor WASH outcomes have been shown to be the result of poor implementation, not poor policy (World Bank 2017).	Existence of national WASH policies and implementation plans from GLAAS.
	Financial resources		Sufficient financial resources from GLAAS.
	Human resource		Sufficient human resources from GLAAS.
Vulnerability	Human rights	Studies show that educating and empowering vulnerable groups in water decision making improves water security (Kujinga, Vanderpost, Mmopelwa, & Wolski, 2014) (Bizikova, Roy, Swanson, Venema, & McCandless, 2013) (Sinyolo, Mudhara, & Wale, 2014).	Recognition of human rights to water and sanitation from GLAAS.
	Inclusion of vulnerable people		Measures to reach poor populations exist from GLAAS.
	Population in poverty	Households with higher incomes are more able to invest in water and sanitation services (Kujinga, Vanderpost, Mmopelwa, & Wolski, 2014).	Population below national poverty lines from the World Bank.
Factors considered, but not included			
Exposure / hazard	Land cover	No direct link between land cover and RHWS could be found.	N/A
	Population growth	Population growth reduces the water available per capita and can reduce water quality (Feng, Zhang, & Luo, 2008); however, population growth can improve water affordability due more centralised populations.	

4.2 Risk datasets

With the factors and elements of risk identified, three databases were used to collate the risk indicators. These three databases and the metrics developed from them are detailed in Table 21.

TABLE 21. DATASETS USED TO COLLATE RISK INDICATORS

Data base	Reference	Data year	Factor	What is being indicated	Metric in indicator table (either from the dataset or developed in this study)
Aqueduct Country Ranking	(Aqueduct 2019)	2019	Competing users	Baseline water stress measures the ratio of total water withdrawals to available renewable water supplies.	Number from 0 – 5, higher values indicate higher water stress
			Drought risk from Climate Change	Drought risk measures where droughts are likely to occur, the population and assets exposed, and the vulnerability of the population and assets to suffering adverse effects.	Number from 0 – 1, higher values indicate higher risk of drought
Water Futures and Solutions	(Wiberg, et al. 2016)	2016	Water stress	Percentage of population that will be in severe water stress by 2030 under the middle of the road scenario.	
GLAAS	(GLAAS 2019)	2019	Planning	Whether rural water and sanitation plans are in place and being implemented and the degree to which they are being implemented.	1 Policies and plan in place and fully implemented 2 Policies and plans in place and partially implemented 3 Policies in place and plans being developed 4 Policies in place without implementation plans 5 Plans and policies not in place
			Financial resources	Whether financial resource assessments have been completed, if they have what percentage of required funding has been made available.	1 Cost estimates developed, more than 75% of resources available to implement plans 2 Cost estimates developed, less than 75% of resources available to implement plans 3 Cost estimates developed, less than 50% of resources available to implement plans 4 Cost estimates for either rural water or sanitation but not both

Data base	Reference	Data year	Factor	What is being indicated	Metric in indicator table (either from the dataset or developed in this study)
					5 No cost estimate
			Human resource	Whether human resource assessments have been completed, if they have what percentage of required human resource is available.	1 HR assessment developed, more than 75% of resources available to implement plans 2 HR assessment developed, less than 75% of resources available to implement plans 3 HR assessment developed, less than 50% of resources available to implement plans 4 Hr assessment for either rural water or sanitation but not both 5 No HR assessment
			Human rights	Whether the right to water and or sanitation is recognised.	1 Recognises rights to both water and sanitation 3 Recognises right to either water or sanitation but not both 5 Does not recognise the right to water or sanitation
			Inclusion of vulnerable people	Whether measures to reach poor populations exist in national policies and plans.	1 Measures in both water and sanitation policy 3 Measures in either water or sanitation policy but not both 5 No measures in place
World Bank	(World Bank 2019)	Varies	Population in poverty	Percentage of rural population below national poverty lines.	

4.3 Risk indicators

TABLE 22. RHWS RISK INDICATORS FOR ADB COUNTRIES. FOOTNOTES HAVE BEEN USED TO EXPLAIN ANY DIFFERENCES IN METRICS

Region	ABD country	Exposure / Hazard			Coping capacity			Vulnerability		
		Future water stress	Drought risk from Climate Change	Population in severe water scarcity	Planning	Financial Resources	Human resource	Human rights	Inclusion of vulnerable people	Population in poverty
AE	AUS	3.5	0.32	26%						
	BRN	0.0		0%						
	JPN	2.2	0.46	21%						
	KOR	2.4	0.22	50%						
	NZL	0.6	0.39	0%	5[10]			5		
CWRD	AFG	3.5	0.62	54%	2	3	3	5	3	55%
	ARM	4.4	0.34	71%						30%
	AZE	4.3	0.55	54%	1	1	1	1	1	43%
	GEO	2.3	0.41	5%	3	3	4	1	1	20%
	KAZ	4.5	0.51	37%						4%
	KGZ	4.9	0.53	56%	2	3	5	1		34%
	PAK	4.1	0.60	53%	3	3	5	1	1	36%
	TJK	3.3	0.59	29%	3[11]	4	4	1	3	35%
	TKM	4.2	0.57	52%						
	UZB	4.4	0.66	66%	1	1	1	1		14%
EARD	CHN	3.1	0.60	45%	1	2[12]	1	3	3	7%
	MNG	4.0	0.38	19%	2	5	5	1	5	26%
PARD	COK									
	FJI				3	4	4	3		44%
	FSM									41%
	KIR									22%
	MHL				4	5		1	1	
	NIU									
	PLW									25%

[10] New Zealand and Vanuatu have only rural drinking water policy in place.

[11] Tajikistan has policies in place and plans not yet implemented.

[12] PR China has cost estimates developed, more than 75% for water less than 75% for sanitation of resources available to implement plans.

	PNG	0.1			1	3	5	1	5	42%
	SLB				2	3	3	5	5	13%
	TON									23%
	TUV				4	5	5	1		28%
	VUT				5[13]			1	5	13%
	WSM									20%
SARD	BGD	0.3	0.77	32%	2	3	2	1	1	35%
	BTN	0.0	0.41	0%	3	2[14]	2	5	1	17%
	IND	3.2	0.74	37%						26%
	LKA	2.8	0.71	6%	3	4		5	1	8%
	MDV			0%	3	5		1		8%
	NPL	2.1	0.56	11%	3[15]	5	5	1	1	27%
SERD	IDN	3.0	0.70	31%	2	3	5	1	1	10%
	KHM	0.4	0.67	5%	2	2	5	5	3	21%
	LAO	0.1	0.35	0%	5[16]	3	3	3	1	29%
	MMR	0.2		1%	4[17]	3	5	5	3	32%
	MYS	1.2	0.47	0%						2%
	PHL	2.7	0.53	25%	3[18]	3	4	1	1	22%
	THA	1.6	0.60	11%	1	3	3	1	1	14%
	TLS	3.1	0.65		3[19]	3	5	1	3	47%
	VNM	1.0	0.62	12%	3	4	4	3	1	19%

[13] New Zealand and Vanuatu have only rural drinking water policy in place.

[14] Bhutan has cost estimates developed, more than 75% for water less than 75% for sanitation of resources available to implement plans.

[15] Nepal has policies under revision, sanitation plan partially implemented and water plan under development.

[16] Lao PDR has plans and policies under development.

[17] Myanmar has water plans in place and partially implemented, and sanitation plans and policies under development.

[18] Philippines has policies in place, sanitation plan partially implemented and water plan under development.

[19] Timor-Leste has policies and plans in place and partially implemented (water policy under development).

A quick analysis of the risk indicators shows several indicators across regions, which point to future risks to RHWS. Below is a list of each of the key risks identified that will be discussed in more detail in Section 5:

- there will be increased water stress in Central West Asia and East Asia
- there will be large populations of people in severe water scarcity in Central West and East Asia, India, Bangladesh, and Indonesia – this largely aligns with water stressed countries with high populations
- there is a lack of financial and human resources across all regions
- poverty will be a big challenge in Central West Asia and the Pacific.

5 Discussion

The scores of each region using mean averages (not weighted by population) are shown in Figure 19.

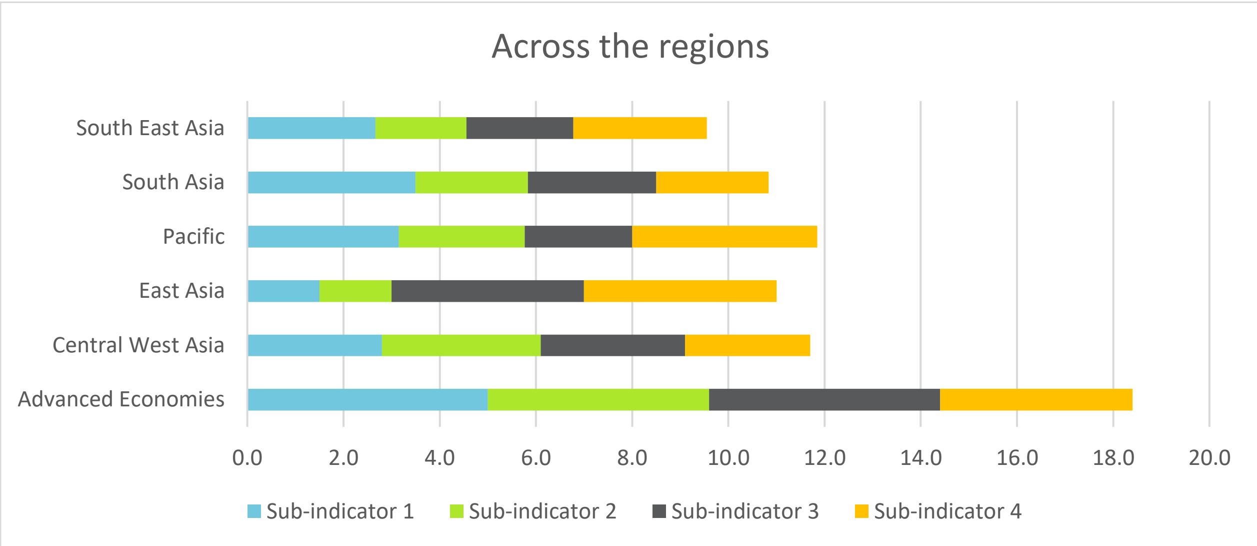

FIGURE 19. AVERAGE KD1 AND SUB-INDICATOR SCORES FOR EACH ADB REGION

As expected, Advanced Economies were found to have the highest water security for rural households, receiving very good scores for all sub-indicators, the highest of all regions in each sub-indicator except Affordability, which was tied with East Asia. This shows that affordability is difficult for both advanced and developing economies to achieve. Central West Asia and the Pacific both performed well out of the other regions with similar scores across all SIs. Central West Asia had poor affordability and the Pacific had poor health impacts. However, not using population weighted averages is somewhat misleading, particularly in the Pacific, this is discussed further in section 5.3. East Asia received poor scores for water supply and sanitation but performed very well in health impacts and affordability. South Asia is relatively strong in water supply, but weak in other areas. South East Asia performed relatively poorly across all the sub-indicators. Finally, the Pacific scored well in water supply and sanitation, in particular sanitation, while performed poorly for health impacts. This is likely because some illnesses that were attributed to WASH can be exasperated by tropical climates.

As well as a discussion on each of the regions, RHWS has been investigated with respect to several key considerations, which each have their own sections, including:

- small island states
- transboundary issues

- gender
- Sustainable Development Goals
- the health impacts caused by climate change.

5.1 Central West Asian region

KD1 scores for the Central West Asia region are shown in Figure 20.

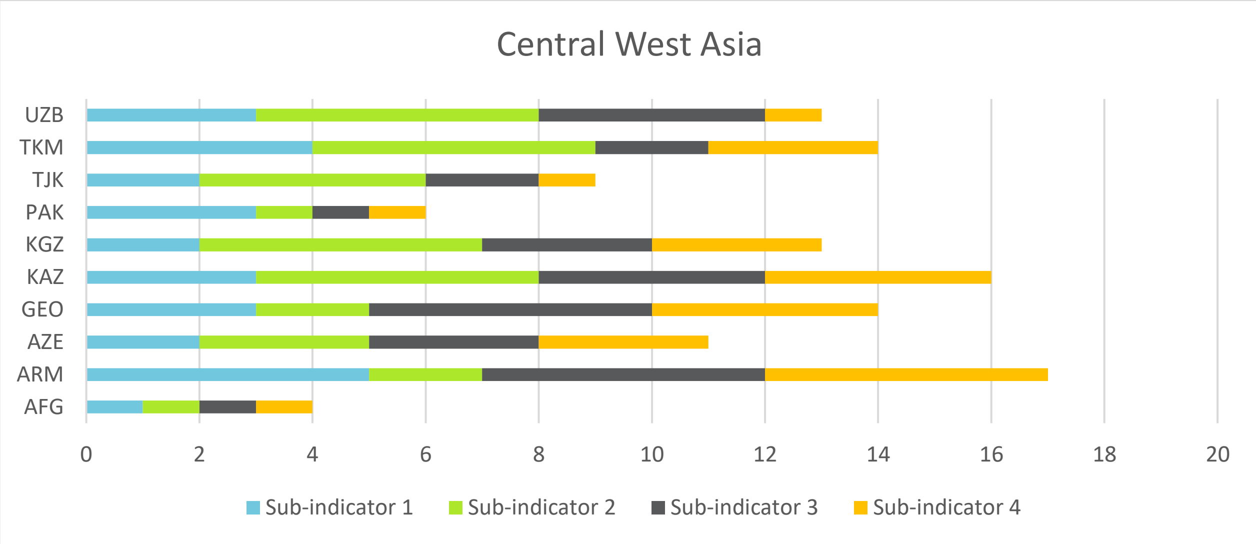

Figure 20. KD1 and Sub-indicator scores for countries in the Central West Asia region

The Central West Asian region shows significant variation among regional neighbours. Kazakhstan and Armenia both were very high scoring, while Pakistan and Afghanistan scored very poorly. The majority of countries had one or two sub-indicators that performed relatively poorly but indicators were not consistent across the region. Across the region, affordability was the worst scoring indicator and concerningly this is getting worse in several countries.

The risk indicators show that, with the exclusion of Georgia, all other countries in the region will face significant exposure / hazards risks. Reduced rainfall caused by climate change and intense competition for water use will contribute to this. Even though Armenia has relatively strong RHWS, it is predicted to have three quarters of the population in severe water stress by 2030. Further, many of the countries have high poverty rates, meaning that rural populations are at significant risk of not being able to afford water resources or services in this highly competitive environment. All these factors combine to create the potential that RHWS in Central West Asia could worsen or stagnate in future.

5.2 East Asian region

Figure 21 shows the KD1 scores for countries in the East Asia region.

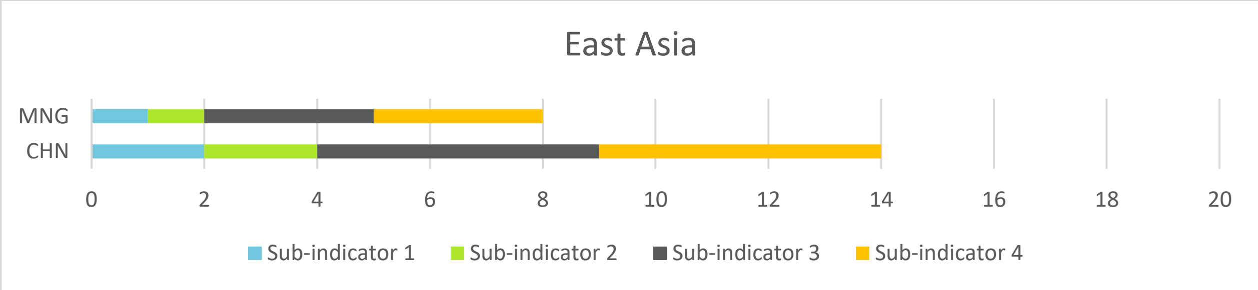

Figure 21. KD1 and Sub-indicator scores for countries in the East Asia region

The only two countries in the East Asia region considered are Mongolia and China as the rest are classified as Advanced Economies or not included in the analysis. Only safely managed estimates are provided for water supply in Mongolia and sanitation in China. In both cases, the safely managed estimate is significantly lower than at least basic, meaning that we would expect both countries' scores to drop should safely managed be considered in the future. Both countries have rapidly urbanising populations, causing issues with the planning of water and sanitation access.

As discussed in Highlight box 4, the PRC has taken steps to improve their planning in recent years; however, as shown in the by the risk framework, Mongolia is yet to achieve the same. In this water security assessment, China has performed significantly better than Mongolia, as it is well resourced and has lower poverty, even with high levels of stress and scarcity caused by its large populations. In contrast, Mongolia has not completed resourcing plans, though this has been recognised as an area of priority in Mongolia (ADB 2018). However, as Mongolia has low water stress and is starting from a lower base, it is also reasonable to expect its scores to improve in the future. With this in mind, it is likely that both countries in the East Asia region are likely to improve their RHWS into the future.

HIGHLIGHT BOX 4. RHWS IN THE YANGTZE RIVER BASIN

Rural household water security in the Yangtze River Basin

The Yangtze River is one of the longest interprovincial rivers in China. It is the home to the Yangtze River Economic Belt and will have significant socio-economic growth in the next decade. This growth will include significant urbanisation of the rural populations. In 2014, the urban population made up 54% of the region, while by 2030 it is predicted to be 69%. The economic output is expected to increase 2.5 times over the same period. This rapid growth is expected to bring with it the same problems faced by urbanisation and industrialisation in all catchments, with increased flood risk and water demand and a decrease in water quality.

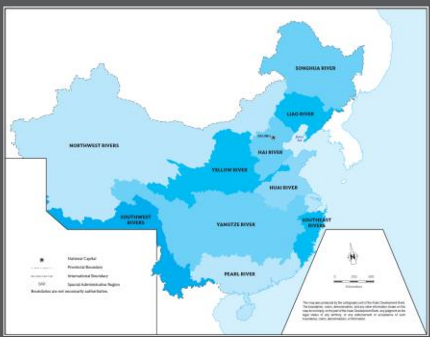

FIGURE IN BOX 1. RIVER BASINS IN CHINA (ADB 2018)

Growth will offer new challenges to RHWS in the Basin. For domestic water, rural populations use only 60% per capita of urban populations. Throughout China, rural household water is predominantly supplied through piped water or protected wells. The rapid urbanisation means that it is likely the demand for household water will increase substantially and that the source of water will change.

In 2018, an ADB report found that water governance in the YREB was relatively poor. The Yangtze Water Resources Commission had no clear mandate, responsibilities were unclear and there was a lack of coordination throughout the basin, creating difficulties in co-ordinating infrastructure, such as dams and the management and regulation of water usage and rights. In turn, water management was identified as a focus of the PRC's 13th five-year plan, released in 2016, leading to a significant improvement domestic water planning, as seen in a comparison between the 2017 and 2019 GLAAS reports.

As well as improving water management, the 13th five-year plan explicitly states that lifting rural people out of poverty and improving their livelihoods is an obligation of the government. The plan also recognises that development of rural areas has lagged urban areas, addressing this being a key part of the plan's development philosophy. The plan states that the strategy of extending urban water networks to include more of the rural population is a way of address the urban/rural disparity.

It is the intention of the PRC to improve the water governance in the region and transition rural populations into either urban areas or piped water networks connected to urban areas. It is also notable that sanitation is not a clearly stated priority like water supply is. This report has found that the PRC has shown sluggish improvements in sub-indicators 1 and 2. However, as the water planning has significantly improved, it could be expected that RHWS will soon do so as well.

References

ADB, Asian Development Bank. 2018. Managing Water Resources for Sustainable Socioeconomic Development. Manila: Asian Development Bank.

CPC, Central Committee of the Communist Party of China. 2016. The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China 2016-2020. Beijing, China: Central Compilation & Translation Press.

5.3 Pacific region

Scores of each of the countries in the Pacific region are shown in Figure 22.

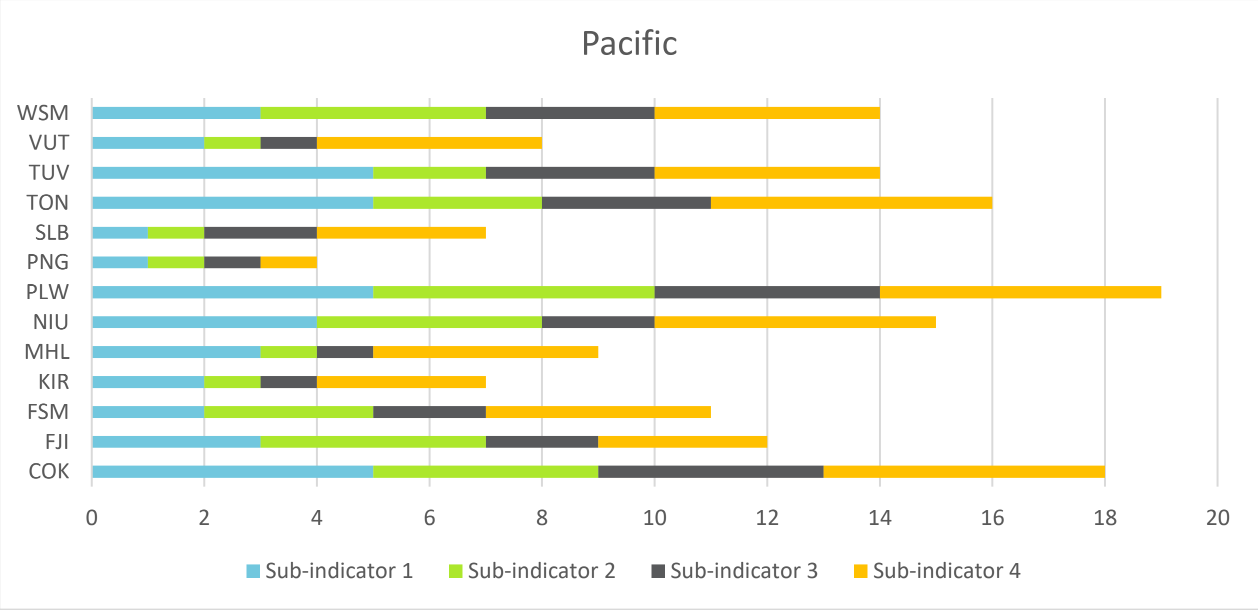

FIGURE 22. KD1 AND SUB-INDICATOR SCORES FOR COUNTRIES IN THE PACIFIC REGION

The Pacific region has high variability between the countries. Palau, the Cook Island and Tonga scored well, while Papua New Guinea, Vanuatu, Kiribati, and the Solomon Islands were among the worst scoring countries in all the Asia-Pacific. This variability means that a regional score calculated using the mean average can be misleading. As almost 80% of the population in the Pacific lives in PNG and PNG has the lowest RHWS of all the Asia Pacific, when the population weighted average is used for the Pacific, a much lower score is calculated. This is shown in Table 23.

Table 23. KD1 for the Pacific region calculated by the mean average and population weighted average

ADB Country	Population	Regional population (%)	SI 1	SI 2	SI 3	SI 4
COK	18,600	0.16%	5	4	4	5
FJI	884,887	7.74%	3	4	2	3
FSM	102,622	0.90%	2	3	2	4
KIR	113,000	0.99%	2	1	1	3
MHL	54,354	0.48%	3	1	1	4
NIU	1,719	0.02%	4	4	2	5
PLW	17,536	0.15%	5	5	4	5
PNG	9,018,940	78.85%	1	1	1	1
SLB	639,418	5.59%	1	1	2	3
TON	99,629	0.87%	5	3	3	5
TUV	11,582	0.10%	5	2	3	4
VUT	278,443	2.43%	2	1	1	4
WSM	197,731	1.73%	3	4	3	4
Pacific region	11,438,460	Regional mean average	3.2	2.6	2.2	3.8
	Regional population weighted average		1.3	1.3	1.2	1.5

There are many countries in the Pacific without safely managed estimates. However, the estimates that have been made show that safely managed services make up less than half of at least basic across the region.

Similarly, there are many data gaps in the risk indicators; however, there are a few trends that can be seen. While there is no data, one would expect that there would be a lot of variability in water stress and scarcity across different countries and across different islands in the same country as water scarcity issues are contextually specific to the small catchments that exist on islands. However, across the Pacific, not one country reported to having a well-resourced rural water and sanitation plan and there are relatively high levels of poverty. While it is impossible to make an informed assessment on the future of water security without the appropriate water stress information, climate change is already impacting Pacific countries. This will likely continue and worsen and therefore it is possible that in future RHWS will decrease in the Pacific. This is discussed further in section 5.9.

5.4 South Asian region

KD1 scores for countries in the South Asia region are shown in Figure 23.

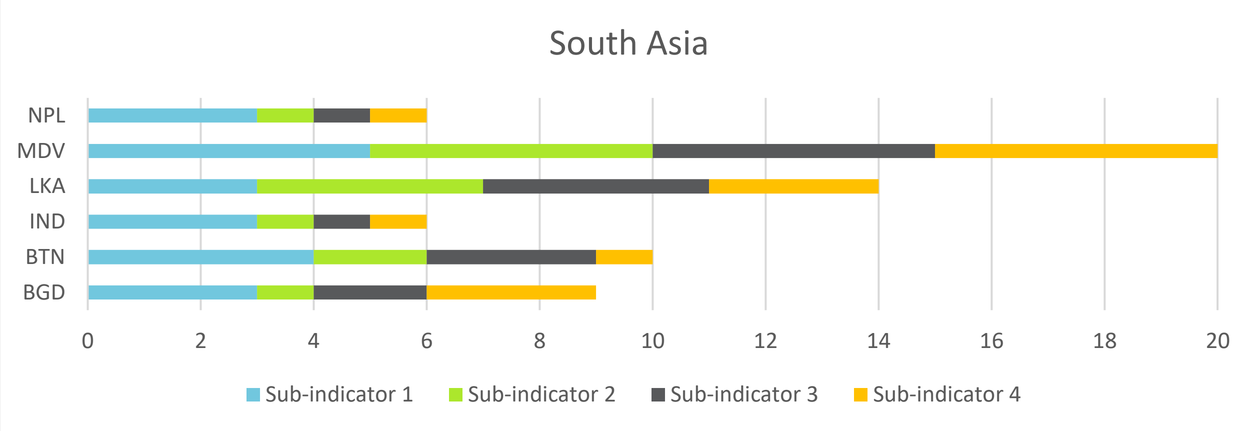

Figure 23. KD1 and Sub-indicator scores for countries in the South Asia region

Of all the South Asian countries, Maldives score very well and is the highest ranked country in the region. Sri Lanka is the clear second highest scoring country in the region due to its strong performance in affordability and sanitation relative to its regional neighbours. In most of the South Asia countries, sanitation is the worst scoring sub-indicator, while water supply is the highest. However, many South Asian countries showed significant improvement in sanitation compared with 2016 and 2013. This is especially true for India and has been discussed further in Highlight box 5. Where there is data across the region, safely managed scores for both water supply and sanitation are significantly lower than at least basic. This is particularly evident in the water supplies of Bhutan and Nepal. Both countries have more rural people receiving piped water than those that are receiving safe water.

Most countries in South Asia have minimal water security future risks, but all face relatively high drought risk from climate change. Bangladesh and India are notable, as both have high water scarcity (>30% population living with severe water scarcity) as well as high levels of poverty. However, even considering these risks, both countries have been showing rapid improvement in KD1, particularly in regard to sanitation. Therefore, it is likely that RHWS will continue to improve in South Asia.

HIGHLIGHT BOX 5. INDIA'S RAPID SANITATION IMPROVEMENTS (SUB-INDICATOR 2)

India's rapid improvement because of focused missions

One of the key issues faced by not only KD 1 but all the KD teams, is that calculations are based off data that is somewhat old. Sub-indicators 1 and 2 are based off JMP data published in 2019, but these estimates are for the year 2017. In 2014, the Indian government began an historic sanitation program called Swachh Bharat in many states, with some states beginning similar missions at similar times. Due to the old data, much of the recent sanitation improvements that should be attributed to these missions have not been captured.

It was noted in the comparison with 2016 and 2013 adjusted scores that India has shown the largest raw score improvement of any country. However, this was calculated from a comparison between JMP estimates for 2014 and 2017. In this highlight box, the 2019 National Annual Rural Sanitation Survey (MDWS 2019) has been used to investigate what India's sub-indicator 2 score would have been if the most recent data was used. A raw score has been found for India in 2014, 2017 and 2019 and has then been comparatively ranked against other countries. These results are shown below.

TABLE IN BOX 3. COMPARISON OF DIFFERENT SUB-INDICATOR 2 SCORES IF INDIA

	JMP service levels						
Year	At least basic	Limited (shared)	Unimproved	Open defecation	Raw score	Sub-indicator 2 score	Rank out of 45
2014	44%	7%	3%	46%	1.49	1	40
2017	53%	8%	3%	36%	1.78	1	39
2019	82%	10%	2%	7%	2.66	2	26[1]

1. COMPARED WITH 2017 SCORES FROM OTHER COUNTRIES

In the first few years of the program, between 2014 and 2017, there was a significant improvement in sanitation access across rural India, an increase in their raw score by 0.29, the highest of all countries. This is the equivalent of approximately 10% of the rural population that openly defecated in 2014 having access to basic sanitation in 2017. Unfortunately, this was not enough to meet the threshold to increase the sub-indicator score and their rank among AWDO countries showed only a minimal increase. However, between 2017 and 2019, there was an incredible improvement in access to sanitation, increasing the raw score by 0.88, 3 times the increase from 2014 – 2017 in fewer years. This is the equivalent of approximately 30% of the rural population no longer openly defecating and now having basic access to sanitation. Further, this increase was enough to result in a sub-indicator score of 2 (only 0.09 shy of a score of 3) and moving up 13 ranking spots.

5.5 South East Asian region

South East Asia region countries have their KD1 scores shown in Figure 24.

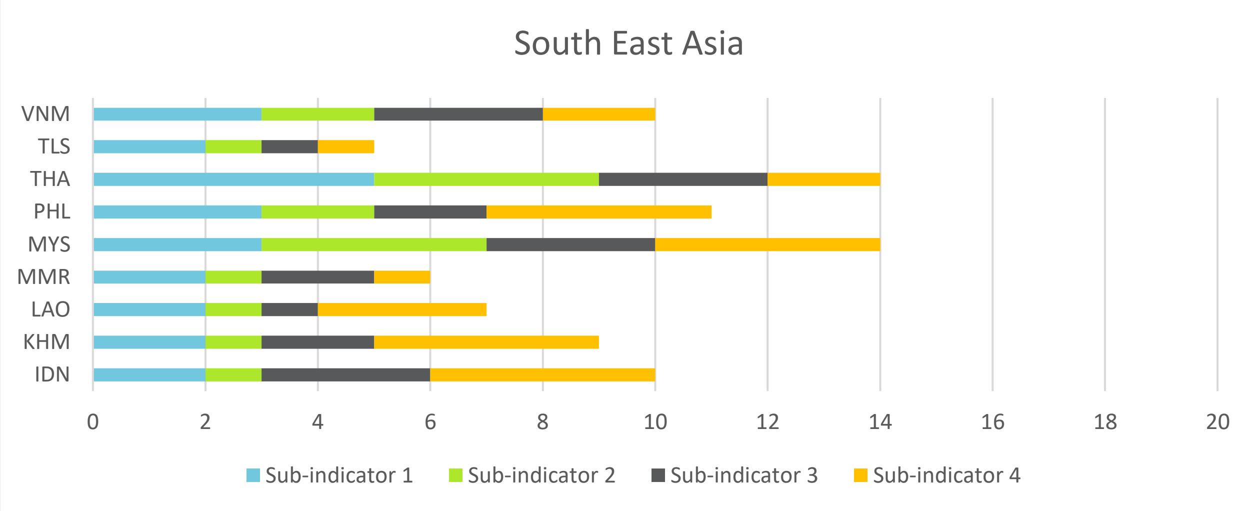

Figure 24. KD1 and Sub-indicator scores for countries in the South East Asia region

Thailand and Malaysia receive the highest KD1 scores in South East Asia. Thailand because of strong water supply and Malaysia scoring relatively well in all sub-indicators. Timor-Leste has received the lowest scores in the region and one of the worst scores of all AWDO assessed countries, with only water supply scoring more than one and having the second least affordable water services of all countries. This is reflective of it being one of the poorest countries in the region. Water services are relatively affordable in South East Asia compared to other regions. Malaysia has relatively high safely managed water supply and sanitation services, indicating that they are placing priority on achieving safely managed for most, rather than basic for all the population, such as Thailand. Most countries in the region are like Thailand in this respect.

Across the region there is expected to be relatively low levels of water scarcity and stress, but several countries have a relatively high drought risk. This indicates high seasonal variability in rainfall, typical considering South East Asia's wet and dry seasons. While most countries have completed resourcing plans for WASH policies, they are heavily under-resourced, meaning that human and financial resources could be an inhibiting factor for regional RHWS improvements. However, all countries in the region improved their RHWS and it is likely that trend will continue.

5.6 Gender

Poor access to water and sanitation disproportionally impacts women. Traditional gender roles mean that it is often women's responsibility to fetch water for the family. Globally, it is estimated that 75% of the burden of collecting water falls to women (UNICEF 2016). While there is data available on only a few Asian countries, Mongolia is the only country in the Asia-Pacific that records men spending more time collecting water than women, as shown in Figure 25 (ADB 2018). In addition, women usually have the bulk of caring and domestic responsibilities in the household, all of which require access to water and sanitation facilities.

Lack of appropriate safe sanitation facilities creates more impact for women and may result in women not using the toilet during the day if she does not have access to hygienic, private, or safe facilities. The impact is further pronounced during menstruation, resulting in many women not leaving the house at all (WWAP 2019). This may lead to increased absenteeism and school dropouts, significantly impacting women's ability to contribute to society. Further, women are most vulnerable if they need to openly defecate. In some countries this has been linked to increased risk of assault.

Currently the JMP does not disaggregate data based on sex, aside from its monitoring of WASH in schools. Without this data, it is difficult to understand for which countries gender is a more pressing issue in RHWS.

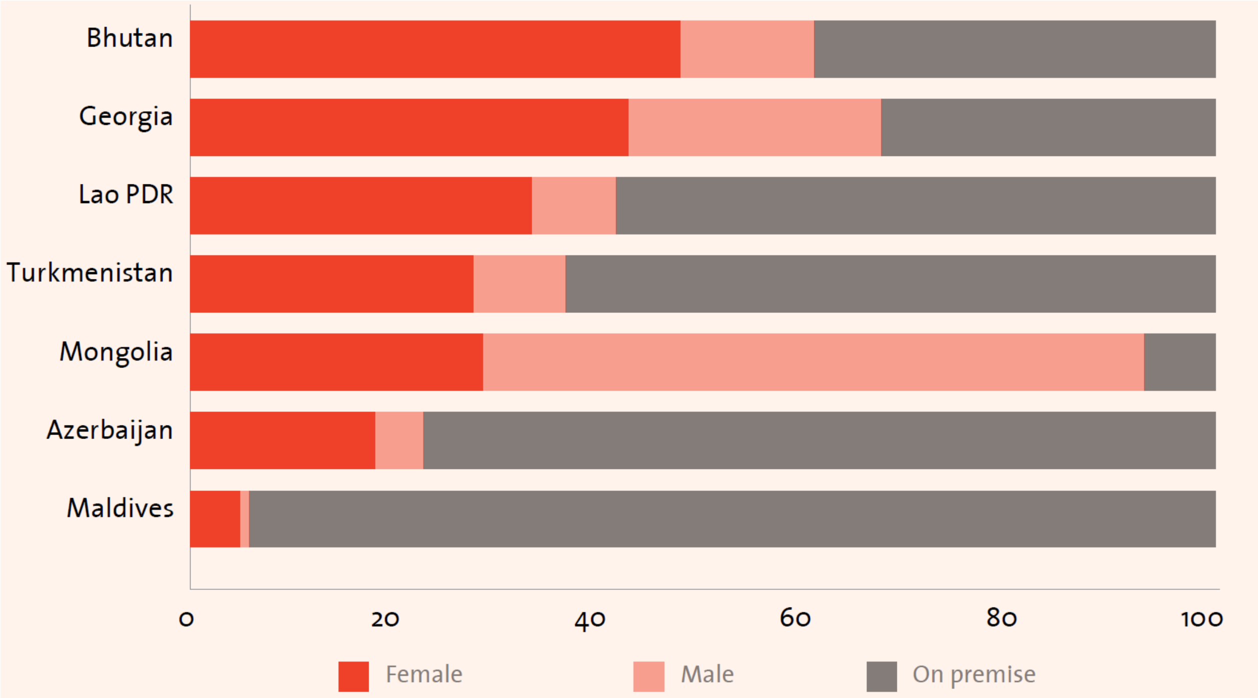

FIGURE 25. HOW WATER IS COLLECTED IN HOUSEHOLDS IN ASIA AND THE PACIFIC IN PERCENTAGE (ADB 2018)

Women's participation in decision making is significantly lower than men. Globally, only 24% of law makers are women. This number is generally lower in the Asia Pacific region (WWAP 2019). Only 10-20% of landholders in developing countries are women (UN ESCAP 2019). While women are often disadvantaged, women globally are not a homogenous group and this disadvantage looks different in different situations (WWAP 2019). This means that a one-size-fits-all plan without engagement or women's participation will not solve the issue. Institutions need to consider inclusive dialogues with all groups when developing WASH policies and plans to ensure that all groups are represented.

To achieve SDG 5 (gender equity), gender sensitivity should be intrinsic to all aspects of governance, management, and financing. Coherency across all levels of government is essential to ensure that policies and plans developed nationally are appropriately resourced and then implemented at lower levels of government. Explicit inclusion policies and approaches to included vulnerable and under-represented groups should be considered for RHWS decision-making processes.

5.7 Sustainable Development Goals

The linkages between the SDGs and the AWDO are more complex than simply highlighting SDGs 6 (Clean water and sanitation) and 14 (Life below water). There are 169 targets that sit behind the 17 SDGs and this study has investigated which targets will be addressed in each of the proposed sub-indicators. The sub-indicators and their related SDG targets have been mapped and are shown in Table 24.

SDG 5 (gender equity) has not been included in this assessment as none of the SDG 5 targets directly relate to or explicitly mention water and sanitation. However, there are multiple indirect or implicit linkages between. Targets 5.1[20], 5.2[21], and 5.4[22] would significantly improve as outcomes of improved RHWS, in particular the unpaid domestic work burden discussed in target 5.4 is specifically related to water fetching. Further, were target 5.5[23] to be met, it could be reasonably expected that RHWS would also improve as a result of better gender sensitive and more participative decision making, as discussed in section 5.6.

An analysis shows that there are six SDG targets that are closely related to KD1, with each sub-indicator most closely related to one target. Sub-indicators 1 and 2 are most closely related to SDG targets 6.1 and 6.2 respectively. Sub-indicator 3 is closely related to SDG target 3.9 and sub-indicator 4 is most closely related to target 1.4. However, each of the sub-indicators are also related to other targets, as shown in Figure 26 with the SDG targets described in Table 24.

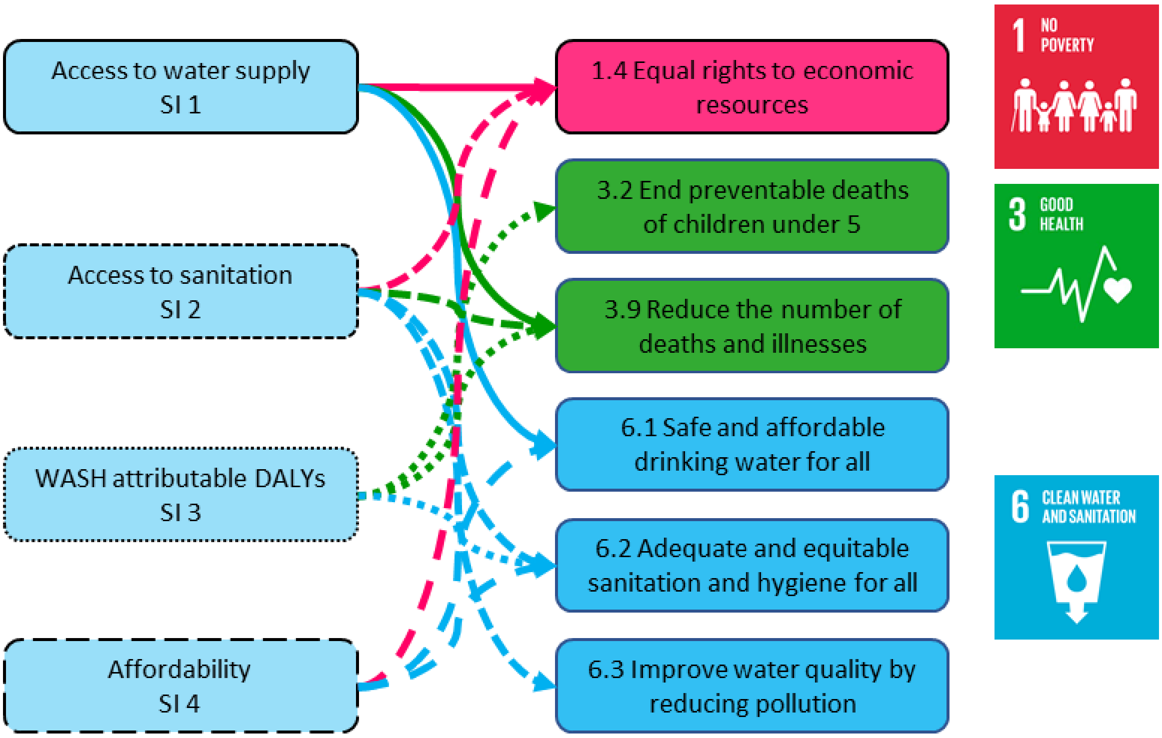

Figure 26. Interaction between KD1 sub-indicators and SDG targets

Table 24. The sub-indicators and their related SDG targets

Relevant sub-indicator	Related SDG targets
SI1 – Access to water supply	**1.4:** By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.

[20] Target 5.1: End all forms of discrimination against all women and girls everywhere
[21] Target 5.2: Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation
[22] Target 5.4: Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate
[23] Target 5.5: Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life

	3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination. **6.1:** By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
SI2 – Access to sanitation	**1.4 & 3.9** **6.2:** By 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation paying special attention to the needs of women and girls and those in vulnerable situations. **6.3:** By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and at least doubling recycling and safe reuse globally.
SI3 – Health Impacts	**3.9 & 6.2** **3.2:** By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births.
SI4 - Affordability	**1.4, 6.1 & 6.2**

Further investigation considers the monitoring indicators used in the SDG dashboards (Sachs 2019); these are shown in Table 25.

TABLE 25. SDG INDICATORS RELATED TO THE KD1 SUB-INDICATORS

Sub-Indicator	Closest SDG target	SDG monitoring indicator (Sachs 2019)
SI 1	Target 6.1	*Population using at least basic drinking water services*
SI 2	Target 6.2	*Population using at least basic sanitation services*
SI 3	Target 3.9	No direct indicator regarding WASH or environmental illness or deaths, however multiple indicators for death and illness more generally
SI 4	Target 1.4	Indicators only looking into poverty rates

Sub-indicators 1 and 2 are very closely linked with the SDG indicators, though the SDG indicators look at national services, not specific to rural households. It is interesting that the monitoring indicators also do not attempt to measure safely managed services, even though the SDG targets clearly state that this should be the case. This is presumably because of large data gaps as described in this report and therefore means that AWDO is highly aligned with the SDG indicators. Further, KD1's method provides some more nuance by also considering the lower service levels.

Sub-indicator 3 is not directly monitored by the SDGs. While there are many related indicators, all of these are more generic than focusing on WASH and even more generic than the environmental causes that target 3.9 mentions. That being said, improvements in SI 3 will lead to improved SDG 3 results.

Sub-indicator 4 is also not directly monitored by the SDGs. While it is mentioned in the targets, the indicators for SDG 1 do not consider the costs of services and measure only poverty rates. While improvements in SI 4 would not lead to improvements in the SDG indicators, improvements in the poverty indicators measuring SDG 1 would result in improved scores for SI 4.

Not only do specific SDG targets interact with a KD 1 sub-indicators, there is also a nexus interaction between No Poverty, Good Health, and Clean Water and Sanitation, SDGs 1, 3 and 6. No SDG exists within a vacuum, while there are some conflicting relationships between goals, (for example doubling agricultural productivity, target 2.3, may reduce forested land, target 15.1), studies show that there is a positive correlation relationship between SDGs 1, 3 and 6 (Dasgupta 2005, Mkondiwa 2013, Prüss-Ustün 2019, WWAP 2019). Working towards reducing poverty, improving health care, or increase access to safe water and sanitation, will make the others more achievable.

5.8 Small island states and transboundary issues

RHWS and the methodology used to create KD1 only considers the very small household scale. Therefore, it does not consider transboundary issues and small island states can be measured using the same methodology as other states. However, it should be noted that data was less available and future impacts of climate change are expected to be worse on some small pacific island states. This is discussed in Section 5.9.

5.9 Health impacts of climate change

It is logical to expect that climate change would have an impact on the WASH-attributable health impacts, as water-related natural disasters become more frequent and intense. Research has shown that climate change will increase the frequency and intensity of heat waves, natural disasters, floods, and droughts. While this will cause some reduction in deaths caused by cold, these will be dwarfed by the negative health impacts of climate change (Haines 2006). During times of drought or water scarcity, the absence of water can reduce both the quality and quantity of water. This is a form of long duration persistent stress. Inversely, flooding, which is the over-presence of water, can also cause issues with water quality and seepage from sanitation systems into water supplies. Each of these sorts of events increase the likelihood of malnutrition, and vector-borne and water-borne related illness (Haines 2006). Further, like any infrastructure, water and sanitation infrastructure can be damaged by natural disasters, which would impact a countries' ability to provide water and sanitation services.

Climate-related health impacts have been shown to be varied and difficult to predict. The El Nino cycle has been shown to worsen the impacts of cholera in some regions of Africa, while some areas have shown reduced rates (Moore 2017). However, links with diarrheal disease have shown a more consistent worsening with heat caused by El Nino in Peru (Checkley, et al. 2000) and seasonal temperature and water level fluctuations in Bangladesh (Rahman 2007). Further, findings from this study show that while there is a positive relationship between health impacts and access to water supply and sanitation, as access improves so do health impacts, the relationship is complex and far from a clear linear correlation.

There are other factors that influence the impact of climate change on health. These include: population growth, health status and access, and the existing environment, including access to safe water and sanitation (Haines 2006). All these factors indicate that more wealthy countries can better mitigate the impacts of climate change on health. For example, during a flood when surface water quality drops significantly, households that had access to a safe clean water supply will be less impacted than those who collect surface water. A study that investigated the impacts of increasing salinity caused by climate change in Bangladesh similarly found that impacts would be less profound on wealthier people that could afford desalination (Vineis 2011). Health impacts in wealthy countries, while lessened, can also be severe with studies measuring increased heat related mortality in Europe (Haines 2006) and a measurable impact on mental health cause by water scarcity in Australian rural communities (Dean 2010).

Pacific countries are likely to be the most impacted by climate change, as each of the above-mentioned contributing factors is worse in some Pacific countries. While some of the wealthier Pacific countries lift the regional ratings in sub-indicators 1 and 2, several countries have very poor access to water and sanitation, with the regional population weighted averages also being very low. Further, the small size of and distance between islands reduces the accessibility of health services and the relative dependence on ground water increases the likelihood of salinity problems (Hadwen 2015). These factors could explain why the Pacific region has rated the lowest in the health impacts sub-indicator.

While there will likely be some positive health impacts caused by climate change, these will be heavily outweighed by the negative impacts on malnutrition, and vector-borne and water-borne illnesses. Although, these are expected to be significant, the exact magnitude of these impacts is near impossible to accurately estimate, as there are many complex factors involved. However, it can be expected that the impacts will greater in countries with less secure RHWS, particularly in the Pacific.

6 The way forward – a systems strengthening approach

A systems strengthening approach has been used to frame recommendations of this report. By assessing the system and finding the where the weaknesses are, we aim to create recommendations that embody the ‘no one left behind’ ambition of the SDGs.

Following the discussion there are four areas from which the recommendations from KD1 are based:

- improved data collection, monitoring and evaluation
- empowering vulnerable people in decision making
- human resource capacity
- locally appropriate solutions for Pacific nations.

6.1 Improved data collection, monitoring and evaluation

Gaps in datasets have been a significant challenge in analysing KD1. Each of the sub-indicators has been altered from what would be ideal because of the practicalities of available data. As previously mentioned, the absence of safely managed data for many countries has been the biggest gap, resulting in sub-indicators 1 and 2 not completely aligning with the SDGs. There have also been similar considerations made in the other sub-indicators and the risk framework, which are discussed in greater detail in the method section and section 7.1.

Highlight boxes 1 and 2 show that a more holistic assessment can be completed if the safely managed service level is considered. However, for rural households, only 11 and seven out of 45 countries assessed had safely managed data for water supply and sanitation respectively.

As well as safely managed, the health impacts of WASH are often unknown. It is broadly accepted that a clean environment, which includes safe access to water and sanitation, will improve health (World Bank 2017). But there are many other factors that can influence health as well (Kwami 2019). The complexity of the WASH and health linkages means that no single indicator is without flaw and national WASH-attributable disease burden was selected as the best measure for KD1.

Not only would this data assist in creating the AWDO and similar research projects, but it is also vital for science-based decision making. Characteristics of mature WASH sectors are those where policies and plans are centred around reasoned, rational arguments, informed by data. Without accurate data, rational policy is difficult if not impossible to create. Improved monitoring and evaluation, in particular regarding safely managed water supply and sanitation and the health impacts of WASH, should be advocated for and invested in by governments and donors in order to facilitate evidence-based decision making.

6.2 Empowering vulnerable people in decision making

Globally, and throughout Asia, vulnerable people have worse access to WASH services than less vulnerable people. Vulnerable people can be defined as women, children, the elderly, those with disabilities, the poor or any ethic or sexual minorities. In general, rural populations are more vulnerable than those in urban areas and therefore it is important that KD1 acknowledge and offer recommendations regarding vulnerable people. Figure 27 shows that in general there is much slower progress towards SDG targets in the rural poor than there is nationally.

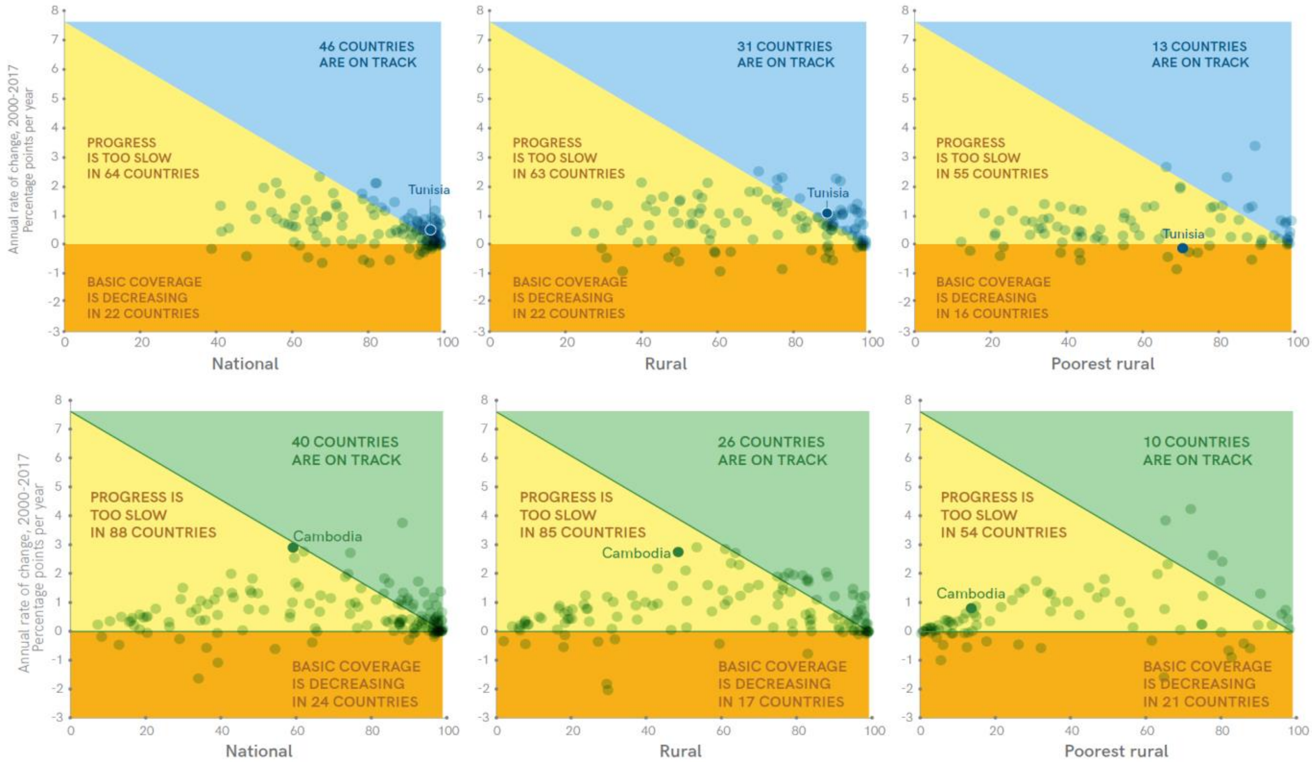

FIGURE 27. PROGRESS TOWARDS ACHIEVING UNIVERSAL WATER SUPPLY AND SANITATION IN NATIONAL, RURAL AND POOREST RURAL COMMUNITIES (JMP 2019)

There is evidence that without targeting vulnerable populations they can miss out and become at much higher risk of health impacts (World Bank 2017, WWAP 2019). Vulnerable populations and those in rural areas have less access to financing than in urban areas. With less access to finance or less ability to pay back loans, vulnerable and rural people are more often forced into open defecation and paying more (Mitlin 2019) for water that is a lower quality (JMP 2019). This further exacerbates the cycle of poverty and vulnerability.

To achieve better outcomes for vulnerable people, governments should invest more in engaging with vulnerable groups through targeted policies and empowered decision making. Vulnerable groups are non-homogeneous having a vast array of needs and desires and will respond to policies in different ways, so a one-size-fits-all model will not work. Of the 23 countries that completed the relevant part of the GLAAS survey (GLAAS 2019), 19 have policies in place specifically to include vulnerable people in decision making. However, it is unknown how well-funded the needs of vulnerable people are in these stretched WASH sectors.

6.3 Human resource capacity

Of the 31 ADB countries that responded to the 2019 GLAAS survey, only two reported that they had allocated the human and financial resources required for their water and sanitation policies. This is similar globally, with under 10% of countries reporting they have sufficiently resourced plans (GLAAS 2019). This is especially concerning as it is often poor implementation, not poor policy, that slows improved WASH access (World Bank 2017).

Many ADB countries have shown considerable growth in RHWS, even in the face of increasing water scarcity and stress. However, without the necessary resourcing and investment in human capacity this is likely to become a factor limiting growth, particularly in South East Asia. Governments throughout Asia should immediately begin to invest in the human resource gaps to be able to deliver the water services of the future.

Highlight boxes 4 and 5 feature examples of improved resourcing and planning. India has seen incredible progress in rural sanitation access due to co-ordinated and well-resourced planning in Swachh Bharat and other similar missions. Meanwhile, the PRC has improved resourcing and planning in recent years, significant RHWS improvements are yet to be seen so it will be interesting to watch in the near future.

6.4 Locally appropriate solutions for Pacific nations

As discussed in section 5.3, the population weighted average KD1 score for Pacific countries is very low. Further, as climate change will continue to impact these countries, it is also possible that they will continue to stagnate of even go backwards in the future. Papua New Guinea, for example, has shown declining rates of water and sanitation access due to population growth and comparatively limited growth in expanded service provision. While research into Integrated Water Resource Management (IWRM) suggests that a holistic focus on a ridge-to-reef catchment planning could be a promising solution (Hadwen 2015), in reality, the human and financial resources to develop tailored plans for every context are lacking. Low economic growth and geographically dispersed populations make service provision especially costly and difficult. Approaches that consider land and water management and temporal variability are needed, especially when considering climate change impacts. Diversifying water sources is an important option to consider. An example of this could include rainwater tanks, which currently have a much greater uptake in rural Thailand than in rural PNG, despite similar monsoonal climates. Rising sea levels disproportionately affect low-lying atoll countries, such as the Maldives, Marshall Islands, Tuvalu and Kiribati, and these countries will face increasing challenges to provide rural households with water and sanitation. At the same time that governments should pursue IWRM plans to land and water management, locally conceived solutions and disaster-preparedness measures should be supported.

7 Improving AWDO for future

7.1 Recommendations to improve the KD1 method

In KD1, the lack of data was a major issue. By necessity, each sub-indicator used a method that was not ideal and if and when data improves it should be updated. Below is a list of recommended changes that should be made if better data is available for the next iteration of AWDO:

- SI 1 and 2 should consider safely managed as the highest service level.

- SI 3 currently uses a national estimate. In future, this should be disaggregated by rural and urban and show only health impacts on rural communities.
- SI 4 the cost of water services is calculated for rural areas, but household consumption is a national mean average. Rural household-specific household consumption data would be more accurate to use if it becomes available. Further, mean average household consumption is not an ideal proxy for willingness or ability to pay and does not consider differences between the richest and the poorest. Ultimately, this sub-indicator would ideally measure the percentage of households that are unable to afford the cost of water services.

Further to this, there are several elements that may be valuable inclusions as future sub-indicators:

- risk, as it links directly with the "acceptable level of water-related risk" element in the definition of RHWS,
- gender, social inclusion, or disadvantage, as these factors have important bearing on equitable costs and benefits of RHWS, and
- governance, as it is a precursor to water security and transparent and inclusive decision-making.

7.2 Recommendations to further improve AWDO methodology

Greater clarity and coherency are needed to understand how sub-indicators interact with one another and what they should measure. The water security indicator framework presented in section 2.2 is a simplistic first attempt at an indicator framework, which could guide future discussions. Other possible frameworks could be the Drivers, Pressures, State, Impact and Response risk framework or a resilience framework, which is often used in water security.

Further, there needs to be great clarity in how KDs interact with one another. Some KDs are defined according to water use (household (KD1), economic (KD2) and environmental (KD4)), some are defined spatially (rural (KD1) and urban (KD3)), while risk (KD5) appears to be overarching as well as being included as an element inside each KD. This current framework leads to potential for overlaps and double counting. This complexity is not fully understood and clear direction to avoid overlaps is needed.

Finally, using the mean average the of all KDs as national water security index may be misleading. If a country is weak in one area of water security but strong in others, it could be argued that the country is weak overall. For example, if one country scores 15 for each KD and another scores 20 for four KDs and 1 for the final KD, the second would have a higher score in AWDO (75 vs 81). In such an example, the statement that the second country has better water security could be misleading and overly simplistic.

8 Conclusion

This study investigated creating a rural household water security score for each country in the Asia-Pacific region, constituting KD1 of the AWDO 2020. This is a significant change from KD1 of the AWDO 2016, which measured Household Water Security, splitting urban and rural households, with urban households being incorporated into KD3 (Urban Water Security). While the delineation between urban and rural is often unclear, it is important to independently measure the water security of rural households, as they are often more vulnerable than their urban neighbours. Improvements to RHWS can have societal impacts to health, education, gender equity and economic development.

After defining RHWS, a methodology developed for KD1 2020 included two status sub-indicators of access to basic water supply and access to basic sanitation, the driver sub-indicator affordability and outcome sub-indicator health impacts. Access to basic water supply and sanitation was calculated using the JMP service levels, WASH attributable DALYs were used as measures of health impacts, and affordability was considered the percentage that safe water services would cost of a country's average household consumption. Each sub-indicator received a score out of five, meaning that each country received a KD1 score out of 20.

As expected, Advanced Economies had the highest water security scores for rural households. The highest of all regions in each sub-indicator, except affordability, which was tied with East Asia. This shows that affordability adds some balance to KD1, as it is difficult for both advanced and developing economies to achieve. Central West Asia and the Pacific both performed well out of the other regions, with similar scores across all sub-indicators. Central West Asia had poor affordability and the Pacific had poor health impacts. However, not using population weighted averages is misleading, particularly in the Pacific where population sizes vary dramatically between countries. East Asia received poor scores for water supply and sanitation but performed very well in health impacts and affordability. South Asia is relatively strong in water supply, but weak in other areas. South East Asia performed relatively poorly across all the sub-indicators. Finally, while many of the smaller Pacific countries scored well in water supply and sanitation, most performed poorly for health impacts. It was shown that there is a correlation between more affordable water services, improved water supply and sanitation access, and improved health outcomes. Both showed linear correlations with low R scores, suggesting that these are not the only factors.

The 2020 method was also used to back cast scores for 2013 and 2016, corresponding with previous versions of AWDO. Most countries have shown measurable improvements in this time period, with only 4 country scores falling. With these few exceptions, it has been shown that RHWS in the Asia-Pacific overall is improving.

This study also investigated risks to future RHWS, using a framework based off a risk framework created by KD5. Overall, this framework was able to show:

- there will be increased water stress in Central West Asia and East Asia
- there will be large populations of people in severe water scarcity in Central West Asia and East Asia, India, Bangladesh, and Indonesia – this broadly aligns with water stressed countries with high populations
- there is a lack of financial and human resources across all regions
- poverty will remain a big challenge in Central West Asia and the Pacific
- climate change is likely to impact RHWS in the region with Pacific countries being most at risk.

As far as recommendations for both improving RHWS in the region, this study found that by better empowering vulnerable people in decision making, it is possible to better target WASH programs to those that are most vulnerable. This study also found significant gaps in the human and financial resources made available for WASH planning and implementation, as we know it is poor implementation not policy causing WASH access to stagnate. Therefore, it is important that this is addressed. Further, some countries in the Pacific have extremely low RHWS, which could worsen with climate change. These countries need locally specific solutions to improve water security for rural households.

Finally, this study developed several recommendations for improving the method of KD1 and the AWDO more generally. Improving data collection, monitoring and evaluation systems across all countries would allow for better evidence-based decision making. Of particular note, many countries do not record the number of rural citizens with access to safely managed water and sanitation. Further, the next iteration of the AWDO and KD1 could be improved by refining the sub-indicators and developing a better understanding of how KDs and sub-indicators interact with one another.

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