WATER MANAGEMENT INITIATIVE

Review of Water Scarcity Ranking Methodologies

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List of Abbreviations

FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
WMI	Water Management Initiative
WRI	World Resources Institute

ABSTRACT

There is no doubt that Jordan is among the most water-poor countries in the world, particularly when considering its limited resources and unique circumstances amid intense regional conflict. This document seeks to provide insight into how water scarcity can and should be quantified, with the aim of ranking Jordan's scarcity on a global scale. Although a vast number of indicators for measuring water scarcity exist, few have been compiled or updated for international comparison. The most commonly used indicator internationally measures renewable water resource supply per capita. In 2014, Jordan was 7th most-scarce globally by this measure. When considering the Gross Domestic Product as a proxy for countries wealth and a factor for comparison, Jordan occupies the second place in scarcity in the Middle East after Yemen and the third in the global scale with Maldives as the most water-poor country in the world.

1. INTRODUCTION

1.1 Background

There is no doubt that Jordan is among the most water-poor countries in the world, particularly when considering its limited resources and unique circumstances amid intense regional conflict. Although water security and access are not necessarily most intuitively defined along political boundaries (particularly at a country level), the fact remains that many political and economic decisions related to water are made across borders. For countries facing particularly dire circumstances, a single number has the potential to tell a compelling story to the international community, creating valuable dialogue and improving access to critical aid. A robust measure of water scarcity that can be tracked overtime can also provide a metric for gauging progress towards reducing water scarcity, and allow for comparison on a global scale. Despite how imperative an issue water scarcity continues to be; however, little consensus exists as to how scarcity ought to be defined. As such, ranking countries based on their comparative levels of water scarcity presents a unique challenge.

1.2 Objective

This brief seeks to understand the many ways in which water scarcity is measured, with the ultimate goal of guiding USAID-WMI in communicating Jordan's water crisis to external actors.

2. REVIEW OF RANKING METHODOLOGIES

2.1 Presentation of Comparative Table

Jordan is frequently mentioned among the ten most water scarce countries in the world—however, too often, such statements come without any clear explanation of how scarcity is measured, or where the rankings originate from. The table below summarizes Jordan's ranking on several key measures of water scarcity, along with a brief explanation of each measure's methodology and limitations.

Table 1: Jordan's Rank on Global Water Scarcity Measures					
Measure	Jordan's Rank	Year	Source	Measure Methodology	Limitations
Internal Renewable Freshwater Resources Per Capita (also known as the Falkenmark Indicator or the Water Stress Index)	7	2014	Food and Agriculture Organization (FAO), AQUASTAT data[i]	Defines water scarcity in terms of the **total water resources that are available to the population of a region**; if less than 1,700 m^3 per person per year, that country is experiencing water stress; below 1,000 m^3, water scarcity; and below 500 m^3, absolute water scarcity[1]. Only renewable surface and groundwater flows are considered. The FAO defines internal renewable water resources as the long-term average annual flow of rivers and recharge of aquifers generated from endogenous precipitation. According to the 2014 data, *Jordan's WSI is 77* m^3 *of renewable internal water resources per capita.*	Fails to account for whether those water resources are accessible, i.e. heavily polluted (quality and accessibility unaccounted for); does not include man-made sources of freshwater such as desalination plants; does not account for differences in water use among countries[ii]
Baseline Water Stress	27 (Extremely High Stress)	2013	World Resources Institute[iii]	Measures **total annual water withdrawals** (municipal, industrial, and agricultural) expressed **as a percentage of the total annual available blue water** (a *criticality ratio*) *Scores above 4 indicate that, for the average water user, more than 80 percent of the water available is withdrawn annually. Jordan's score is 4.59.*	Doesn't consider the capacity of countries to adapt to lower water availability through changing behavior or new technology; also, it does not consider sustainable water resources availability (as actual withdrawal cannot be used to indicate scarcity)
Interannual Variability of Water Supply	33	2013	World Resources Institute[iv]	Calculated as the **standard deviation of total annual supply divided by its mean**	Although predictability of water supply is relevant to meeting demand, this measure provides little insight into whether a country faces water scarcity at any given point in time; no consideration of sustainable water resources availability with this measure
2040 Future Water Stress	14 (Extremely High Stress)	2015	World Resources Institute[v]	Considers a variety of climate models and socioeconomic scenarios in order to provide a **measure of future competition and depletion of surface water**	Future climate conditions and development patterns are impossible to predict; these rankings illustrate one possible future of water supply and demand[vi]

Total Renewable Internal Freshwater Resources	19	2014	The World Bank[vii]	Raw measure of **total renewable internal freshwater resources**, in billion cubic meters. *In 2014, Jordan had .682 billion cubic meters of total renewable internal freshwater resources.*	Kuwait and Bahrain at the top: this raw number provides no insight into the resources a country has at its disposal to manage its water resources (or lack thereof), nor does it account for country-unique circumstances such as population pressures
Water Security Risk Index	3	2011	Maplecroft[viii]	Designed to allow decision-makers to assess where water supply will be limited or interrupted in the future; calculates water security by **measuring countries' water stress; population rates; reliance on external water supplies; sustainability of water use; intensity of water use in the economy; government effectiveness; and virtual water use**, which is a unique assessment of the water intensity of imported goods, such as food and oil.	Many factors included in calculation: the importance of each respective factor likely varies extensively on a global scale

2.2 Discussion of Ranking Methodologies

Economically speaking, the definition of water scarcity is simple—when demand for water exceeds supply. In practice, however, the concept of water scarcity is highly dynamic, making it difficult to define. According to the National Institutes of Health, more than 150 indicators for water scarcity exist, each capturing a different understanding of the notion of "water scarcity." Some metrics not shown in Table 1 include "adaptive capacity," which measures a country's ability to adapt to water shortages, and the "water poverty index," which seeks to empower poor people in water resources planning. Although many metrics have been developed, little research exists as to how meaningful the individual metrics are.

No matter the metric, a common challenge remains—updated numbers are difficult to come across; complete lists comparing each country's ranking, even more so. This is in part because water data are often collected and reported at local geographic scales. The relative nature of water scarcity also makes global rankings a challenge—so much of a country's scarcity depends on country-specific factors, such as its natural resources, its climate, the sociopolitical environment, and its population. These complexities make it exceedingly difficult to find a metric that does justice to each country's unique context while simultaneously providing means for comparison against other nations. In particular, ignoring a country's financial means of dealing with water shortages would grossly misrepresent which countries face the most pressing scarcity.

For example, consider Singapore, which has a highest-possible stress score of 5.0 on the WRI's baseline water stress measure (shown in Table 1). Although this indicator shows Singapore facing maximum water stress, thanks to its wealth and subsequent ability to invest heavily in technology, Singapore has very little trouble meeting its water needs. Similarly, many Gulf countries rank very high on various water scarcity measures. According to the Falkenmark Indicator (which remains the most widely applied measure of water scarcity globally, despite presenting an oversimplification of water scarcity's many components), in 2014, Jordan ranked 7th in the world in water scarcity (see Table 1). Ranked 1st is Kuwait, with no renewable resources per capita. However, Kuwait has the means to invest heavily in technology that enables it to address its scarcity—Kuwait's numerous desalination plants, for instance, provide 92 per cent of water for domestic and industrial needs. Jordan simply does not have the financial means that some of its water-stressed counterparts do, and the Kingdom's situation only grows tougher as existing resources are increasingly depleted and its population continues to grow.

3. PRESENTATION OF INCOME-ADJUSTED MEASURE

Table 2 below lists the top 10 countries according to their 2014 Falkenmark measure, accompanied by two ratios that account for income. WMI carried out these supplementary calculations to shed light on the drastic differences in income among the world's most water-lacking countries. A higher GDP is indirectly associated with less scarcity, given that it implies greater access to resources for managing water shortages. Among the ten poorest countries in the world according to the standard Falkenmark measure (based on the most recent 2014 data), we see in the second column of Table 2 that Jordan is the third poorest after accounting for income (preceded only by Yemen and the Maldives). The relatively high ratio of Jordan's cubic meters of renewable water resources per capita to GDP speaks to an expected result. When taking income into consideration, Jordan's water crisis stands out among those of its wealthier neighbors.

Table 2: Ratios of Falkenmark Indicators to Income for Most-Water Scarce Countries (as measured by Falkenmark Indicator), Ranked According to Cubic Meters Per Capita over GDP (descending)

Country	Income-Adjusted Falkenmark Rank	Cubic meters renewable resources per capita	GDP, in million USD	GDP per capita, in USD	Cubic meters per capita over GDP (in million USD)[1]	Cubic meters over GDP (in million USD)[2]
Maldives	1	75	4,224.21	10,118.10	0.01775	0.00741
Yemen	2	80	27,317.61	990.3	0.00293	0.08078
Jordan	3	77	38,654.73	4,087.90	0.00199	0.01884
Israel	4	91	317,744.78	37,175.70	0.00029	0.00245
Qatar	5	24	152,451.92	59,324.30	0.00016	0.00040
Saudi Arabia	6	78	646,438.38	20,028.60	0.00012	0.00389
Bahrain	7	3	32,179.07	22,579.10	0.00009	0.00013
Egypt	8	20	332,791.05	3,477.90	0.00006	0.00575
UAE	9	17	348,743.27	37,622.20	0.00005	0.00045
Kuwait	10	0	110,875.58	27,359.20	0	0

[1]Calculated by USAID-WMI as CM per capita divided by GDP, in million USD
[2]Calculated by USAID-WMI as CM per capita divided by GDP, in USD, per capita
Data Sources:
World Bank, World Bank Open Data. (2014). *Renewable internal freshwater resources per capita (cubic meters)*. Retrieved from https://data.worldbank.org/.
World Bank, World Bank Open Data. (2016). *GDP (current USD) and GDP per capita (current USD)*. Retrieved from https://data.worldbank.org/.

4. DISCUSSION AND CONCLUSION

In Jordan's case, population pressures are among the greatest concerns facing the water sector today—thus, it makes sense to stress the renewable resources per capita water access measurement when sharing Jordan's story (as well as its income-adjusted supplement). Measurements that consider the future, such as the WRI's Future Water Stress indicator and Maplecroft's Water Security Risk Index, are particularly of interest when highlighting the pressing nature of Jordan's water crisis—however, very recent numbers are unavailable. On the other hand, comparing Jordan's water supply alone to that of other nations, especially in the Middle East, paints an incomplete picture, and as such raw numbers ought not to be placed at the forefront. At the end of the day, Jordan is struggling in the face of a uniquely challenging set of circumstances. Not only does the Kingdom lack the financial resources that enable some of its wealthier regional neighbors to tackle their own water shortages, but Jordan continues to bear much of the weight of surrounding regional conflicts. The combination of Jordan's increasingly limited resources and its continued willingness to provide a safe-haven for those escaping violence creates a crisis that is largely unparalleled on a global scale.

The ultimate focus ought to be on telling Jordan's story, however, rather than on finding the perfect measure to quantify its struggle. According to the FAO, accessible fresh water in [North Africa and the Near East] has fallen by two-thirds in the past 40 years, [and] now amounts to 10 times less per capita availability than the worldwide average. The entire region's water security is exceedingly vulnerable, but Jordan's unique position can only be understood through a holistic consideration of its present and future challenges, particularly as they relate to the tremendous pressures on Jordan's population and limited resources. The most effective way of communicating Jordan's extreme water scarcity to donors and agencies alike is by doing justice to the complexity of Jordan's circumstances. The rankings outlined in Tables 1 and 2 tell a tale of dire need and urgency, but so, too, do human stories and images. When packaged alongside compelling stories and other data concerning Jordan's challenges, seemingly arbitrary numbers come together to paint a complete and captivating picture.

5. REFERENCES

[i] https://data.worldbank.org/indicator/ER.H2O.INTR.PC?year_high_desc=false
[ii] http://www.globalwaterforum.org/2012/05/07/understanding-water-scarcity-definitions-and-measurements/
[iii] http://www.wri.org/sites/default/files/aqueduct_coutnry_rankings_010914.pdf
[iv] http://www.wri.org/sites/default/files/aqueduct_coutnry_rankings_010914.pdf
[v] http://www.wri.org/blog/2015/08/ranking-world's-most-water-stressed-countries-2040
[vi] http://www.wri.org/sites/default/files/aqueduct-water-stress-country-rankings-technical-note.pdf
[vii] https://data.worldbank.org/indicator/ER.H2O.INTR.K3?year_high_desc=false
[viii] https://maplecroft.com/about/news/water_security.html