Analysis of Key Performance Indicators of Water Service Providers in the Gaza Strip to Achieve UN Sustainable Development Goal 6

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This article addresses the causes of instability and non-sustainability of municipal water and wastewater by the 25 Service Providers (SPS) in the Gaza Strip (GS), Palestine. The analysis of Key Performance Indicators (KPIS) of municipal water and wastewater SPS in the GS shows a serious deficiency in the administrative, financial, and operational dimensions; such deficiency affects efforts to achieve the UN Sustainable Development Goal 6 (SDG 6). The deficiencies include inappropriate planning, lack of comprehensive capacity-building programmes, very high levels of Non-Revenue Water, and distortions in the tariff structures of almost all service providers, where the average selling price per m^3 of water was less than the average unit cost of m^3 of water sold. Moreover, levels of collection efficiency were very low, which resulted in a serious cash flow problem for the SPS.' The study has found a lack or absence of accurate or completed customer complaint, satisfaction, and inquiry logs; this is clearly reflected in customer behaviour related to reluctance to pay bills and high levels of illegal connections.

Key Words: Sustainable Development Goal 6 (SDG 6), Key Performance Indicators (KPIS), water sector, Service Providers (SPS), municipalities, Gaza Strip (GS), Palestine
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Introduction

The continuous sophistication of requirements in human lives, in addition to the complications of the inhabitants' and environmental needs, which have resulted from the fast and rapid change in urban develop-

ment, have led to increasing realization and awareness of population needs for potable water to ensure sustainable and positive development of human societies.

The World Bank (2018) has reported that Palestinian Territories face significant and growing shortfalls in the water supply available for domestic use. It was also mentioned that Palestinians living in the Gaza Strip (GS) suffer from complex problems in different aspects of livelihood, including sustainable water and wastewater services. Under the section entitled 'Financial Viability of Water Services in the Palestinian Territories,' it was stated that 'A lack of commercial focus undermines the viability of the sector at multiple levels. Tariffs in both the West Bank and GS are low.'

There are 25 water and wastewater service providers (SPS) in the GS responsible for service provision for almost 2 million inhabitants (24 municipalities and the Coastal Municipalities Water Utility – CMWU). The National Water Sector Strategic Plan and Action Plan 2017–2022 (Palestinian Water Authority 2016) has shown many vulnerabilities, weaknesses and threats facing the water and wastewater SPS in Palestine and has provided a detailed SWOT analysis, that identified the affective factors and priority issues, which form the grounds for starting the identification of the strategic development framework for the Water Sector.

The article's main question is, what are the requirements to achieve UN Sustainable Development Goal 6 (SDG 6) in the GS based on analyses of the Key Performance Indicators (KPIS) data for the year 2019, whereas the sub-questions are:

1. What are the operational (technical, financial, and administrative) problems that may cause deterioration and eventually stop provision of water and wastewater services in the Gaza Strip?
2. What are the requirements to ensure continuity and sustainability of water and wastewater service provision in the Gaza Strip in conjunction with the SDG 6?

The specific objectives of this article are:

1. Identify technical, financial, and administrative weaknesses that jeopardize the continuity and sustainability of water and wastewater service provision in the GS.
2. Quantify the operational status of the water and wastewater services in a specific performance indicator.

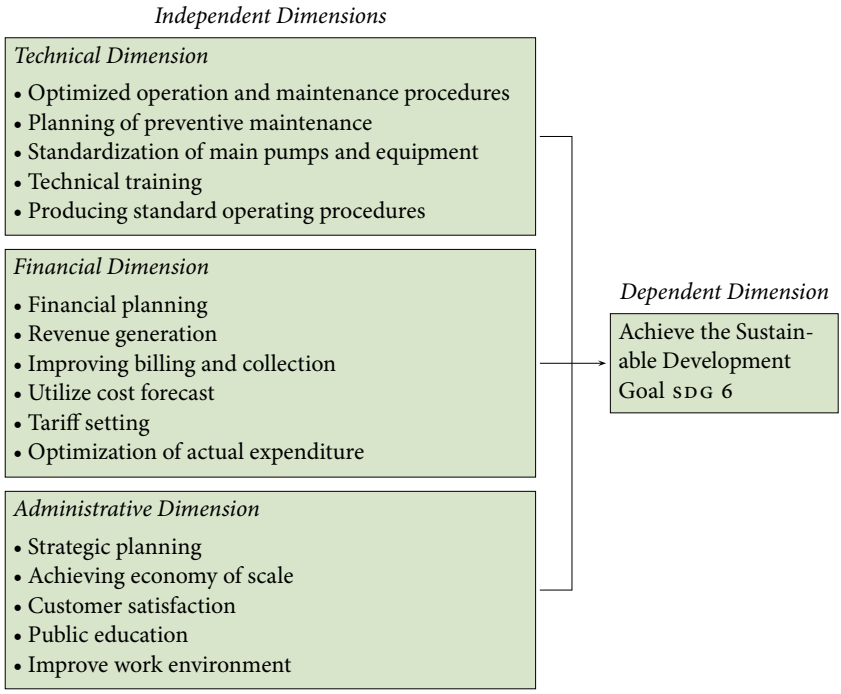

FIGURE 1 Study Dimensions

3. Provide recommendations to ensure operational stability and continuity of water and wastewater service provision by the 25 service providers.

The present study is qualitative and includes both literature and empirical analysis. The collection of cross-sectional data and information of Service Providers (SPS) took place during 2019. There are no correlated statistical links between the data of the 25 SPS due to total independence in operations, water and wastewater networks, and administrative and financial systems of each service provider. Hence MS Excel software is most suitable to tabulate, produce individual indicators and sort data. The Descriptive/Narrative information resulting from the questionnaires and structured interviews were summarized to produce direct numerical weights and percentages from them. Therefore, MS Excel is ideal for this exercise.

The first section includes the study's background, research questions, objectives, and methodology. The second section briefly describes the structure of the water sector in Palestine. The third section discusses re-

lated previous literature. The fourth section describes operational results compared to benchmarks. The fifth section present findings of data analysis. The sixth section shows the cause-effect matrix and its details. The seventh section includes recommendations to improve technical, financial, and administrative dimensions.

Structure of the Water Sector in Palestine

There are three main levels of stakeholders in the water and wastewater sector in Palestine:

1. The Service Providers (SPS)
2. The Regulators
3. Other Local and International Entities/Donors

THE SERVICE PROVIDERS (SPS)

The GS is divided into 25 municipalities across 5 governorates. The municipalities vary in the geographic size and number of populations. The 25 municipalities are the official SPS of water and wastewater services through municipal networks.

Rafah municipality has joined the Coastal Municipalities Water Utility (CMWU), which is a joint services council under the supreme umbrella of the Ministry of Local Government. Rafah Municipality is still legally responsible for water and wastewater services in Rafah city and refugee camps, although CMWU is responsible for all operational and financial services in that area.

THE REGULATORS

The regulators of the water sector in Palestine are:

- Palestinian Water Authority (PWA).
- The Ministry of Local Government (MOLG).
- Water Sector Regulatory Council (WSRC).
- Ministry of Health (MOH).

OTHER LOCAL AND INTERNATIONAL ENTITIES/DONORS

There are different local and international entities/stakeholders, who affect the water and wastewater sector in Palestine and in particular the GS. The United Nations Relief and Works Agency for Palestine Refugees in the Near East is still responsible for water provision in Jabalia refugee camp, but not for the wastewater collection network.

TABLE 1 Water Service Providers in Gaza Strip

Municipality	Local communities served	(1)	(2)
Um Ennaser	Um Ennaser city	5,010	5,010
Beit Hanoun	Beit Hanoun city	55,248	55,248
Beit Lahiya	Beit Lahiya city	95,016	95,016
Jabalia al Nazla	Jabalia refugee camp	52,313	234,971
	Jabalia city	182,658	
Gaza	Shati refugee camp	42,361	656,432
	Gaza city	614,071	
Wadi Gaza	Wadi Gaza city	4,769	4,769
Mughraga	Mughraga city	11,916	11,916
Zahra	Zahra city	5,551	5,551
Nusairat	Nusairat refugee camp	33,243	90,678
	Nusairat city	57,435	
Buraij	Buraij refugee camp	29,344	45,565
	Buraij city	16,221	
Maghazi	Maghazi refugee camp	19,012	29,138
	Maghazi city	10,126	
Zawaida	Zawaida city	24,964	24,964
Musaddar	Musaddar city	2,709	2,709
Dair Al Balah	Dair al Balah refugee camp	7,314	85,985
	Dair al Balah city	78,671	
Wadi as Salga	Wadi as Salga city	7,031	7,031
Qarara	Qarara city	30,488	30,488
Khan Younis	Khan Younis refugee camp	43,289	258,910
	Khan Younis city	215,621	
Bani Suhaila	Bani Suhaila city	43,559	43,559
Abasn Kabira	Abasn Kabira city	28,137	28,137
Abasan Jadida	Abasan Jadida city	9,765	9,765
Khuza'a	Khuza'a city	11,971	11,971
Fukhary	Fukhary city	6,773	6,773
Nasser	Nasser city	9,426	9,426
Shuka	Shuka city	17,254	17,254
Rafah	Rafah city	180,354	218,702
	Rafah refugee camp	38,348	
Total			1,989,968

NOTES Column headings are as follows: (1) no. of population per community, 2019, (2) total population, 2019. Based on data from Palestinian Central Bureau of Statistics (http://www.pcbs.gov.ps/site/lang__en/803/default.aspx).

The International Bank for Reconstruction and Development (IBRD), The United Nations International Children's Emergency Fund (UNICEF), The United Nations Development Programme (UNDP), The International Committee of the Red Cross (ICRC), Office of the Quartet Committee (OQ), Japan International Cooperation Agency (JICA), Kreditanstalt

für Wiederaufbau – German Development Bank (KFW), French Development Agency (AFD), Austrian Development Agency (ADA), Kuwait Fund For Arab Economic Development (KFAED), Netherlands Development Cooperation and other funding/aid agencies provide technical and financial support to the water and wastewater sector in the GS through the Palestinian Water Authority (PWA) and Coastal Municipalities Water Utility (CMWU) and through projects implemented by International Non-Governmental Organizations (INGO's) and Non-Governmental Organizations (NGO's) working in the sector.

The Water, Sanitation and Hygiene (WASH) cluster was formed in Gaza in 2009 and works under the general umbrella of the United Nations Organization humanitarian coordinator, with direct coordination with the UNICEF & United Nations Office for the Coordination of Humanitarian Affairs (OCHA). The WASH cluster coordinates humanitarian aid/support and projects carried out by the INGO's and NGO's in the GS that are directed towards water sanitation and hygiene.

All the above entities either provide infrastructure projects or emergency response and humanitarian support related to water and wastewater services (coordination for chemicals and spare parts entry, for example). Nevertheless, none provides the necessary support for municipalities/SPS to maintain/sustain their services from a solid business point of view.

Literature Review

The researchers have carried out an in-depth revision of previous studies, reports and articles. This study contributes to the literature on SDGS and economic growth and brings, as a novelty, the analysis of the nexus relationship between performance indicators of water service providers and SDG 6 in the GS.

Berg (2020) concluded that benchmarking initiative needs to be embedded in a regulatory system that goes beyond the regulatory agency and the water utility operator to include stakeholders (including customers, Ministries, and citizens without quality service). Berg also found that domestic politics and tribalism can limit the effectiveness of regulatory institutions and that stakeholders need to have a shared vision, even if they have different preferred strategies for meeting objectives.

Smith et al. (2020) found that utilizing mixed methods can illuminate important gaps in the progress towards achieving the SDGS 3 and 6 by 2030. Guppy, Mehta, and Qadir (2019) showed there are two potential

gaps in the SDG 6 indicator framework. First, between the aspirations captured in SDG 6 targets and what will be measured by the relevant indicators. Second, between what is being measured in 'means of implementation' indicators and what the key means of implementation achievements of many countries are expected to be under SDG. Paoli and Addeo (2019) suggested that a composite index for each SDG to measure SDG achievement across the 17 goals should be created and explores the social, environmental, and economic dimensions of SDGS as defined by the EU.

Ortigara, Kay, and Uhlenbrook (2018) found that education, training, and research could contribute to enable and accelerate progress towards achieving SDG 6. Weststrate et al. (2019) concluded that SDG 6 indicators fail to report (lack transparency) whether progress has been made through centralized piped infrastructure or decentralized options. Barbier and Burgess (2017) have shown that it is possible to develop the system approach to sustainability to make such welfare assessments, and more importantly, such an approach is directly relevant to the 2030 Sustainable Development Agenda of the United Nations (https://www.un.org/sustainabledevelopment). This approach is directly relevant to the 17th SDG, as each one of these goals can be attributed to economic and environmental systems and there are clear trade-offs in attempting to attain progress across these goals.

Smith et al. (2020), Paoli and Addeo (2019), and Weststrate et al. (2019) concluded there is a serious need to utilize mixed data collection and to illuminate important gaps in the progress towards achieving the SDGS 3 and 6 by 2030, as well as the need to create a composite index for each SDG to measure SDG achievement across the 17 goals. They propose indicators that distinguish advancements made with regard to piped infrastructure and decentralized infrastructure and propose adding regulation as a parameter to the SDG 6 indicators, especially for decentralized infrastructure. Hutton and Varughese (2016) mention that the global costs of achieving universal basic WASH by the year 2030 are achievable under current overall sector spending. Moreover, resources need to be shifted to basic sanitation and hygiene in countries where the service gap is greatest. The Palestinian Water Authority (2016) concluded that development issues should be identified and highlighted clearly, and water sector projects should be aligned to achieve PWA strategic vision of improving the levels of water services in Palestine.

Berg and Phillips (2017) advised that it is important to publicize information about trends over time and performance patterns across sup-

pliers, because without financial and operating statistics, it is difficult (if not impossible) to evaluate sector performance and to identify the strengths and weaknesses of current regulatory and managerial arrangements. There is a need for a permanent regulatory effort related to data collection and verification, and the operating utility needs to invest in robust information systems if managers are, indeed, going to manage.

Walters and Javernick-Will (2015) concluded that sustainability of rural water infrastructure in developing countries is largely affected by the dynamic and systemic interactions of technical, social, financial, institutional, and environmental factors that can lead to premature water system failure. Han et al. (2015) show that local administrators are focusing on selecting the highest priority for a management area through a risk-based approach or by allocating additional funds for sustainable water management. Waage et al. (2015) propose a framework for classifying and clustering goals and their interactions, identify the different problem structures and challenges for good governance, propose potential solutions, show why different goals interact positively or negatively, and where and why governing these interactions can lead to a 'win-win,' as well as where governing these interactions is a much more politically difficult challenge. Lo Storto (2011) found that there are important inefficiencies in the water service management industry in Italy. In particular, there is a number of Aree Territoriali Ottimali (ATO) that are inefficient due to their size. The inefficiency is not only due to the scarcely effective use of inputs (i.e. the number of employees, the amount of operative costs, etc.) but also to an unbalanced size of the ATOs. Whittington et al. (2009) suggested that policymakers and donors need to know what improved services are worth to people in developing countries, not only to assess the wisdom of water and sanitation investments. Marques, da Cruz, and Pires (2015), and Marques and Monteiro (2001), discussed the concept of 'sustainable water services' and suggested a multicriteria method to assess it. They developed a proposal of 50 indicators divided into five groups, which are structural indicators, operational indicators, water and service quality indicators, personnel indicators and economic indicators. The studies found that a low performance in a given criterion should automatically mean that the global sustainability score cannot be above a certain threshold (irrespective of the actual performance in all the other criteria); the 'veto power' of some criteria would require the use of non-compensatory models to perform a global evaluation,

Literatures discussed the strategic planning for service provision, the

prerequisites needed for water and wastewater projects to operate in a sustainable manner and management of services beyond first installation, and continuity of the service provision from the administrative, technical, financial and customer participation/satisfaction point of view. It was concluded that utilizing mixed methods in data collection and analysis can illuminate important gaps in the progress towards achieving the SDGS 3 and 6 by 2030 and can increase the community-level knowledge base. Moreover, there is urgent need for more data and improved monitoring to assess SDG 6 progress and to enhance decision-making. The need to address the serious lack of human and institutional capacity that was constraining progress towards achieving SDG 6 was discussed.

The current article addresses, first, the services providers in Gaza Strip, second, sustainability of services only regardless of the quality of water, and third, sustainability of services of a region of scarce resources and bad quality, while previous studies addressed bad management and scarce resources yet of good quality.

Operational Results Compared to Benchmarks

The following matrix provides a visual indicator about the status of each performance indicator and the 'distance to frontier' to reach the minimum benchmark requirements. The matrix can be read according to the following instructions:

1. All numbers should be read in their absolute values.
2. The (+) or (–) sign in front of any value indicates the distance from the benchmark.
3. The distance to frontier is calculated as follows:
   - For numerical values:
     $$\frac{\text{benchmark value} - \text{indicator's value}}{\text{benchmark value}} \times 100.$$
   - For percentage values:
     $$\text{benchmark value in \%} - \text{indicator's value in \%}.$$
4. The negative sign (–) in some benchmarks like 'average daily per capita water consumption at domestic level' is a good thing as it means that the value of the actual indicator is higher than the minimum benchmark, while the positive sign or number indicates the gap to be bridged to reach the benchmark.

5. The triangles (△) are always positive indicators, i.e. the actual value of the performance indicator has reached or succeeded the minimum bench mark value by the indicated absolute percentage value.
6. The circles (○) are always negative indicators, i.e. the actual value of the performance indicator is behind the minimum benchmark value and needs to be improved by the indicated absolute percentage value.
7. The diamond (◇) means that either there is no specific benchmark for this indicator or the components of the respective indicator are independent factors affecting other indicators, such as 'Operating costs per m^3 of water sold,' as this indicator affects the 'Average selling price per m^3 of water,' hence the operating costs constitute a benchmark for the selling price to achieve full cost recovery.
8. Empty or N/A cells mean either the data were not created in first place, i.e. microbiological test, where not all networks in all municipalities were tested, or it means that the situation is not applicable, i.e. collection efficiency of wastewater service, as there are 6 SPS with no wastewater collection network.

Data Analysis

After analysing the KPIS and making comparisons with applicable benchmarks, we concluded that there are serious weaknesses that are putting at risk the continuity and sustainability of the water and wastewater service provision:

- There are serious deficiencies in the administrative, financial and operations dimensions of the water and wastewater SPS in the GS.
- The deficiencies include lack of proper short-, medium- and long-term planning, absence of standard operating procedures, absence or lack of a comprehensive capacity building programme and an improper performance evaluation system.
- There are high levels of NRW that reached 40.16% for the GS as one operational unit, which constitute a serious waste of resources, both natural and financial.
- NRW reduces the revenue of SPS while keeping the overall operation costs unchanged, which is reflected in the higher unit cost of production and distribution of the quantities of water sold.

TABLE 2 Benchmark Comparison Matrix

((KPIS)s)	Unit	Large Service Provider									Medium Service Provider										Small Service provider									
		Nusairat	Jabalia al Nazla	Khan Younis	Gaza city	CMWU -Rafah	Dair al Balah		Beit Lahiya	Buraij	Zawaida	Qarara	Maghazi	Bani Suhaila	Beit Hanoun	Abasan Kabira		Zahra	Shuka	Fukhary	Musaddar	Mughraga	Nasser	Um Ennaser	Khuza'a	Abasan Jadida	Wadi as Salga	Wadi Gaza	
Technical Indicators																														
Average daily per capita water consumption at domestic level	l/c/d	84	99	70	85	75	68		85	78	70	96	82	95	98	111		161	76	112	117	90	119	109	130	100	63	73		
Benchmark	100																													
Current status																														
Distance to frontier	%	16%	1%	30%	15%	25%	32%		15%	22%	30%	4%	18%	5%	2%	-11%		-61%	24%	-12%	-17%	10%	-19%	-9%	-30%	0%	37%	27%		
Average daily water sold per capita based on total population served	l/c/d	84	103	77	96	76	73		86	79	91	98	82	97	101	122		167	78	113	118	91	121	111	131	102	72	77		
Benchmark	120																													
Current status																														
Distance to frontier	%	30%	14%	36%	20%	37%	39%		28%	34%	24%	18%	32%	19%	16%	-2%		-39%	35%	6%	2%	24%	-1%	8%	-9%	15%	40%	36%		
Average daily per capita water consumption per connection	l/con/d	867	1256	846	1217	797	745		800	712	759	1000	800	782	981	834		734	827	627	772	575	677	825	806	729	753	333		
Benchmark	N/A																													
Non-Revenue Water by volume	%	40%	37%	23%	42%	38%	56%		55%	42%	36%	39%	49%	29%	54%	22%		25%	38%	25%	44%	58%	14%	29%	19%	22%	25%	29%		
Benchmark (less than)	28%																													
Current status																														
Distance to frontier	%	-12%	-9%	5%	-14%	-10%	-28%		-27%	-14%	-8%	-11%	-21%	-1%	-26%	6%		3%	-10%	3%	-16%	-30%	14%	-1%	9%	6%	3%	-1%		
Non-Revenue Water per connection per day	l/c/d	568	729	263	881	479	1065		997	507	421	645	760	320	1133	234		242	393	213	601	803	114	335	195	209	283	134		
Benchmark	N/A																													

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TABLE 2 *Continued from the previous page*

(KPIS)	Unit	Large Service Provider								Medium Service Provider								Small Service provider								
		Nusairat	Jabalia al Nazla	Khan Younis	Gaza city	CMWU -Rafah	Dair al Balah	Beit Lahiya	Burayj	Zawaida	Qarara	Maghazi	Bani Suhaila	Beit Hanoun	Abasan Kabira	Zahra	Shuka	Fukhary	Musaddar	Mughraga	Nasser	Um Ennaser	Khuza' a	Abasan Jadida	Wadi as Salga	Wadi Gaza
Financial Indicators																										
Average selling price per m^3 of water	NIS	1.85	1.21	1.84	0.95	1.37	1.85	1.23	1.82	1.81	1.6	1.91	2.41	1.89	2.12	1.55	1.19	1.46	2	1.57	1	1	2.35	2.55	1.49	2.54
Benchmark	≥operation costs per m^3 water billed	●	●	●	●	●	●	●	●	▲	●	●	●	▲	●	●	●	●	▲	●	●	●	●	▲	●	●	●
Current status																										
Distance to frontier	%	8%	8%	13%	64%	19%	36%	39%	14%	-46%	21%	28%	45%	-17%	60%	12%	28%	55%	-13%	4%	73%	51%	43%	-4%	18%	5%
Operating costs per m3 of water sold	NIS	2.02	1.32	2.12	2.65	1.69	2.87	2	2.12	1.24	2.02	2.64	4.42	1.62	5.35	1.77	1.66	3.22	1.77	1.63	3.69	2.05	4.09	2.45	1.82	2.68
Benchmark	N/A	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Collection efficiency-water service	%	34%	48%	38%	22%	34%	23%	45%	27%	26%	43%	21%	33%	38%	25%	68%	19%	38%	41%	40%	58%	24%	53%	31%	43%	34%	61%
Benchmark (equal or greater than)	95%	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Current status																										
Distance to frontier	%	61%	47%	57%	73%	61%	72%	50%	68%	69%	52%	74%	62%	57%	70%	27%	76%	57%	54%	55%	37%	71%	42%	64%	52%	61%	24%
Collection efficiency-waste water service	%	24%	12%	9%	26%	35%	28%	40%	14%	23%	46%	23%	5%	31%		75%	4%		38%	13%		27%					
Benchmark (equal or greater than)	90%	●	●	●	●	●	●	●	●	●	●	●	●	●	◆	●	●	◆	●	●	◆	●	◆	◆	◆	◆	◆
Current status																										
Distance to frontier	%	66%	78%	81%	64%	55%	62%	50%	76%	67%	44%	67%	85%	59%	90%	15%	86%	90%	52%	77%	90%	63%	90%	90%	90%	71%	19%
Working ratio (Efficiency Ratio) -	No.	1.21	0.73	0.92	1.85	1.37	2.2	1.74	1.43	0.91	1.35	1.55	1.39	1.14	2.44	1.37	1.86	2.06	1.28	0.85	3.43	2.79	1.69	0.89	1.34	0.96

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TABLE 2 *Continued from the previous page*

(KPIS)	Unit	Nusairat	Jabalia al Nazla	Khan Younis	Gaza city	CMWU -Rafah	Dair al Balah
		Large Service Provider					
water & wastewater service							
Benchmark (equal or less than) / Current status	1	●	●	◆	●	●	●
Distance to frontier	%	-21%	27%	8%	-85%	-37%	-120%
Liquidity ratio (current ratio)	No.	1.1	2.3	1.2	1.5	1.5	2.2
Benchmark (equal or greater than) / Current status	1	▲	▲	▲	▲	▲	▲
Distance to frontier	%	-7%	-132%	-18%	-51%	-45%	-122%
Cash ratio	No.	0	0	0	0	0	0
Benchmark (equal or greater than) / Current status	1	●	●	●	●	●	●
Distance to frontier	%	100%	100%	100%	97%	99%	99%
Operating costs per m3 of wastewater	NIS	0.73	1.02	1.76	0.85	1.31	2.33
Benchmark (equal or less than fees per m3 of wastewater collected & treated)		◆	◆	◆	◆	◆	◆
Quality Indicators							

(KPIS)	Unit	Beit Lahiya	Buraij	Zawaida	Qarara	Maghazi	Bani Suhaila	Beit Hanoun	Abasan Kabira
		Medium Service Provider							
water & wastewater service									
Benchmark (equal or less than) / Current status	1	●	●	◆	●	●	●	●	●
Distance to frontier	%	-74%	-43%	9%	-35%	-55%	-39%	-14%	-144%
Liquidity ratio (current ratio)	No.	1.93	1.2	1.7	0.6	1.4	0.8	0.7	0.5
Benchmark (equal or greater than) / Current status	1	▲	▲	▲	●	▲	●	●	●
Distance to frontier	%	-93%	-24%	-70%	40%	-43%	20%	27%	54%
Cash ratio	No.	0	0	0	0	0	0	0	0
Benchmark (equal or greater than) / Current status	1	●	●	●	●	●	●	●	●
Distance to frontier	%	100%	99%	100%	100%	100%	100%	97%	100%
Operating costs per m3 of wastewater	NIS	1.1	1.25	0.92	0.36	1.31	1.14	1.22	0
Benchmark (equal or less than fees per m3 of wastewater collected & treated)		◆	◆	◆	◆	◆	◆	◆	◆
Quality Indicators									

(KPIS)	Unit	Zahra	Shuka	Fukhary	Musaddar	Mughraga	Nasser	Um Ennaser	Khuza' a	Abasan Jadida	Wadi as Salga	Wadi Gaza
		Small Service provider										
water & wastewater service												
Benchmark (equal or less than) / Current status	1	●	●	●	●	◆	●	●	●	◆	●	◆
Distance to frontier	%	-37%	-86%	-106%	-28%	15%	-243%	-179%	-69%	11%	-34%	4%
Liquidity ratio (current ratio)	No.	6.6	2.5	1.3	1.3	2.6	4.6	1.1	4.3	0.5	3	5.8
Benchmark (equal or greater than) / Current status	1	▲	▲	▲	▲	▲	▲	▲	▲	●	▲	▲
Distance to frontier	%	-558%	-152%	-26%	-32%	-164%	-364%	-13%	-329%	52%	-202%	-482%
Cash ratio	No.	2.1	0	0	0	0	0.1	0	0	0	0	0.2
Benchmark (equal or greater than) / Current status	1	▲	●	●	●	●	●	●	●	●	●	●
Distance to frontier	%	-114%	100%	99%	100%	100%	95%	100%	99%	100%	99%	83%
Operating costs per m3 of wastewater	NIS	1.4	1.17	0	1.46	1.23	0	1.86	0	0	0.35	1.42
Benchmark (equal or less than fees per m3 of wastewater collected & treated)		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Quality Indicators												

Continued on the next page

TABLE 2 *Continued from the previous page*

Water samples (taken from network including mains) containing free chlorine residual (RC)	Benchmark (equal to or more than 95% of samples contain free chlorine residual) – Current status	Distance to frontier	Water samples (taken at source) free from total coliform contamination	Benchmark (equal to or more than 95% of samples free of total coliform) – Current status	Distance to frontier	Water samples (taken at source) free from faecal coliform contamination	Benchmark (equal to or more than 95% of samples free of faecal coliform) – Current status	Distance to frontier	Microbiological tests carried out	Benchmark (WHO standard, relevant to number of water sources and population)
%	95%	%	%	95%	%	%	95%		%	N/A
100.00%	▲	-5%	100.00%	▲	-5%	100.00%	▲	-5%	49.80%	◆
100.00%	▲	-5%	100.00%	▲	-5%		◆	N/A	41.30%	◆
98.80%	▲	-4%	100.00%	▲	-5%	100.00%	▲	-5%	118.10%	◆
95.40%	▲	0%	88.00%	●	7%	90.40%	●	5%	117.40%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	54.00%	◆
100.00%	▲	-5%	70.60%	●	24%	88.20%	●	7%	155.60%	◆
80.80%	●	14%		◆	N/A		◆	N/A	0.00%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	70.20%	◆
100.00%	▲	-5%	100.00%	▲	-5%	100.00%	▲	-5%	303.60%	◆
98.40%	▲	-3%		◆	N/A		◆	N/A	0.00%	◆
100.00%	▲	-5%	83.30%	●	12%	100.00%	▲	-5%	84.40%	◆
100.00%	▲	-5%	100.00%	▲	-5%	97.60%	▲	-3%	168.30%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	0.00%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	0.00%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	230.80%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	0.00%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	0.00%	◆
98.60%	▲	-4%		◆	N/A		◆	N/A	41.70%	◆
100.00%	▲	-5%	0.00%	◆	N/A		◆	N/A	47.60%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	0.00%	◆
96.50%	▲	-2%		◆	N/A		◆	N/A	0.00%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	0.00%	◆
100.00%	▲	-5%		◆	N/A		◆	N/A	0.00%	◆
98.60%	▲	-4%		◆	N/A		◆	N/A	50.00%	◆
98.60%	▲	-4%		◆	N/A		◆	N/A	33.30%	◆

Continued on the next page

TABLE 2 *Continued from the previous page*

(KPIS)	Unit	Large Service Provider								Medium Service Provider										Small Service provider									
CUSTOMER SATISFACTION		Nusairat	Jabalia al Nazla	Khan Younis	Gaza city	CMWU -Rafah	Dair al Balah			Beit Lahiya	Burayj	Zawaida	Qarara	Maghazi	Bani Suhaila	Beit Hanoun	Abasan Kabira			Zahra	Shuka	Fukhary	Musaddar	Mughraga	Nasser	Um Ennaser	Khuza' a	Abasan Jadida	Wadi as Salga	Wadi Gaza
Service Complaints per customer - water service	No.	0.13	0.04	0	0.04	0.36	0.08	0.02	0.01	0.05	0	0.03	0	0	0.46	1.28	0	0.08	0.01	0	0.78	0	0	0	0.08	0.03	0	0	0	0.14
Service Complaints per customer - wastewater service	No.	0.08	0.01	0	0	0.16	0.02	0.01	0.01	0.01	0	0	0	0	0.18	0.08		0.09	0.01	0	0.02	0	0	0		0.01				0.09
Continuity Complaints (%)	%	42%	8%		26%	28%	17%	17%	8%	33%		37%			41%	9%	40%	25%	38%		18.30%				23%	38%				25%
Water Quality Complaints (%)	%	4%	15%		7%	0%	8%	8%	15%	0%		5%			3%	1%	0%	14%	24%		0.00%				8%	24%				14%
Billing Complaints and Queries (%)	%	47%	46%		3%	45%	56%	56%	46%	44%		45%			50%	68%	60%	53%	24%		66.20%				54%	24%				53%
Other Complaints and Queries (%)	%	7%	31%		64%	27%	18%	18%	31%	22%		13%			6%	22%	0%	9%	14%		15.50%				15%	14%				9%
Benchmark	N/A																													

NOTES Based on data collected from SP's for 2019.

- There are distortions in the tariff structures of almost all service providers, where the average selling price per m^3 of water was less than the average unit cost of m^3 of water sold. This means that the financial situation of SPS is deteriorating with time.
- Levels of collection efficiency were very low, which resulted in a serious cash flow problem for the SPS' that has an immediate effect on the ability of SPS to meet short-term financial obligations including staff salaries, operation and maintenance needs and others, which jeopardizes the continuity and sustainability of services.
- The cash ratio for almost all SPS reaches zero or very close to zero, resulting in a serious inability of SPS to respond to their short-term financial obligations. The cash ratio confirms the conclusion about the indicator of low collection efficiency.
- There is a lack or absence of accurate or completed customer complaint, satisfaction and inquiry logs, which shows a serious gap in customer service and satisfaction planning and procedures.
- This is clearly reflected in customer commitment to payment of service bills and customer behaviour, which is reflected in high levels of illegal connections, which are a major part of NRW quantities.
- Most of the SPS do not provide the public with technical and financial information that clarifies the crisis in the water and wastewater services and real obstacles. The lack of information, and hence transparency, has made people less understanding of the problems facing the SPS and caused an increase in the level of complaints about non-stability of the services.

Cause/Effect Matrix

The cause-effect matrix illustrates the effect of technical, financial and administrative deficiencies on the sustainability of water and wastewater services. The cause-effect matrix shows the consequences of an inadequate level of water services represented in KPIS on quality of life, and the behaviour of population on short and medium ranges as 'sub-effects,' whereas effects on SDG 6 are concluded in the 'main effects.'

One of the main questions asked to officials of the 8 SPS that are serving more than 80% of the population of the GS is, 'Does the tariff reflect the National plans to achieve the SDG 6?' There were 5 negative answers and 2 'I don't know.' Moreover, the Palestinian Authority/Prime Minister's office created a national team to follow up the process of setting the

TABLE 3 Cause/Effect Matrix

		Cause		Effect	
		Indicator	Details	Sub-effects	Main effects
Technical Indicators	1	Low average daily water sold per capita based on total population served	Insufficient water supply for homes, public services, and private sector businesses. Intermittent supply of unscheduled or disturbed schedule of supply.	Deterioration of public services such as health, education and social services. Commercial businesses will tend to look for alternative sustainable and reliable water supplies such as digging private wells, or purchase water from private vendors. Lack of confidence in service providers.	Waste of economic resources of businesses and Municipalities. Threat to sustainability of service provision. Not reaching SDG 6.
	2	High NRW by volume	SPS abstract larger quantities of water than they actually bill. Extra operation costs carried out by service providers. Unbilled consumption of some public and municipal buildings. No calibration or maintenance for customers and bulk production meters.	Some customers do not receive their share of water. Loss of natural resources (water). Loss of revenue for the service provider. Higher costs of operation.	Deterioration of service levels. Financial hardships to service provider. Higher levels of vandalism to network. Threat to sustainability of service provision. Not reaching SDG 6.
Financial Indicators	3	Average selling price per m^3 of water not covering operational cost	If less than average unit operating cost, service provider's revenues are not sufficient to cover operating costs. Inadequate tariff setting process.	Service provider faces financial difficulties. Less funds allocated for maintenance.	Continuous deterioration in service provider's strategic assets. Establishment reaches bankruptcy. Threat to sustainability of service provision. Not reaching SDG 6.
	4	High operating costs per m^3 of water sold	Bad or inadequate maintenance raises cost. Absence of standard operating procedures. Unjustified administrative costs. High energy cost.	Loss of internal resources. Loss of financial resources. Deterioration in level of service. Accumulation of debts to external vendors (example: electricity company).	Deteriorated level of service. Sustainability of services is doubtful. Not reaching SDG 6.
	5	Low collection efficiency – water service	Low collection rates of water charges. Inadequate treatment of old debts. Inadequate customer service. Inadequate public awareness about service provider's activities.	SPS suffer from cash crisis in general. Less funds available for operation and maintenance of water plants. Deterioration in the condition of water assets. Salaries for water service staff not paid.	Deteriorated level of service. Sustainability of services is doubtful. Not reaching SDG 6.

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necessary plans and propose regulations to achieve the UN 17th SDGS.

The Palestine State Audit and Administrative Control Bureau con-

TABLE 3 *Continued from the previous page*

	Cause		Effect	
	Indicator	Details	Sub-effects	Main effects
6	Collection efficiency – waste water service	Low collection rates of wastewater fees. Inadequate treatment of old debts. Inadequate customer service.	Less funds available for operation and maintenance of wastewater plants. Deterioration in the condition of wastewater assets. Salaries for wastewater service staff not paid in full or on time.	Deteriorated level of service. Sustainability of services is doubtful. Not reaching SDG 6.
7	Greater than '1' working ratio (efficiency ratio) – water and wastewater service[1]	Inadequate operation schemes raise operation costs. Absence of preventive maintenance plan raises operation and post maintenance costs. Structural deficiency in tariff structure and business planning which negatively affect operating revenue.	Lack of funds for operation and maintenance of water and wastewater facilities. Deterioration in conditions of assets. Service provider faces financial hardship, requests loans with interest or waits for donations. No funds for future development and enhancement of level of service.	Continuous deterioration in service provider's strategic assets. Establishment reaches bankruptcy. Threat to sustainability of service provision. Not reaching SDG 6.
8	Smaller than '1' liquidity ratio (current ratio)[2]	Current assets are not sufficient to meet current liabilities. Most current assets are old debts with high doubts of collection. Current liabilities are related to operation and maintenance costs.	Mid-term and continuous cash crisis. Service provider has to reduce costs which affects level of service. Service provider faces legal law suits and negative consequences.	Continuous deterioration in service provider's strategic assets. Establishment reaches bankruptcy. Threat to sustainability of service provision. Not reaching SDG 6.
9	Smaller than '1' cash ratio[3]	Collection rates are very low. Absence of cash flow management plan. Current liabilities are increasing due to increase of operation costs. Tariff structures are not well planned.	Midterm and continuous cash crisis. Service provider has to reduce costs, which affects level of service. Service provider faces legal law suits and negative consequences.	Continuous deterioration in service provider's strategic assets. Establishment reaches bankruptcy. Threat to sustainability of service provision. Not reaching SDG 6.
10	High operating costs per m^3 of wastewater	Some cost items are very high. Absence of cost centres. Absence of SOP and preventive maintenance.	Shortage in spare parts and maintenance items. Deterioration in wastewater collection network and overflows. Incomplete or non-treated wastewater pumped directly to sea or in open lagoons. Increase of health hazards related to wastewater pollution.	Deteriorated level of service. Sustainability of services is doubtful. Not reaching SDG 6.

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ducted a review of the Palestinian government's preparedness to implement the 17th SDGS by 2030. The audit took place in 2017 and the report entitled 'Review of the Palestinian Government Preparedness for the Sus-

TABLE 3 *Continued from the previous page*

		Cause		Effect	
	Indicator	Details		Sub-effects	Main effects
Quality Indicators	11 Less than 95% positive results of water samples (taken from network incl. mains) containing free chlorine residual (RC)	Presence of residual chlorine sampling & monitoring programme.		If successful, low health hazards, contamination. Fewer customer complaints. Higher confidence in supply system. More appreciation for role of service provider and increase of willingness to pay bills.	If no compliance, serious water borne diseases and community disturbance. Potential law suits and administrative crisis and extra cost. Deterioration in level of service. Sustainability of services is doubtful. Not reaching SDG 6.
	12 Less than 95% positive results of water samples (taken at source) free from total coliform contamination	Absence of comprehensive microbiological sampling and monitoring programme.		Higher health hazards to public. High risk of contaminated sources. Higher maintenance cost. Less customer confidence. Loss of revenue due to less willingness to pay.	If no compliance, serious water-borne diseases and community disturbance. Potential law suits and administrative crisis and extra cost. Deterioration in level of service. Sustainability of services is doubtful. Not reaching SDG 6.
	13 Less than 95% positive results of water samples (taken at source) free from faecal coliform contamination.	Absence of comprehensive microbiological sampling and monitoring programme.		Higher health hazards to public. High risk of contaminated sources. Higher maintenance cost. Less customer confidence. Loss of revenue due to less willingness to pay.	If no compliance, serious water borne diseases and community disturbance. Potential law suits and administrative crisis and extra cost. Deterioration in level of service. Sustainability of services is doubtful. Not reaching SDG 6.
Customer Satis. Indic.	14 Absence of data of service complaints per customer.	Absence of integrated customer service/follow up system. Absence of strict benchmarks for complaints response time. Absence of complaints internal quality control scheme.		Increased levels of illegal connections. Loss of confidence in service provider's system. Higher levels of vandalism to public network. Less tendency to pay bills.	Deterioration of service levels. Financial hardships to service provider. Higher levels of vandalism to network. Threat to sustainability of service provision. Not reaching SDG 6.

NOTES Based on SP's data analysis for 2019. [1] Total Operation & Maintenance (O&M) and administrative costs (excluding depreciation)/total operating revenues from water and wastewater. [2] Current assets/current Liabilities. [3] Cash and cash equivalents/current liabilities.

tainable Development Goals' was released in June 2018, prior to Palestine's presentation of its first Voluntary National Review (VNR) during the July 2018 session of the UN High-level Political Forum on Sustainable Development (HLPF).

The report highlighted the formation of a national team to coordinate

and follow up on SDG implementation, and to check on the inclusion of the SDGS in Palestine national policy agenda. When the audit was conducted, the national policy agenda did not include specific information about the financial means necessary to implement the SDGS. Nevertheless, the audit found a 'strong' SDG commitment from the Palestinian government and noted the creation of 17 working groups composed of governmental and non-governmental entities, one for each SDG. The report also highlighted the lack of communication channels between the government and civil society regarding the SDGS, and a lack of effort from the Palestinian government to raise public awareness of the Goals and disseminate necessary information; due to the absence of a national programme to communicate the Goals through different communication tools (State Audit and Administrative Control Bureau – Palestine 2018).

The continuity and sustainability of water and wastewater operations are at risk of collapse. There were no references to SDG 6 in the 'National Water Sector Strategic Plan and Action Plan' (SDP) (2017–2022) nor to the Millennium Development Goals (MDGS). Furthermore, the report on the 'Review of the Palestinian Government Preparedness for the Sustainable Development Goals' was entirely prepared in and within the context of West Bank, but no reference was made to SDGS or SDG 6 status in the GS. To bridge the gaps between the different stakeholders in the water sector concerning the achievement of SDG 6 and other SDGS, a new radical law should be created to legalize and put in mandatory perspective the sustainable development goals as a fundamental part of the strategic planning and projects design, rather than to keep it as occasional committees or temporary efforts that have no legal jurisdiction, nor the necessary tools for continuous follow up and measurement of achievement.

The efforts of local, regional, and international regulatory and standardization organizations should be integrated in a centralized global body for optimization of resources and maximization of output.

Recommendations

Based on numerical findings, data and cause effect analysis, the researchers have developed two sets of recommendations, one to improve the technical and financial dimensions in terms of the key performance indicators related to them, and a second to improve the administrative dimension and related features.

Table 4 shows the first set, which includes recommendations to im-

TABLE 4 Recommendations to Improve Technical and Financial Dimensions

	Indicator	Improving operations/performance	Improving data reporting/records
1	Average daily water sold per capita based on total population served	Modernize meter reading methods. Categorization of subscriptions. Reducing NRW. Implement meter maintenance and calibration programme.	Installing meter for every subscription. Separation of water sales per customer category. Checking customers' meters on regular basis. Update customer registers. Regular and periodic meter readings.
2	Non-Revenue Water by volume	Installing meters for all customers. Installing bulk meters for all wells and bulk sources. Design and implement an ongoing programme to eliminate illegal connections. Design and implement a continuous programme for leak detections on water network and repair. Design and implement a comprehensive public awareness and education programme to show negative effects of illegal connections, legal and ethical consequences.	Update customer meter reading registry. Make real readings and avoid as much as possible estimated readings. Continuous sampling and checking of readings. Holding accurate and updated records for public/governmental and municipal building consumptions and issue bills.
3	Average selling price per m^3 of water	Accurate categorization of customer groups to separate pricing block and increase selling price for higher consumption customers. Redesign tariff structure and increase consumption blocks.	Update customer activity/category details. Periodic check on customer details registry. Eliminate estimated meter readings.
4	Operating costs per m^3 of water sold	Install meters for all customers including public and municipal buildings. Design and implement preventive maintenance programme to reduce maintenance costs. Design and implement power optimization/conservation programme to reduce electricity/power costs. Design and implement leak detection and repair plan to reduce NRW, and cost of pumping extra quantities of water.	Creating cost canters in accountancy books. Separating cost items. Requesting services of external auditing. Implementing a computerized inventory system. Holding accurate invoices for purchased water from external sources.
5	Collection efficiency-water service	Activate legal measures against big consumers with considerable outstanding debts to service providers. Coordinate with other governmental entities to request water bill clearance from customers for different public services. Encourage/make mandatory for non-domestic customer to have pre-paid water meters. Design and implement public awareness/education programme to raise customer's willingness to pay.	Audit and review customers' invoices. Review meter reading logs. Record all customer payments and partial payments against receipts.

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prove the operational/performance level of the technical and financial dimensions/aspects and improve the level of data reporting and records which are essential to measure the key performance indicators and hence level of improvement to achieve SDG 6 and its targets.

TABLE 4 *Continued from the previous page*

	Indicator	Improving operations/performance	Improving data reporting/records
6	Water samples (taken from network including mains) containing free chlorine residual (RC)	Activate an electronic platform to enable stakeholders working in water sector to record testing results they make. Link the chlorination system with Supervisory control and data acquisition (SCADA) control system to enable full monitoring & intervention 24/7. Design and implement a programme for dealing with contaminations at very short notice.	Keep accurate and computerized records of testing results and their details. Apply local and international standards in keeping testing records. Conduct periodic and comprehensive calibration for testing equipment both used in field or at laboratory. Implement real-time reporting and data recording system.
7	Service Complaints per customer – water service Service Complaints per customer – wastewater service Continuity Complaints (%) Water Quality Complaints (%) Billing Complaints and Queries (%) Other Complaints and Queries (%)	SPS should register all customer complaints & inquiries. Implement customer service/tracking system. SPS should allow computerized web-based customer interactions platform. Assign Free call numbers for call canters and emergency response. Design and implement customer/public awareness – education programme. Develop a modern customer charter to clarify contractual relationship with customer, rights and obligations of each party.	Update customer service records and data. Update customer service complaint records. Categorization of complaints & inquiries. Implement computerized and secured customer complaint/tracking system. Conduct periodic check/review on sample inquires and complaints.

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