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Implications of Simplified Policy Indicators on Drinking Water Insecurity in Jordan

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Abstract

Water policies framed by a scarcity discourse often rationalize system outcomes as prod- ucts of apolitical, physical factors, correlating water access vulnerabilities with national water production and supply capacity alone. This article examines the implications of such discourse prevalent in Jordan's 2016-2025 period water strategy and policies on drinking water security in two districts with high concentrations of vulnerable households. The study compares national and regional assessments of distribution and infrastructure performance with end-user experi- ences of system outcomes. Findings reveal that policy indicators, based on averaged supply data at the governorate level, inaccurately presumed accessibility and equity of service and quality across districts and homes. Significant variations in water security, influenced by factors such as network delivery frequency, tank storage capacity and alternative supply sources, were largely unrepresented in policymakers' data and unaddressed in management strategies. The article advocates for indicators that better reflect end-users' capabilities to secure reliable, adaptable water supplies, urging a shift from simplified scarcity metrics to addressing multidimensional access challenges.

Keywords: Drinking water security, water policy indicators, end-user data, vulnerable households, water scarcity, Jordan

1. Introduction

The Hashemite Kingdom of Jordan faces quintessential challenges of a pressured, water-scarce region. Freshwater resources in the country are sorely limited, attributed in part to arid climate and aridification, reoccurring droughts, reduced surface water flows from geopolitical competition, and over-extracted aquifers after substantial expansion of multi-sector uses (Salameh et al., 2018; Salameh & Al-Alami, 2021; Schyns et al., 2015). Capacity of the municipal piped water networks have suffered from years of under-maintained infrastructure, illegal extractions, low cost-recuperation and unresolved

power dynamics (Jemmali & Abu-Ghunmi, 2016; Zeitoun et al. 2011). Compounding the situation, an estimated 1.4 million Syrian refugees have been added to the country's total population of now 11 million since 2013 (Alshoubaki & Harris, 2018; UNICEF, 2021). Over 80% of this displaced Syrian population settled outside of refugee camps in northern Jordanian communities. The Government of Jordan (GoJ) has assumed the responsibility of servicing these individuals' drinking water[1] needs, as well as those of the growing local population, and despite the country's limited freshwater resources.

Following the onset of the Syrian refugee crisis, Jordanian water strategists and policymakers updated their *2008-2022 Water for Life* plan with the *2016-2025 National Water Strategy* ('the Strategy') and a series of complementing policy documents, including the *Water Reallocation Policy* and *Demand Management Policy*. The Strategy and its policies emphasize the country's alignment with Sustainable Development Goal (SDG) 6, 'sustainable management of water and sanitation for all Jordanians' (Ministry of Water and Irrigation [MWI], 2016a, p. 8), and its prioritization of drinking water among the many demands on their limited resources (MWI, 2016b, p. 13; MWI, 2016c, p. 2). In the 2016 Strategy, Jordan's drinking water supply efforts are described as follows:

> 'Jordan has achieved high levels of water coverage (94%), providing high-quality water to residents although coverage remains affected by intermittent supply. The country is on track to achieve the MDGs for water and sanitation by end-2015. The current level of water supply delivered to the population, on average, is about 61 litres/capita/day, which excludes 65 litres/capita/day of NRW' (p. 36).

The Reallocation policy published similar statistics for 2014: 125.5 l/c/d (litres per capita per day) supplied across the Kingdom and 58.5 l/c/d of billed consumption (the volumetric difference being non-revenue water). The policy goes on to compare these monitored supply and consumption numbers to the government's desired water supply performance based on assumed demand: 'domestic water share per capita is assumed to be 120 l/c/d for Amman city, 100 l/c/d for other cities, and 80 l/c/d for suburban areas and villages' (MWI, 2016b, p. 6).[2] Given the reported high rates of household water coverage, a reasonable justification for the severely low per capita quantities might be nation-wide resource scarcity or insufficient distribution infrastructure. The government's existing policies supporting production and supply interventions would, therefore, be concluded as the correct diagnosis to alleviate scarcity and positively contribute to the population's water access rates.

Existing analyses of Jordan's national water strategy and policy documents, however, highlight the prevalence of a strong water scarcity discourse (Hussein, 2016, 2017, 2018a, 2019; Weinthal et al., 2015). Globally, water policies framed by a scarcity discourse have been found to rationalize poor water system outcomes as the product of apolitical

[1] 'Drinking water' is used synonymously with 'domestic water' throughout this article. Both imply water that is serviced to domestic buildings or homes for the purpose of consumption by households.

[2] In the 2016 National Water Strategy, the supply goal was set at 105 l/c/d by 2025 and described as the 'supply of water to meet the demand for all uses'.

(Allan, 2003; Warner et al., 2008) and solely physical (Lynch, 2013) drivers. These policies, consequently, often hyper-focus on supply management and resource augmentation responses (Loftus, 2014; Mehta, 2010a, 2010b). In contexts where this national-level discourse was present, drinking water system performance and any corresponding water access vulnerabilities have been exclusively, and falsely, correlated with total water resource production and overall supply capacity alone (Anand, 2007; Budds, 2009; Edwards, 2013).

Consistent with such symptoms of scarcity discourse, all solutions to achieve water security objectives presented in the 2016-2025 Strategy target technical production and allocation performance across the country; examples include the Red-Dead Sea Canal, treated wastewater, desalination, the Disi aquifer conveyance and system rehabilitation.[3] As suggested by previous analyses, the Strategy lacks qualitative or quantitative assessment on 'how water is distributed in the society, who is benefiting from the current allocations, who is excluded, and which are the marginalized groups' (Hussein, 2019, p. 11). Indicators of drinking water disparities among household end-users are likewise absent.

In addition to the discourse found within these documents, contemporary research points to the increasingly political nature of water in Jordan. This includes indications that the Kingdom has been exchanging water access for the continued loyalty of influential, farm-owning elites – a possible result of 'shadow state' influence, where individual actors hold real power and authority while allowing 'a neo-patrimonial regime' to maintain 'a façade of laws, procedures, and governmental institutions' (Hussein, 2018b, p. 171). Such unofficial authority is observed to be undermining the water sector's genuine goals of achieving sustainable and equitable management (Yorke, 2013, 2016). These findings prompt further questioning of whether the centralized management strategies and policies in Jordan have been effectively supporting drinking water access for all household users, as intended.

1.1 Research Objectives and Approach

This article continues the line of research investigating the prevalence and implications of water scarcity discourse and related political biases in Jordan's water policies and management strategies. It introduces two interrelated dimensions to the existing literature: (1) a focus on drinking water security and disparities among household end-users and (2) an examination of the policy indicators used to appraise drinking water system performance.

Regarding the first dimension, it is known that a dominant scarcity lens can divert accountability from the individual needs of domestic water users (Jepson et al., 2017) and lead to national policy interventions that are disassociated from household-level outcomes. In contrast, fostering progress towards SDG ambitions requires performance assessments that consider the end-user and their access to sufficient, quality water supplies

[3] Since this study was conducted, some of these project proposals, including the Red-Dead Sea Canal, have been cancelled.

for household use (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2019; WHO & UNICEF, 2021). Academics and international authorities continue to encourage new perspectives on scarcity that can reveal explanations for deprivation and disparities in access to safe drinking water beyond natural or utilitarian discourses (Lynch, 2013; UNESCO, 2019). Our first objective is, therefore, to understand Jordan's state of drinking water 'scarcity' as indicated by the ultimate access or 'securing' of water by household users in the quality and quantity that meet their domestic needs – through the central supply system or otherwise. This perspective can provide insights and recommendations to support Jordanian policymakers' commitment to ensuring access to drinking water for their entire population.

The second research dimension responds to a growing body of literature critiquing the adequacy of centrally monitored drinking water performance indicators in accurately reflecting distribution and access disparities (Milman & Short, 2008; Renou, 2017). For decades, research has shown that politicians often manipulate data and indicators to bias evidence toward their policy interests (King & Kraemer, 1993). It has revealed how the implicit assumption of data neutrality can legitimize the mobilization of numbers, regularly presented as objective and neutral, to justify decisions regardless of their scientific validity (Porter, 1995). In the context of water poverty policy, this research has highlighted cases where national water management interventions were informed by water scarcity indicators that presented a significantly '*simplified (yet biased) viewpoint'* of the diverse access realities across a population (Molle & Mollinga, 2003, p. 539). As a second research objective, we aim to investigate the data and indicators used to inform Jordanian drinking water policy, offering an additional case study on the effectiveness and relevance of public action under conditions of acute water scarcity.

The study applies two research questions:

How do the data and indicators used for orienting Jordan's water strategy and policies reflect the performance of the drinking water system in highly vulnerable communities?

How does that reflection compare to the experiences of water security among end-users in those communities?

We hypothesize that strategy-level indicators and data representing drinking water system performance in Jordan present a simplified reality of diverse states of household water security, aligning with the overarching national water scarcity discourse. We further assume that the policy decisions justified by these simplified indicators will have led to interventions misaligned with the causes of accessibility insecurities faced by many end-users.

2. Methods and Materials

To respond to these questions and hypotheses, the research unpacks and compares drinking water system performance as measured by Jordanian water strategists and

policymakers with household-level outcomes as reported by local end-users. Policy-level indicators and data from Jordan's municipal water network are presented by ministry officials, water utility managers and international donor organizations. Household-level experiences of system outcomes are collected from surveys and interviews with users in two north-western districts of Jordan. Performance and outcomes are both studied using a modified framing of household water security (Jepson et al., 2017, p. 51): *what is secured through the system*, *how* and *to what end* – with additional attention to 'for or by whom'. After methods and results, commentary is offered on identified cases of simplification or inaccuracy in policy data, incongruencies among stakeholder perspectives on security, and potential implications on vulnerable households in the case study region.

2.1 Data and Perspectives of National Strategists and Policymakers

Water resources in Jordan are centrally controlled and allocated by the MWI and its partner institutions – namely, the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA). The MWI oversees all public and private water extractions, as well as the formulation of national water strategies and policies. WAJ has authority over bulk water supply and sewage systems across all governorates and acts in coordination with the JVA, which directs water development and irrigation distribution in the western Jordan Rift Valley. WAJ is assisted in its functions by three water utility companies that it owns. The Yarmouk Water Company (YWC) is the youngest of these semi-private companies, having taken over operations in 2011 to service north-western territories and, subsequently, the demands of the majority of the Syrian refugee population. Jordan's drinking water supply regime has been based on an intermittent (or rationing) system since 1987 in response to national experiences of water stress (Potter & Darmame, 2010). Price of water delivered by all WAJ utility companies has always been heavily subsidized.

Jordan's water strategy and policies, including those that dictate drinking water allocations under investigation in this study, are also heavily influenced by the interests of the Kingdom and international donors or governments. The previous two water strategy documents – the 2008-2022 *Water for Life* water strategy and the *2016-2025 National Water Strategy* – were commissioned by King Abdullah II and overseen by an appointed Royal Water Committee led by Prince Faisal (Hussein, 2016). International donor groups and governmental agencies have also gained an active role in policymaking through their provision of funds and technical assistance during the refugee crisis (Hussein, 2016). In 2015, the Jordan Response Plan for the Syria Crisis (JRPSC or JRP) was introduced to provide the MWI with a platform to appeal to donors with its crisis-related grievances, vulnerabilities and project proposals. Water projects funded for implementation became those that were selected by international sponsors from the JRP listing. Projects related to drinking water supply were categorized under the WASH (water, sanitation and hygiene) category. WASH projects appeal to donors for support in enhancing the GoJ's capacity to distribute essential and sustainable water and sanitation to populations that were affected by the Syrian refugee crisis.

Qualitative and quantitative methods were used to gather network performance perspectives and data from this stakeholder group. All interview-based information was original, primary data collected in Amman and Irbid between April and June 2019 by the research team. Raw, quantitative datasets presented by government and utility officers were obtained through in-person requests and official terms of agreements during this same period. Seven semi-structured interviews were conducted with government strategists; representatives from MWI, WAJ and JVA were intentionally sought for interviews, and professionals working expressly in technical and strategic functions were requested. Three interviews were conducted with YWC employees following introductions through phone calls and visits to two YWC offices. Interviews were also held with seven unique international organizations sponsoring and supporting water interventions with impact in the case study communities – Ramtha and Irbid Qasaba. All government, YWC and donor interviews were conducted in English and lasted from 30 minutes to 2 hours.

Government water supply data were personally released to the research team by WAJ and the YWC, including Excel spreadsheets of disaggregated production, distribution and consumption datasets for domestic water flow at the national, governorate and districts levels. Key performance indicators across the YWC's customer base were also shared. Water network data for the 2013-2018 period were extracted from the various Excel spreadsheets to utilize in our analysis; however, 2018 data were used for this study's comparative analysis with household user data for the 2018–2019 period. Population numbers came from the Department of Statistics. Reports and statements published by policy and management groups were also reviewed and used in the analysis. Definitions for individual data elements of these water security metrics came primarily from the YWC's official Key Performance Indicators (KPIs) spreadsheets. These data and qualitative explanation were used to present calculated reflections of *what was secured through the system*, *how* and *to what end was it secured* by households in Irbid Qasaba and Ramtha. Ministry, water utility and donor perspectives were analysed separately.

2.2 Selection of Study Area and End-User Data Collection

Irbid Qasaba and Ramtha, two districts in the north-western Irbid governorate, were selected as case study regions for assessment of local drinking water security performance and outcomes. These districts experienced some of the most severe cases of increased competition for local water resources in the country since the Syrian refugee crisis, leading thousands of Syrian and Jordanian households being identified by the GoJ and foreign aid workers as 'vulnerable'.[4] According to publicly available government documents, gross and net drinking water supply to Irbid governorate fell to the lowest among all governorates in the country during the Syrian refugee crisis. During the largest waves of Syrian influx, between 2013 and 2014, Irbid Qasaba and Ramtha became home to two of

[4] 'Vulnerability' of Jordanian population is determined by criteria set by Ministry of Social Development (MoSD). The list of these households provided by the MoSD was used as a basis for the Jordanian Vulnerability Assessment Form (JVAF).

the largest refugee settlements by locality in the country, experiencing a 34% and 63% increase in population, respectively (Department of Statistics, 2017; UNHCR, 2019). By 2019, the majority of these refugees had been recipients of water supply services from the MWI and YWC for nearly five years. While Mafraq received most of the media and political attention related to the country's influx of refugees, it primarily hosted refugees in internationally run camps which were not integrated into the central water distribution system. Irbid Qasaba and Ramtha also had an acknowledged history of strains on their water distribution networks from decades of metropolitan expansion, including deteriorating infrastructure and high rates of non-revenue water supply (Ministry of Water and Irrigation & Ministry of Planning and International Cooperation [MWI & MOPIC], 2013). The two districts also offered the largest available datasets on household-level water access and sufficiency, collected through government and foreign aid surveys for the assessment of household vulnerability (UN Jordan, 2019).

Experiences of security outcomes were collected through means available to researchers during the study period: household vulnerability assessment questionnaires that were pre-developed and conducted by local nongovernmental organizations, and semi-structured interviews held during two days of household visits. Both methods captured household descriptions of what was accessed at the household level, how and to what level of satisfaction according to their needs. The three household questionnaires were completed between 2017 and 2019 by NGOs serving Irbid Qasaba and Ramtha communities, and resulting datasets were accessed and assessed by our research team in the spring of 2019. Experiences of Jordanian households in Irbid Qasaba were studied through the questionnaire results from the Jordanian Vulnerable Assessment Form (JVAF; $n = 3{,}022$), provided by Amman-based Action Contre la Faim (ACF). Syrian refugee households in Irbid Qasaba responded to the similar Vulnerable Assessment Form (VAF; $n = 4{,}008$), also provided by Action Contre la Faim. Syrian refugee households in Ramtha were surveyed with a partial VAF questionnaire ($n = 1{,}539$), collected and provided by the Irbid-based Norwegian Refugee Council (NRC). Datasets were shared with corresponding guidance documents and/or explanations of the correlating, English translations of the variables. Questionnaire responses were cleaned and sorted in Excel. Questions varied slightly among the three sources, with the biggest differences found between the survey for Jordanians and the two Syrian surveys. Metrics pulled from these datasets for analysis in this research included whether the house was connected to the system, its storage capacity and whether the household had issues with access or supply, including leakage, conflict, payments and so on. Each of the VJAF, VAF and Norwegian Refugee Council questionnaires also explicitly asked a question regarding the household's experience of water availability for their household needs, either relating to sufficiency of supply or sufficiency of storage. These questions were treated as equivalent for the purpose of this study's analysis.[5]

[5] While the JVAF questionnaire used the same question, 'In your opinion, is the current water supply (with regards to quantity) fulfilling your basic daily needs of water?', the VAF and NRC questionnaires used a slightly different question for sufficiency, 'Do you consider the water storage capacity enough to cover all family needs?' These were the closest-relating questions regarding experiences of water deficits.

Household visits were attended by one lead researcher and two Jordanian translators in May 2019 in order to complement the statistical analysis of the system's performance in relation to household security provided through the questionnaires. These interviews were investigatory in nature and sought to explore and identify the potential vulnerabilities and insecurities experienced by the broader district communities. To collect perspectives from a variety of user experiences across the system, neighbourhoods and buildings were selected based on characteristics including housing type (apartment or freestanding), elevation and known locations of either Jordanian or Syrian residents. Those who answered their doors and agreed to the research team's request to ask questions related to their water access were included in the data. Two days of house visits resulting in a dataset of 20 complete interviews, including 6 Syrian refugee and 6 Jordanian homes in Irbid Qasaba and 1 Syrian and 7 Jordanian homes in Ramtha. The 15-to-30-minute interviews were primarily conducted in Arabic by the translation team, using prepared questions and supplemented with assisted translations between the non-Arabic-speaking research team and the local users for clarifications and explanatory information. Qualitative descriptions of the system were requested, as well as any quantitative evidence the users could provide, such as physical water bills and/or other payment statements. Basic descriptive (frequency) and binomial distribution analyses were performed on the four datasets.

3. Results

3.1 Policy Perspectives on Drinking Water Allocation Performance

3.1.1 What Is Secured Through the System?

Government officials organized their national-level datasets for the municipal piped network by governorate.[6] Allocation of water at the district and end-user scale was not tracked or discussed by the MWI in their evaluations of network performance. Water allocations to households in Ramtha and Irbid Qasaba were therefore implicitly interpreted within the data that presented regional and national production capacities and distribution quantities. These volumes were collected by WAJ from the semi-private utility companies, with the YWC reporting data for the Irbid governorate. MWI strategists calculated the system's total allocation for the population of Irbid using YWC's reported total supply for Irbid, minus losses from YWC's reported average non-revenue water rate for Irbid.

To determine per capita performance, strategists divided the net distribution volume by the official population number for the corresponding region, in this case the Irbid governorate. During interviews, government strategists referenced policy reports that claimed between 94% in 2014 (MWI personal communications, May 2019; MWI, 2016b, p. 3) and 'more than 95 percent' (MWI, 2018, p. 22) of the population was connected to the

[6] Interviews explained that the Ministry did not request further data from the region's water companies. As an YWC officer wrote, '*Why we don't have data only on governorate level because the ministry asked the data on gov. level to compare with other governorates'* (personal communications, June 2019).

municipal piped network. Total residency statistics[7] were therefore considered an acceptable denominator for calculations of per capita distribution performance. Using these data, the MWI rationalized that average allocation in 2018 per the municipal distribution system was 48 l/c/d across essentially all residents (Row 1, Table 1).

When probing further into the allocation data reported to policymakers, we learned that the supply measurement reported to WAJ by the YWC came from the KPI *domes- tic billed volume*. According to the YWC's KPI spreadsheet, this metric was defined as a 'total volume of water billed for residential customers only (in cubic metres)', which accounted for regionally specific non-revenue water rates and explicitly noted that unmetered consumption was not included in the calculation. The water utility managers used this same metric to calculate their own allocation KPI: *water consumption per capita*. The distribution measurement for Irbid, represented in the denominator of the reported consumption rate, however, was calculated using the estimated, active subscribed population across the Irbid governorate – 1,226,286 persons[8] in 2018, as presented in the YWC's official datasets (Table 1). This number of water subscribers per year constituted only 64% of Irbid's total population in 2018 according to official population statistics.[9] Because the YWC's indicator for water usage per capita was calculated only across billed households, the average number of litres per capita per day according to the YWC perspective on allocations was higher than what the MWI calculated: around 75 l/c/d in 2018 versus 48 l/c/d (Row 2, Table 1). Despite this statistical calculation, a lead engineer at the utility company still told interviewers that '*98 percent [of the population are] connected*' (YWC engineer, personal communication, June 2019).

Although the YWC did not report district-level KPIs, the company did capture data on active subscribers and the volumes of supply sold by city regions, by which it was possible to interpret what was being allocated through the system to Irbid Qasaba and Ramtha. Billed user statistics show that only around 35% of Ramtha's residents (based on an average 5.4 person per household) were living in a household subscribed to the central network and considered to be supplied legal water resources from the YWC. Similarly, the central network was found to reach around 70% of Irbid Qasaba's residents. When divided out across these serviced populations, billed consumption data showed the cities having actual supplies around 82 and 69 l/c/d, respectively, from a utility perspective (Rows 3 and 4, Table 1).[10]

[7] Population statistics used in these calculations came directly from the Department of Statistics and include refugee persons.

[8] Calculation: 227,090 water subscribers across the districts of the Irbid governorate x 5.4 person per household average (source: YWC KPI data). Rounded to 1,200,000 persons in Table 1.

[9] When asked about knowledge of 'non-subscriber demands', the interviewee at YWC did not demonstrate a clear understanding of the question. The response referred to the company's two types of customers: urban and rural. This could be a consequence of the language barrier. A professor of water management in Irbid later discussed, however, that (he does not believe) the water company conducted any survey for the entire service area, as is common practice among utility companies in other countries (personal interview, June 2019).

[10] If calculating supply using billed consumption volumes versus sold volumes, the rates would be 90 and 75 l/c/d, respectively, in Ramtha and Irbid Qasaba.

Table 1
Summary of government and water utility perspectives on drinking water allocation performance in Irbid Qasaba and Ramtha between 2018 and 2019
Allocation performance described as an outcome of municipal piped water network supplies.

Stakeholder Perspective	What Is Secured	Who Is Securing the Allocations	Indicator Calculation Description	Indicator Calculation Summary
Government strategists	48 l/c/d (average)	95% of total national population, including Irbid governorate	Total supply by YWC to Irbid governorate after NRW, distributed across total Irbid governorate population	33,700,000 m^3 ÷ 1,900,000 persons
Regional water utility	75 l/c/d (average)	64% of Irbid governorate	Domestic billed volume in Irbid, distributed across number of active subscribers in Irbid governorate with average household size of 5.4 pp	33,700,000 m^3 ÷ 1,200,000 persons
	82 l/c/d (average)	35% of Ramtha	Amount of water sold at specific district level, distributed across number of active subscribers in specific district with average household size of 5.4 pp	2,800,000 m^3 ÷ 93,000 persons
	69 l/c/d (average)	70% of Irbid Qasaba		17,600,000 m^3 ÷ 700,000 persons

Sources: Metrics are presented in quantitative calculations and qualitative, descriptive form. Government strategist results are based on official datasets provided by the MWI and developed by WAJ. Regional Water Utility results are from YWC KPI reports, Department of Statistics and official water utility datasets. All calculation numbers are rounded.

Water quality was also found to be monitored by the water utility company and reported to WAJ and MWI. In the YWC's KPIs, 'microbiological water quality compliance' and 'number of effluent quality tests' were used as metrics on quality. In 2018, the YWC's original data for 'microbiological water quality compliance' were documented at 100% across their supply network with over 3,000 effluent quality tests conducted that year. These same indicators were what MWI officers referenced in their interviews, citing their 2017 Facts and Figures report, which stated that 99.67% of all central network water conforms to Jordan's water quality standards (MWI, 2018). Both regional managers and national strategists confirmed that the quality of water supplied throughout the central network was meticulously monitored to ensure they met international standards (personal communications, May 2019).

3.1.2 How Is Drinking Water Secured Through the System and to What End?

When questioned about distribution objectives, professionals in the MWI, WAJ and JVA discussed the national supply deficit. Employees of the MWI quoted the official, written-policy ambition (120/100/80l/c/d). As a WASH expert at the MWI explained:

> *We are committed in Jordan to provide at least the minimum international standards of drinking water… but Jordan as a transitional country, from developing to developed country, we actually*

upscale our benchmark. That's why we provide now water with a minimum of 100 litres per capita per day.

System outcomes from this government and policy perspective, therefore, were measured by the size of deficit between the national target net supply and the aggregated, national net supply calculated across the country. Furthermore, poor system outcome, or the failure to allocate litres per capita per day across all regions at the rate of the national objective, was viewed as a nationally shared experience of insecurity, with all regions at a deficit, albeit slightly different ones, and Irbid having one of the largest (i.e., performing at 48 l/c/d in 2018 as compared to the 100 l/c/d target).

Ministry actors spoke of the numerous ways they created, rehabilitated and reallocated water resources, primarily groundwater, in order to provide the ballooning population with between 80 and 120 l/c/d. Questions on policy solutions turned to large-scale production projects and system efficiency improvements. The former theme often surfaced in discussions about the Red-Dead Sea Canal, desalination and the installation of more wastewater treatment plants to reallocate freshwater from irrigators and mitigate wastewater pollution of surface waters. The latter theme focused on reducing NRW and included examples of new, precision-improving water management technologies like SCADA (Supervisory Control and Data Acquisition) and WEAP (Water Evaluation and Planning System). The MWI's proposals to the Jordan Response Plan also exhibited preference towards projects that enhanced water production strategies, such as well rehabilitation.

The YWC's approach to assessing and augmenting system allocations mimicked that of their higher-ups seated in Amman: '*We say the deficit is what is between what the person consumed the year before and what this new year goal is [from the MWI]*' (YWC engineer, personal communication, June 2019). YWC interlocutors stated that they were given the goal of meeting 85 to 90 l/c/d net supply by the MWI. The company identified a supply deficit or water security concern when this litre per capita target set by the MWI was above the water utility's maximum production capacity. Importantly, however, water utility managers shared that their total supply goal was calculated using the Department of Statistics' forecast for how many people would be in their entire service area in the upcoming allocation period (as opposed to the number of billed users; see Section 3.1.1, Results). The resident population recorded in YWC's 2017 KPI, which cited Jordan's Department of Statistics, for their entire administrative region was 2,882,700. YWC, therefore, would have reported to WAJ that to meet the MWI's master plan target in 2017, their population of nearly 3 million individuals would demand distributions of some 85 to 90 l/c/d worth of clean water, with the additional consideration of an average non-revenue loss estimated across the region (source: original YWC dataset).[11]

YWC informants spoke intensely about the infrastructure and financial burden of producing water for such a substantial increase in demand: '*if we want to meet [the MWI's] standards, we need new sources*' (YWC officer, personal communication, June 2019). The YWC discussed solutions related to supply-led production measures and to the delivery of

[11] NRW was 37% in 2017-2018 according to official YWC datasets.

stable, average rates for their subscribed customers. Short-term fixes mentioned included drilling new wells and renting private wells. The utility company's limited budget was also brought up numerous times as a barrier to fully addressing the underperforming distribution system.

3.1.3 International Donor Influence

During interviews with international donor agencies who either directly contribute to the policymaking process or sponsor policy implementation through platforms like the JRP, the research team identified two primary perspectives on the state of household water. The first was directly informed by the MWI's statistics and observations; this perspective was most recognized in conversations with large government donors. The second was a lens developed through insights from household users; this perspective was held by international missions that focused on livelihoods and purchasing power.

Large donors, specifically those associated with foreign governments, explained their presence in Jordan primarily as support to the GoJ and MWI in achieving their ambitions and adopting their metrics. They shared the notion of water supply in Jordan being a concern of national resource scarcity, contextualizing the problem using explanations of the country's gross availability of water resources for production and efficiency of distributing that limited water supply. The MWI's national per capita supply deficit calculation (comparing a theoretical per capita demand to a net supply number divided across the entire population) can be found in many opening problem statements and assessments on the state of Jordan's water services and supply since the Syrian refugee influx. Thus, representatives from these international entities proposed financial and technical interventions for both water sourcing and distribution assistance in parallel with the requests of the government and water utilities, including training for wellfield management, rehabilitation of pipelines and water use efficiency measures to augment net supply across the distribution network. As an example, one foreign government-sponsored agency stated, '*rehabilitating networks has always been our approach in Jordan water sector [since 1986]*' (foreign government representative, personal communication, May 2019).

Specifically, this actor targeted water pressure by reducing leakage in the main network and creating direct connections to more proximal, source reservoirs. Large donor representatives were also intentional in commending Jordan's efforts; '*there is equitable distribution [thanks to] access at very low prices; water is managed well, socially*' (foreign aid director, personal communication, May 2019). National and regional stability was also a prominent, reoccurring theme in the government-aligned donor interviews. Mul- tiple interlocutors pointed to the strategic and important position Jordan held as a peaceful country amidst the turmoil of her region: '*Jordan's most important asset is its stability*' (international donor, personal communication, April 2019), and again, '*[our] objective is to support Jordan's stability*' (international donor, personal communication, April 2019).

'Livelihood' organizations with bases in Amman and Irbid were characterized for working more directly at the household level to improve assets for water access; these efforts were referred to as 'social' projects by the MWI. Livelihood donor actors developed

their perspectives on household security from data collected in detailed household surveys, including the JVAF, VAF and other independent questionnaires (the same surveys used by this research). The survey responses provide international development strategists with direct insights on case-by-case experiences with the central supply network and the state of household access. Their interventions included replacement of storage tanks, fixing leaks in houses, and connecting homes to the central network (the latter of which was explained to be an issue due to the role that unwilling landlords must play in the documentation process). These parties were also aware that most Syrian and vulner- able households were renters and, as such, were not the subscribed party and could not submit supply complaints directly to the YWC service providers. Livelihood donors used questionnaires and relationship-building to identify unspoken complaints and assist with relevant, household-specific interventions.

3.2 User Experiences of Water Security in Irbid Qasaba and Ramtha

In the previous section, policy-level interpretation of allocation performance only considered the effectiveness of the central, municipal network. Household users' reflections and responses to questions on drinking water supply and security, however, presented a multisource interpretation of the system. In the following section, security outcomes as described by household users are accepted to be the product of more than just outputs from the municipal piped network.

3.2.1 What Is Secured Through the System?

Overall, 5,195 respondents, or 61%, of the total 8,569 vulnerable Jordanian and Syrian households answered 'true' to the question used in this research to represent water security with regards to quantity of water (see Table 2, for breakdown by questionnaire and population type). This response indicated that up to one-third of the vulnerable and/or refugee households in these districts were not securing sufficient water at the household to fulfil their basic daily needs. Similarly, 42% overall in this population said they experienced at least some type of trouble with water access.

During household visits in Ramtha and Irbid Qasaba, 3 of the 20 interviewed users described their water supplies as insufficient for their household's domestic needs – 2 Syrian

Table 2

'What is secured?' – described by sufficiency of supply and storage to meet daily household needs among Syrian refugee and Jordanian households in Ramtha and Irbid Qasaba

Stakeholder perspective (nationality, location)	Sufficient water available (%)
Jordanian, Irbid Qasaba ($n = 3{,}022$)	54
Syrian refugees, Irbid Qasaba ($n = 4{,}008$)	76
Syrian refugees, Ramtha ($n = 1{,}539$)	34

Source: Raw data provided by JVAF and VAF (ACF, 2019) for Irbid Qasaba results and by NRC questionnaires for Ramtha results; averages calculated by authors.

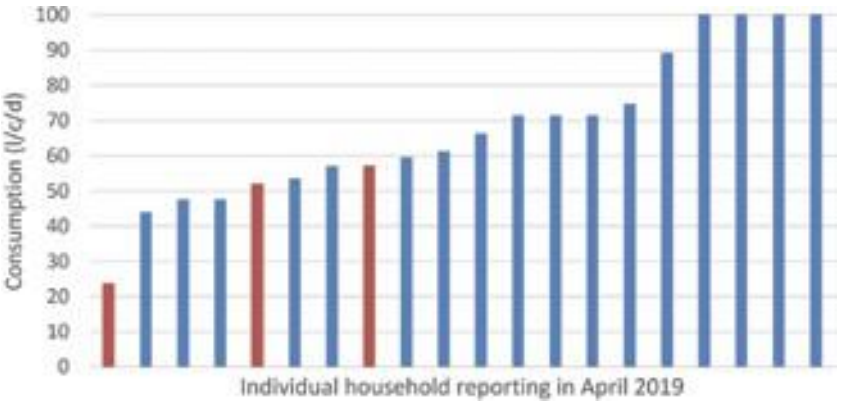

Figure 1 Water supply rates to 20 Ramtha and Irbid Qasaba households.

homes in Irbid Qasaba and 1 Jordanian home in Ramtha (Figure 1). Respondents in this broader, albeit small, representation of the local population generally indicated that access to water supplies was 'enough'. Consumption could be very low (less than 50 l/c/d) without households reporting an experience of stress (Figure 1). Even Syrian refugees who had come from previous lifestyles with an abundance of water – gardens and courtyard fountains – quickly responded that the water quantities they secured in their new homes in Jordan were adequate, if not humble: '*Now we use less so that we don't need to pay more*' (Syrian refugee, personal communication, May 2019). Conversely, four of the Jordanian households visited – three in Ramtha and one in Irbid Qasaba – had water bills that indicated consumption over 100 l/c/d (Figure 1; again, household visits were in water-stressed areas, but the households were not necessarily 'vulnerable' per the govern- ment's definition like those that participated in the vulnerability questionnaires). All four of these households had four or fewer individuals in the household and were regular, billed customers of the municipal network. Two also supplemented their municipal supplies with tanker deliveries approximately once per month.

Red bars are households that stated insufficiency in supplies for their domestic needs. Litres per capita per day figure are calculated by authors based on original data. Final four bars are cut off for scale. Their consumption rates are 119, 122, 191 and 595 l/c/d.

Regarding quality, 18 of the 20 households interviewed bought additional water from stores for their drinking water (approximately 3–6 l/c/d). These households considered water quality from the local network and trucks to be unsuitable for drinking according to local knowledge shared among family and neighbours. Storage tanks were also gener- ally recognized to be unclean and unkept. Water supplies from all distribution sources, however, were used for other household washing and hygienic activities without concern or narrative experiences of negative health impacts associated with poor water quality.[12]

[12] When NGO personnel and local experts were questioned about the inconsistency in water quality perceptions, they suspected that the tainting of tap water at the household was a result of its storage in unkept tanks.

Table 3
'How is it secured?' – described by source and storage to meet daily household needs among Syrian refugee and Jordanian households in Ramtha and Irbid Qasaba

Stakeholder Perspective (Nationality, Location)	Municipal Network Is an Important Source for Water (%)	Tank Storage Capacity (Average)
Jordanian, Irbid Qasaba (n = 3,022)	84	0.74 m^3/c
Syrian refugees, Irbid Qasaba (n = 4,008)	93	n/a
Syrian refugees, Ramtha (n = 1,539)	97	0.37 m^3/c

Source: Raw data provided by JVAF and VAF (ACF, 2019) for Irbid Qasaba results and by NRC questionnaires for Ramtha results; averages calculated by authors.

3.2.2 How Is Water Secured and to What End?

According to the questionnaires, 97% (n = 1,539) of Syrian refugee households in Ramtha and 93% (n = 4,008) of those in Qasaba responded that piped, municipality water was the main source of water in their homes. A lower rate, 84%, of vulnerable Jordanian households in Qasaba identified the municipal piped system as one of their most important sources of household water (n = 3,022) (Table 3). More than a quarter of the Jordanian households who said piped water was important also named at least one other water source as important (Source: JVAF, VAF, NRC datasets).

Effectively half of all vulnerable Jordanian respondents in Irbid Qasaba stated that their current quantity of supply (circa 2017–2018) was insufficient to meet basic daily needs of water. This included about 44% of the respondents who answered that municipal water was an important source of water. The JVAF questionnaire also captured data on households' alternative sources of water. A total of 543 of the 3,022 JVAF respondents, 18%, named private water tanker trucks as one of the most important sources of water in their households; 356 respondents, 12%, named private water trucks as the only important source of water for their household (JVAF questionnaire);[13] 749 (25%) of the JVAF group also selected 'Shop/market (i.e. bottled water)', 'Other Families' and/or 'Private Well' as one of their most important sources of household water.

According to interlocutors, the supply of water to households by the central network took place in planned rotations, reaching district neighbourhoods between one and three times per week. Ramtha end-users said their weekly delivery lasted 24 hours at a time, with one household reporting that their delivery only came for 8 hours in the evening. Households in Irbid Qasaba mostly concurred that on days water was delivered, it would run for 10 to 12 hours.[14] Qasaba respondents included that, although the rotation should

[13] The YWC's KPI dataset did include trucked delivery, but as verbally explained by YWC officers, this only represents trucks sponsored by the water utility company during emergency scenarios. YWC only documented this type of emergency tank water in 2015 with volumes around 700,000 m^3.

[14] Delivery accounts matched statements by the YWC that they close valves along the line after a certain number of hours to avoid that those households with greater storage capacity or those using 'water delivery day' for extra household chores do not deplete too much of the bulk quantity sent out.

be three times per week, good pressure came only once a week.[15] Because of the low pressure, delivery was only made to lower storage tanks; residents or landlords were responsible for installing pumps to carry water to rooftop tanks, which feed households by gravity. Across the 20 households interviewed, 16 considered the municipal supplies as an important source of water; the exceptions were one Syrian home in Irbid Qasaba, one Syrian home in Ramtha, and two Jordanian homes in Ramtha. One of the Jordanian homes not serviced by the YWC had chosen not to connect to the network and bought all its water from a tanker; the other had been cut from the central network when the household failed to pay their water bill. The two Syrian households without service reported that they did not receive any municipal water despite having a connection. Their landlords required that they pay for tanker deliveries supposedly because municipal service was unreliable. Among the 16 households receiving from the municipal network, 3 bought supplemental water volumes (2 m^3/month, 4 m^3/month and 39 m^3/month), sometimes the majority of their total consumption, from local tankers.

4. Discussion

The above results show how data and indicators used for orienting Jordan's water strategy and policies reflect the performance of Irbid Qasaba and Ramtha's drinking water system. That reflection of performance is juxtaposed with experiences of household water security among end-users in those communities. We now return to the known preva- lence of Jordan's national water scarcity discourse. What can the comparison between calculated performance and reported experience tell us about the implications of a discourse narrative and simplified policy indicators?

4.1 End-User Insecurities Hidden by Regional Policy Assessments

In the previous section, we see Jordanian government and water utility stakeholders assessing distribution and infrastructure performance of the centrally controlled, municipal water network using total input and output data at a regional scale. The resulting *water share per capita* metric, found in Jordanian policy documents (MWI, 2016a, 2016b) and analysed in our research (Table 1), represented an average supply across end-users per governorate. This average calculation was functional in drawing attention to the country's real issues of limited freshwater availability, experienced by the nation as a whole, and it supported policymakers in justifying efforts to strengthen resilience measures across the national water network and distribution system (Hussein et al., 2020). However, the normalized assessment failed to distinguish household security from national security. As a result, the collection of simplified, average per capita data was found to obscure strategists' perspective on the actual variation in household-level allocations by the distribution system's performance.

[15] During water utility interviews, the YWC recognized that pressures provided were only around 0.5 to 1 bar, far below what it should be.

Policymakers' datasets on municipal allocations presented a picture of scarcity experienced evenly across the Irbid governorate. In turn, policy applied the rationale that increasing overall system production would equate to increasing security, perhaps even equitably, throughout the country's ballooning population in local districts like Irbid Qasaba and Ramtha. Yet, the findings of this research suggested that the data perspective assumed by government strategists supported a drinking water system that met demands of the YWC on behalf of its customers (reported through billed volume data) from season to season but remained unaccountable to households excluded from this indicator. Concern over the potential disparity caused by this strategy perspective arose from the number of subscribers and billed users captured by YWC and WAJ, which sat well below total population statistics (e.g. a 2.9 million resident population according to the Department of Statistics versus 1.6 million residents supplied by YWC according to official datasets in 2017). We saw in the VAF and NRC questionnaires that the average numbers in Syrian refugee households were approximately 0.5 higher than YWC's estimate (Table 1), which could imply an inaccurate population calculation by the utility company.

Regardless, MWI's official statements continued to suggest that their water production was the primary source for household needs of more than 94% of the country. It would appear, therefore, that households not serviced by YWC were mistakenly believed to be benefitting from supply-centred policy interventions, which focused exclusively on delivering more water through the central network. However, we learned through user questionnaires that even the households that were actively benefitting from the municipal network would commonly depend on supplemental sources of supply to achieve sufficient qualities and qualities for their needs. Utility managers had a similar misperception of household insecurity related to water quality. WAJ and the MWI assessed quality-related system performance based on the YWC's report against their KPI for the number of microbiological tests that complied with Jordanian quality standards. Despite the efforts of the municipal piped network to stringently monitor contamination rates, most users in this study were distrustful of the network water for drinking purposes and purchased bottled water. This was an additional experience of insecurity and expense by households that was not acknowledged or addressed in the national water strategy.

When assessing the distribution system through reported regional water utility data, we observed policymakers in Jordan excluding data on non-network-related water resource allocation and consumption. In particular, the market of tanker water was left out of the policy frame. This data could be significant for several reasons. On the one hand, tankers' unmonitored sourcing and quality compliance could be considered a compounding, technical strain on the network, as well as an environmental management and public health concern (LeChevallier et al., 2003), leading to further distribution inequalities. In the case of Ramtha and Qasaba, it was possible that hundreds of households were hav- ing their tanks automatically filled when their section received water, which would have impacted transient flow in the piped system and caused further problems with overall distribution and maintenance of adequate water pressure across the network (Afshar et al., 2008). Financially speaking, tankers demonstrated themselves to be competitive providers

of a reliable and immediate service compared to the restricted capacity of the municipal network; tanker deliveries were therefore seemingly drawing critical operations and maintenance funds away from the central network while charging households a much higher cost per unit.

On the other hand, excluding non-network security analyses may have also been a missed opportunity to creatively utilize tankers' positions as an established security mechanism for vulnerable households. Either way, tankers were a dynamic, third-party actor within the intermittent, government-managed distribution system of Irbid's communities. These findings join those of other urban water studies (Grasham & Neville, 2020; Smiley, 2019) in suggesting that informal vendors should be acknowledged in government-level systems planning; this is particularly important in Jordan, as more households find means to expand their storage capacities and/or purchasing power. Knowing that essentially all neighbourhoods in Jordan are on a rationed supply cycle, we can imagine that Ramtha and Qasaba have not been alone in turning to the private water market. If some 20% of a vulnerable population with limited expenditures were buying from tankers, it is possible that average- and upper-income Jordanian families were able to buffer their own intermittent network supplies with even larger supplies from tankers since the Syrian crisis.

4.2 The Importance of Household Assets and Capacities in Supporting Security Outcomes

Vulnerable households in Ramtha and Irbid Qasaba demonstrated that, in order to secure desired water volumes and qualities for their daily needs, they employed multiple sources of distribution and household-level management mechanisms. An averaged supply metric, presenting distribution performance as an output of the municipal network alone, was thus found to be an inadequate indictor for a household's complete experi- ence of drinking water security. Our analysis of household questionnaires did not reveal a strong relationship between security responses ('sufficient water available for daily domestic needs') and the household population type (Syrian refugees or Jordanian), city (Ramtha or Qasaba) or the household's use of the central network. A basic trend was noticed, however, between households that reported experiences of insecurity or insufficient access to water supplies and the general lack of reliability across the multisource distribution system. Lack of reliability could have been caused by no network connection, insufficient storage and/or inability to pay for and access private vendors and other ways to compensate the lagging central network, such as supplemental wells, or neighbours to cover their water needs when the tank runs dry before the next water delivery. In this way, drinking water security appeared to relate at least as much to indicators of access and capacity characteristics as to allocation metrics for infrastructure and compliance.

These findings align with research that posits water access and security in relation to an individual's command of a specific set of assets and capabilities (Mehta, 2010a; Nussbaum, 2009; Sen, 1999; Swyngedouw, 1999). In Irbid, strategists' calculations of aggregated water allocation and consumption often masked what was ultimately collected by

individuals across the system. Similar disparities between simplified government measurements and actual household outcomes have been discovered in global contexts, including regions where physical water scarcity and social instability are less severe (Hughes, 2022; Meehan et al., 2020). Adding 'social and financial' or 'socio-demographic' descriptors of an end-user population to performance assessments, in these global research examples, has resulted in more accurate models of drinking water systems than conventional assessments using only physical variables like watershed health, infrastructure gaps and age.

The case of Ramtha, where insecurity rates were highest despite a high rate of sourcing from the municipal system, further illustrates the utility of more holistic system appraisals. Questionnaire data showed that Syrian refugees had some of the most limited access to water, primarily due to an average rooftop tank storage of 0.37 m^3/capita (Table 3) and a delivery schedule of once per week. Supposing that the pressure and duration of the delivery were sufficient, the maximum quantity an individual in these households would have available to them was around 50 l/c/d, managed over the entire week. Even if the household were among those receiving YWC's estimated 82 l/c/d (Table 1), the tank required to capture that amount in a single weekly delivery (for the average family of six) would be 3.4 m^3. Deliveries in the larger, neighbouring district of Irbid Qasaba were more frequent, sometimes three times per week, meaning that water security for the week would have been less dependent on the size (and quality) of a household's storage tank.

Government and water utility performance calculations did not account for the volumetric contributions of private tanker trucks or those of bottled water purchases and shared water among neighbours and family. However, these additional sources played a crucial role in the drinking water security of hundreds of vulnerable households in Irbid. Policy-supported supplies alone were not meeting the demands of this population; nor were they solely mitigating the potential social instability caused by water insecurities (Mouench, 2002). Instead, the underserved population, with support from a few international livelihood NGOs, managed their access insecurities. Again, these results support the growing scientific argument that monitoring and managing only the physical dimension of a drinking water system is insufficient to mitigate inequality and achieve security among all end-users. Variables related to the household itself –such as the mobility of financial and social assets to address or navigate insecurity – are equally strong indicators of drinking water vulnerability (Hughes, 2022). Where NGOs are already collecting data on housing-related assets, as in Irbid, greater partnership and data-sharing among policymakers and utility providers should be considered. Policies that augment a household's point-of-access capabilities, such as storage capacity or purchasing power, could arguably be more impactful in improving security outcomes in vulnerable communities than the current policy proposals for increasing the physical system's allocation rates to 100 l/c/d.

4.3 Security for the Sake of Stability

Finally, we consider stakeholders' reflections on the ultimate purpose of securing water. The overarching theme across all groups was an approach to drinking water security

that prioritized stability. By managing water supplies according to water company requests, the government aims to meet user expectations, even during periods of heightened pressure on the system. Study results showed that the government consistently met the YWC's requests on behalf of their customers, maintaining expected supply levels for system users throughout the shock of population growth. Likewise, the unaccounted-for NRW suggests that discontented individuals are finding ways to satiate their needs, albeit at the expense of equitable system outcomes. Allowing landowners and 'shadow actors' to enjoy privileges and benefits keeps disgruntled 'shadow state' elites at bay (Hussein, 2018a, 2018b; Mustafa & Tillotson, 2019; Yorke, 2016). A scarcity discourse that focuses policies on increasing production and supply might indeed be advantageous for these groups, who are already well-connected and influential within this system (Swyngedouw, 1999). It would make sense, therefore, to conclude that effectiveness and relevance of performance indicators are more aligned with the appeasement of end-users who have significant social and political influence than with insurance of equitable distribution.

Large government donors explicitly stated that their presence in Jordan was primarily to support the country's stability in the region, a strategic alliance also detected in Yorke's earlier research (2013). The JRP has played a key role in facilitating foreign sponsorship of the government's strategy for sustainable and fair distribution of water to its population. Most foreign actors thereby reinforce the prevailing measurement of public action and its indicators, which appear to indicate output stability, even if accountability to drinking water outcomes for all households is questionable. Lax scrutiny of the government's supply-driven agenda is further exemplified in a revealing 2020 study on wastewater treatment in Jordan, a popular policy solution in the JRP for augmenting resources. While increasing the volume of water in dams, these interventions were found to simultaneously reduce water quality, depriving the country of tens of millions of cubic metres of high-quality flood and base flows annually that could have been used for drinking water purposes (Mohammad et al., 2020).

Yet, for vulnerable households, the ability to secure a desired lifestyle appears to be more related to their personal coping mechanisms and lowering of water expectations than to the actual securing of a normative amount of water. As one donor representative rationalized, as long as there is water to be secured – whether in low quantities, of poor quality, at a higher price or with help from a neighbour – there are far more pressing vulnerabilities and issues for households to deal with. During our 2019 study, water was accessible, if not through the municipal network, then through more expensive supplies from alternative, informal sources. Essentially, what mattered for these users was the holistic system's provision of a '*sense of reliability, adaptability, and freedom from fear*' (Zeitoun et al., 2016). In other words, the MWI's policies to ensure peace and stability have not achieved the objective on their own. Household-level security mechanisms have allowed individuals underserved by the municipal system to maintain a relative sufficiency of access: livelihood NGOs have been equipping homes with adequate tank storage; neighbours have shared their meagre collections; private vendors sell clean, bottled water; and tankers commoditize excess demand. In Irbid, we discover vulnerable households paying the price for both water security and national stability within a system uncalibrated to their needs.

4.4 Limitations of the Study and Remaining Questions

The above results and discussion should be recognized in context of the significant constraints and inherent biases of this research, including the biases inherent in our own data. Most notably, the outcomes of our analysis of household-level data were highly determinant on secondary quantitative data from the three vulnerability questionnaires, in which indicators and their units for 'household water security' were pre-established and nonstandard across the questionnaires. Collected datasets referenced three different questionnaire templates with existing data, across which questions and coding did not match. For example, some interpretation had to be made to cross-analyse expressions of 'satisfaction'. As we learned through our findings, satisfaction or sufficiency was a relative experience and could not rightly be captured in absolute terms; nonetheless, the integrity of the household user analysis within this research could have benefitted from a standardized dataset, particularly one with the direct question, 'How much water are you able to secure?', as was posited during the research team's household visits. Furthermore, we recognize that, although interviews and questionnaires documented gender, age and household position (i.e. mother, father, son-in-law etc.) of the interlocutors, analyses in this article excluded the potential household-level bias of the individual whose experience of security was used to represent that of their household (Cleaver & Elson, 1995).

This research also studied a narrow scope of water distribution performance. Only two districts of a single governorate in Jordan were studied, and the concept of water security was refined to focus solely on household supply and access. Points for discussion beyond this scope remain open to question, such as experiences of system performance in governorates with fewer refugee settlers and in rural communities, identified to be some of the populations in Jordan most negatively impacted by the additional demands on the water system (Baylouny & Klingseies, 2018; Shah, 2021). In addition to expanding the study's scope, our findings recommend further studies on the following three themes: (a) the extent of the informal sector (Mustafa & Talozi, 2018). Specifically, we were unable to research the quantities and qualities sourced by private tankers, as well as the level of engagement or ignorance by the MWI; (b) modelling impact of improved efficiency and/or frequency of deliveries by the distribution system on real water demand. In other words, if households become accustomed to more reliable deliveries, how would their consumption patterns change and how would the government need to respond?; and (c) interplay of agricultural allocation policy and achievement of household-level water security with the application of a strong political economy framework (Hussein, 2018b; Yorke, 2016).

5. Conclusions

This study expanded on existing water scarcity and security research in Jordan by placing it in the context of on-going, global examination of appropriate indicators for drinking water system performance and effective policy interventions for addressing disparities in water access. Data used in Jordan's water strategies and policies as a measure

of public action were analysed in relation to drinking water security realities reported by vulnerable households in Irbid Qasaba and Ramtha districts. The objective of this research was not to refute Jordan's undeniably compromised stock of fresh, renewable water resources. The country's resources were and are in a dire state. Rather, the unpacking of Jordan's water policy data was in direct response to the country's resource limitations and its stated commitments to user-centred SDGs and to realizing the human right of water for all. This study observed that Jordanian policymakers present district- and household-level water security as being equivalent to the regional average per capita from net allocations distributed through the municipal piped network. Investigation of the water utility's datasets indicated that these regional allocations were unlikely to be servicing the entire local population as claimed in policy statements and calculations; nor were they likely to be contributing to equal (average) outcomes of security among users. Analysis of end-user experiences further confirmed a significant variability in accessed volumes and qualities of water among Syrian refugee and Jordanian households attributed in part to a dependency on diverse sources of supply beyond the municipal network.

Development of new and reallocated water resources, as well as improvement of the municipal network's delivery efficiency, have been vital policy responses to the growing number of households across Jordan. Nonetheless, these system-level approaches set by previous water policy have failed to address the insecurities that relate not to total national scarcity and utilitarian indicators of distribution and infrastructure performance but to an end-user's capabilities to access reliable, adaptable supplies for their household's daily needs. Households in Irbid Qasaba and Ramtha, including those of Syrian refugees and vulnerable Jordanians, have augmented Jordan's municipal distribution system using their own means of informal water services, such as tanker trucks, water sharing and bottled water purchases to achieve outcomes of sufficient access and security on their own terms. By presenting Jordan's water security as a singular supply-demand gap across the municipal water network, water policy data have evaded strategic analyses of end-users' multidimensional access challenges and has potentially drawn attention and funds further away from solutions able to relieve household-level access barriers.

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