WATER MANAGEMENT INITIATIVE

Review of Water Scarcity Ranking Methodologies
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<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>WMI</td>
<td>Water Management Initiative</td>
</tr>
<tr>
<td>WRI</td>
<td>World Resources Institute</td>
</tr>
</tbody>
</table>
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 over time 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>
<thead>
<tr>
<th>Measure</th>
<th>Jordan’s Rank</th>
<th>Year</th>
<th>Source</th>
<th>Measure Methodology</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Renewable Freshwater Resources Per Capita (also known as the Falkenmark Indicator or the Water Stress Index)</td>
<td>7</td>
<td>2014</td>
<td>Food and Agriculture Organization (FAO), AQUASTAT data</td>
<td>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.</td>
<td>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.$^2$</td>
</tr>
<tr>
<td>Baseline Water Stress</td>
<td>27 (Extremely High Stress)</td>
<td>2013</td>
<td>World Resources Institute$^3$</td>
<td>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.</td>
<td>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)</td>
</tr>
<tr>
<td>Interannual Variability of Water Supply</td>
<td>33</td>
<td>2013</td>
<td>World Resources Institute$^4$</td>
<td>Calculated as the standard deviation of total annual supply divided by its mean</td>
<td>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</td>
</tr>
<tr>
<td>2040 Future Water Stress</td>
<td>14 (Extremely High Stress)</td>
<td>2015</td>
<td>World Resources Institute$^5$</td>
<td>Considers a variety of climate models and socioeconomic scenarios in order to provide a measure of future competition and depletion of surface water</td>
<td>Future climate conditions and development patterns are impossible to predict; these rankings illustrate one possible future of water supply and demand.$^6$</td>
</tr>
</tbody>
</table>
### 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)

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

¹Calculated by USAID-WMI as CM per capita divided by GDP, in million USD
²Calculated by USAID-WMI as CM per capita divided by GDP, in USD, per capita

Data Sources:


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

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