التعاون الألماني
DEUTSCHE ZUSAMMENARBEIT

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Resilience - Oriented Indicators Overview

Yemen Water Sector Performance Indicators

of The Water and Sanitation Local Corporations in
Aden, Sana'a, Ibb, Taiz, Hodeidah, Dhamar, Mukalla and Seyoun

1st Quarter

January – March 2021

Contents

List of Abbreviation

BOD	Biological Oxygen Demand
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GIZ-IDWS	GIZ project 'Institutional Development of the Water Sector'
LCs	Water Supply and Sanitation Local Corporations
MWE	Ministry of Water and Environment
NWRA	National Water Resource Authority
PDA	Personal Digital Assistant
WASH	Water, Sanitation and Hygiene
WWTPs	Wastewater Treatment Plant

1 Overview

The urban population in Yemen is supplied with drinking water through multiple water supply systems. Most systems are public and managed through the Water and Sanitation Local Corporations (LCs) and their affiliated Water Utilities (WUs) and branch offices. Other systems are private, like water tanker suppliers. Sewerage networks are available and cover only a certain percentage of the population. All LCs differ significantly in terms of size, organizational setup, and operating environments. However, they all share one major challenge—that is, expanding access to appropriate levels of services to their growing urban populations.

Since 2015, the situation in Yemen has been drastically exacerbated by the conflict and its repercussions. As a result, , the LCs are operating under different institutional, administrative, operational, and financial conditions. They encounter several challenges in securing an enabling environment for service quality improvement, cost recovery, and financial sustainability. In addition, network rehabilitation and extension projects funded by the government and/or donor organizations have been suspended or completely terminated due to the protracted crisis.

Given the significant impact of water and wastewater services on the population's life and public health, ensuring financial sustainability and good service quality is crucial. Hence, the LCs ability to provide acceptable services depends on a range of factors, such as adequate infrastructure, access to energy and consumables, qualified personnel, and efficient financial and performance-oriented management. Likewise, the current situation confirms that conflict and fragility can be extremely disruptive to these interrelated elements and that the quality of service delivery could be degraded to a point of no return or perpetuate a ´vicious cycle´ of managerial, financial, and operational deficiencies, which, in due course, leads to customers' dissatisfaction with the services they receive, and low revenue collection due to their unwillingness to pay for those services, which, sooner or later, undermines the resilience of the service delivery and providers.

One of the utmost consequences of poor sanitation and low access to clean drinking water have had catastrophic hygiene and health effects by forcing most of the urban population to rely on unsecured alternative water supplies, making them susceptible to water-borne diseases. The outbreak of cholera, on the other hand, has placed a burden on the social responsibility and mandate of the LCs. Yemen also reported its first case of COVID-19 in April 2020, and the severity of the current response to COVID-19 posed grave detrimental impacts on WASH service provision and sustainability, which are vital to disease prevention and core to survival and protection. To confront and mitigate further severity of pandemics, the Yemen WASH Cluster and the other humanitarian societies have mobilized all possible resources to support the resilience of the LCs with urgent operational measures to secure the continuity of safe drinking water supply and wastewater treatment.

Improving the performance of LCs is challenging because the problems they face are multidimensional. Problems associated with dysfunctional and intricate business processes cannot be overcome solely by short-term emergency measures. Achieving resilient and sustained service delivery requires a framework that integrates institutional measures with short/mid/long-term investments to shift from crisis management to strategic and performance improvement planning.

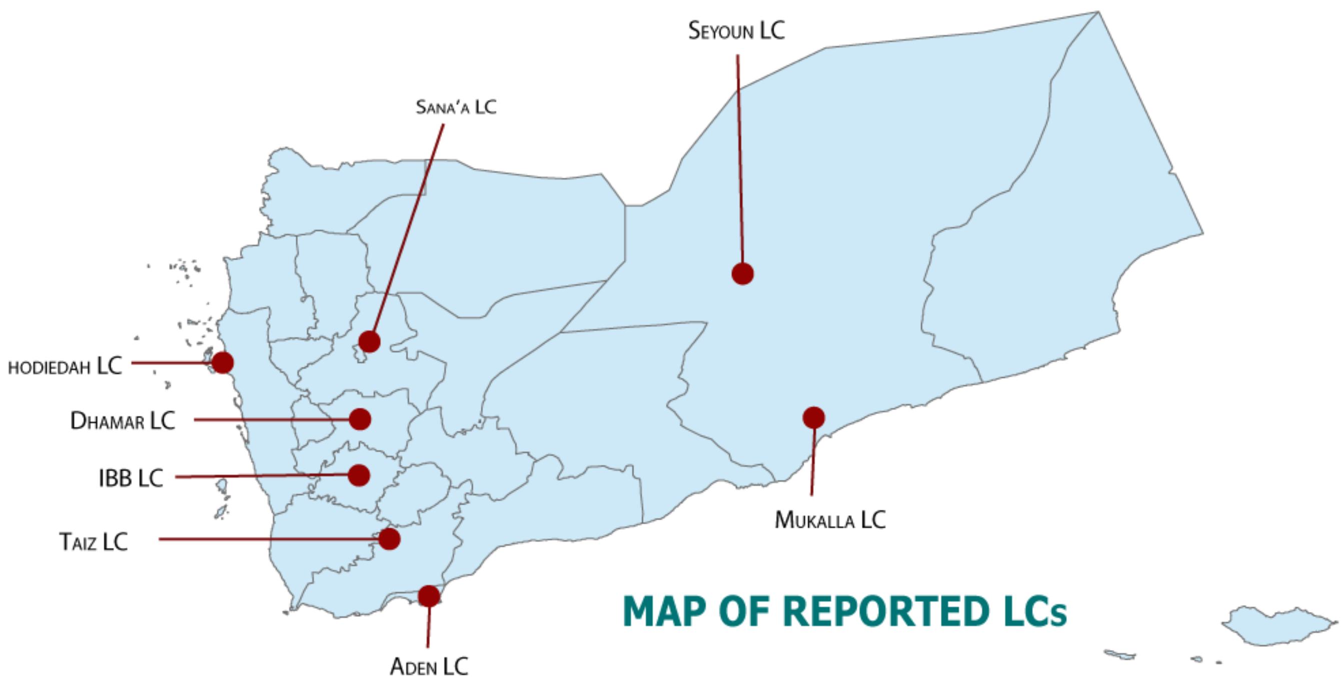
2 Performance Monitoring Methodology

Since the conflict broke out in late March 2015, the Ministry of Water and Environment (MWE) with the assistance of the GIZ Water Sector Program (GIZ-IDWS), has initiated a quarterly-basis performance monitoring reports of 5 selected LCs serving in metropolitan cities of Sana'a, Aden, Taiz, Hodeidah and Ibb, including three additional LCs (Mukalla, Seyoun, and Dhamar) that have been recently included in the monitoring process as of 2021.

These reports are based on performance indicators (PIs) that are commonly used for the urban water sector to assess the systems in terms of efficiency and effectiveness and are oriented on the guidelines of the `Performance Indicators for Water Supply Services - Manual of Best Practice Series` of the International Water Association (IWA). The conceptual structure of the monitoring is divided into four indicator groups: Quality of service, technical, operational, and financial performance.

In view of the given conflict situation in Yemen, 23 indicators were selected that allow a cross-comparison between the LCs according to the availability of data. In addition, further reviews were integrated in 2019, summing up from 23 to 39 resilience-oriented PIs adapted to fit with the contextual situation, and monitoring purposes and constitute a valuable reference for the evaluation of performance and the impact of relevant sector interventions.

This report covers the period from January to March 2021, together with a brief technical analysis of key indicators on different indicator groups of performance of each reported LC. The reporting exercise should not be perceived only as unilateral monitoring by GIZ-IDWS. The process was carried out with data submitted and signed by the LCs' management through appointed focal points. Many clarifications were sought on the data provided, especially for consistency and reliability of data and indicators. In some instances, estimates were given by the LCs in the absence or lack of systematic information. Nevertheless, the GIZ-IDWS team made every effort to improve data quality by validation, analysis, and subsequently, reviewing the results, if necessary, with the LCs for further quality assurance; thus, the data finally presented is the best that could be obtained in the circumstances. The data variables obtained after this quality review and used to determine the PIs can be viewed in the table in the *Annex 1 Resilience Emergency Indicators Sheet.*



3 Emergency Water Sector Performance Indicators

A broad range of indicators was selected on the basis of their usefulness in capturing resilience performance differences in the key priority themes of the urban water sector. However, it was necessary to translate them into corresponding performance categories and indicators as shown below:

a. Service Coverage, Service Levels and Quality - Piped Water Supply

1. Total population in service area (capita)
2. Number of IDPs in service area (capita)
3. Number of water connections (No.)
4. Number of population served through water supply network (capita)
5. Water supply service coverage = population served through water supply network vs total population in service area (%)
6. Number of service days of piped water supply per month (day/month)
7. Number of residual chlorine samples taken (No./month)
8. Number of residual chlorine samples according to standards (No./month)
9. Proportion of bacteriological quality samples of distributed water according to standards = Number of residual chlorine samples according to standards per total number of samples taken (%)

b. Service Coverage and Quality - Sewerage

10. Number of population served with sewerage connections (capita)
11. Number of sewerage connections (No.)
12. Sewerage connection coverage = population served through sewerage network vs total population in service area (%)
13. Number of BOD-samples of effluent of WWTP taken per month (No./month)
14. Number of BOD-samples of effluent of WWTP according to standards per month (No./month)
15. Proportion of effluent quality samples of wastewater treatment plants according to standards = Number of BOD samples according to standards per total number of samples taken (%)
16. Average BOD value of raw influent at WWTP (mg BOD_5/l)
17. Average BOD value of treated effluent at WWTP (mg BOD_5/l)
18. Treatment efficiency of WWTP regarding BOD (%)

c. Production and consumption

19. Total quantity of water produced (m^3/month)
20. Per capita quantity of water produced (l/cap/day)
21. Storage capacity (m^3)
22. Storage capacity share per capita (l/cap)
23. Energy costs per m^3 water produced (YER/m^3)
24. Effluent produced (m^3/month)
25. Effluent produced (l/cap/day)
26. Effluent treated in wastewater treatment plant (m^3/month)

d. Performance of Pumps and Generators

27. Total number of main pumps for the water supply system (No.)
28. Number of functional pumps in service (No.)
29. Number of working hours of all operating pumps of the water supply system (h/month)
30. Number of main functional pumps failures due to technical reasons (No./month)
31. Number of working generators in the operation of pumps (No.)
32. Number of working hours of all operating generators used to run the functional pumps of the water supply system (h/month)

e. Financial Sustainability

33. Total collected operational revenues (YER/month)
34. Total billed operational revenues (YER/month)
35. Total operational costs (YER/month)
36. Collection efficiency = Collected revenues vs. Billed revenues (%)
37. Actual operational cost coverage (%)
38. Monthly governmental subsidies (YER/month)
39. Percentage of basic monthly salaries paid (%)

4 Technical Analysis

a. Service Coverage, Service Levels and Quality - Piped Water Supply

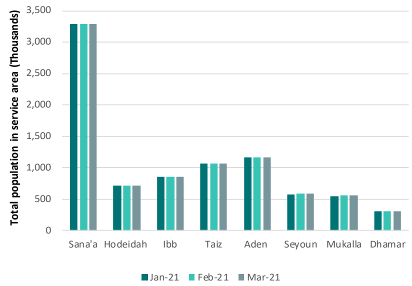
Water supply service coverage

The service coverage (%) indicator aims to demonstrate the physical water accessibility of the resident population that are connected to the distribution system, expressed as a percentage of the total population in the served area. Its evaluation usually depends on whether the population data are up-to-date and accurate, therefore the estimation is relatively easy if the LC has a good record of customers. However, it must be stressed that this procedure is accompanied by high uncertainties. Since accurate records of connections (e.g., household, commercial, industrial) to the water system typically transform into inhabitants using average household dimension. This is particularly problematic in regions with significant fluctuations of population or a lack of data availability.

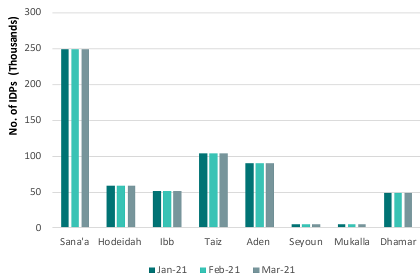
Water supply service coverage (Figure 5) varies from LC to LC given the urban expansion accompanied by rapid population growth and high urbanization growth rate (3.9%, 2021, World Bank), making it difficult for LCs to maintain adequate service coverage. In the service area of the 8 reported LCs, an average of 54% of the total urban population is connected to the public water supply system. With an 84% average coverage rate, the LC of Aden tops the list, followed by Mukalla, which serves 72% of the residents. The other LCs serve 60-68% of the residents, namely, Ibb (60%), Dhamar (63%), Hodeidah (68%), and Seyoun (68%). Sana'a is with 33% the area with the lowest coverage, whereas Taiz LC reported 53% and claims to serve households other than those registered customers. It is also interesting to look at the total population in the LCs (Figure 1). Although Sana'a has the lowest service coverage, it is home to by far the largest number of people. Moreover, the three LCs with the lowest service coverage rates are also those with the highest average number of residents per household, Ibb (15 persons/household), Sana'a (12 persons/household), and Taiz (10.5 persons/ household). Which means that an increase in connection rates has an exponential impact on the number of people with water access.

The massive influx of internally displaced persons (IDPs; Figure 2) seeking safe areas and shelters in recent years has exacerbated the burden on the LCs to adequately comply with both humanitarian aid efforts and residents' pressing water demands. This is one of the reasons why the coverage figures derived must be seen not as representative but as an orientation, since exact data on the number of inhabitants cannot always be collected. For LCs without data, estimates were made based on values from previous years, considering average population growth. Efforts made by other actors to address service coverage gaps have centered on urgent operation and maintenance (O&M) supplies, with little attention given to rehabilitation or building new infrastructure. However, estimates of finance requirements for water and sanitation expansion point to large funding gaps, and the economic returns appear unattractive for private sector investments. Meanwhile, this encouraged the business of other service providers (such as water trucks) to flourish in tandem or the form of substitutes for the LCs.

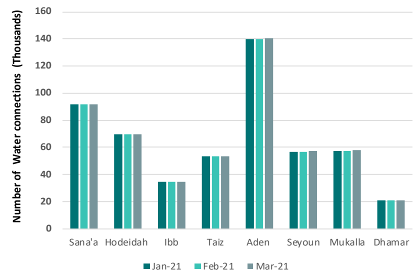
1. Total population in service area (capita)



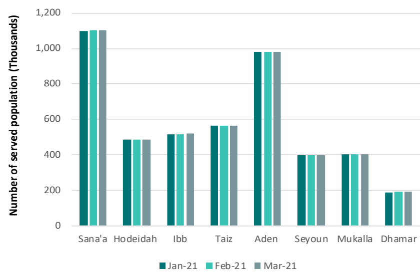
2. Number of IDPs in service area (capita)[1]



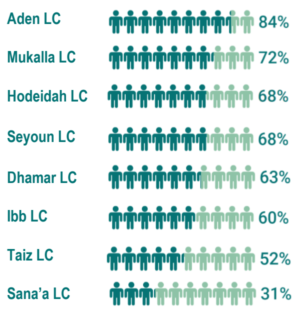
3. Number of water connections (No.)



4. Number of population served through water supply network (capita)



5. Water supply service coverage (%)



1. Yemen HNO population dataset, 2021 (https://data.humdata.org/dataset/yemen)

Number of service days of piped water supply

The scarcity of water resources in some areas is one of the reasons water supply susceptible to poorly fulfilling the pressing demands of the served customers. LCs of Sana'a and Taiz, hereby, have the lowest water supply frequency maintained on average at approximately 2-3 times a month. Despite the significant drop in the water source levels and supply, both LCs of Ibb and Dhamar have been struggling to optimize the services with an average of 8 days per month or at an average rate of two days per week across all served areas. The best performance in terms of supply duration compared to others belongs to the LCs of Aden, Seyoun, and Hodeidah, with an average supply of more than 25 days per month.

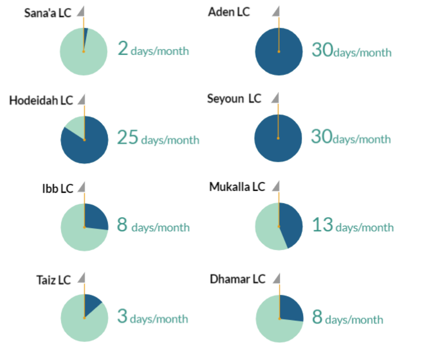
Customers served by intermittent systems are generally not satisfied with the amount of water they receive. Consequently, they try to maximize the amount they draw from the system during supply periods. The amount customers are able to collect depends on their localized pressure conditions. This puts those who are located far away from the main pipelines or at higher altitudes in the service area at a disadvantage. Customers collect and store water when the supply is on to meet their demand through the off-hours. When the supply cycle is short, the majority of customers pursue to draw their entire water demand within this very short period. This results in larger than expected flows in the pipes, causing high pressure losses, which result in low pressures at customers' end connections.

To respond as best they can to satisfy their needs. Customers incur a range of so-called coping costs to deal with interrupted water supply. These costs can relate to the purchase of facilities such as additional tanks to store water, domestic pumps because of low pressures, or the need to purchase alternative water supplies (e.g., private sector). Since the poorest customers can least afford such facilities, they are likely to be disproportionately affected by poor access to the public network.

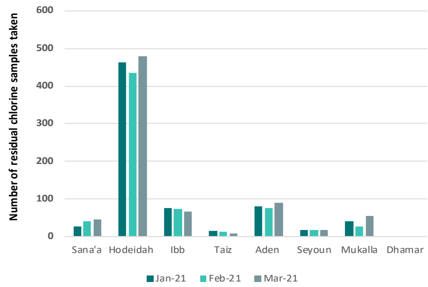
Bacteriological quality samples of distributed water

Alongside the obvious implications for water quantity, it brings concerns about water quality. In particular, interruption of water supply leads to zero pressure during non-supply periods, allowing contaminants to enter through broken or cracked pipes. These contaminants, which are in proximity to the water network, are the result of poor or inadequate sanitation and drainage, raising the prospect of contamination. Hence, the water supply sourced by the LCs has been identified as a suspicious causality of water-borne diseases if not treated, and the LCs were urged as preventive measures to carry out regular chlorination and tests for residual chlorine in the network to meet the required standards. Accordingly, most of the LCs have shown compliance with bacteriological quality standards of approximately 100% as of Sana'a, Hodeidah, Seyoun, and Aden, and an average of 90% for LCs of Ibb and Mukalla. Nonetheless, these results remain doubtful unless the specific procedures and availability of measuring equipment and resources are verified. As for other LCs, the water quality treatment facilities (laboratories and equipment) of Taiz LC were entirely demolished during the armed clashes in the city. Alternatively, the LC has managed to conduct water sample tests either in the labs owned by the National Authority of Water Resources (NWRA Taiz branch) or in Ibb LC. Surprisingly, Dhamar LC offered no data, suggesting that there is either a either a lack of facilities or routine measurement.

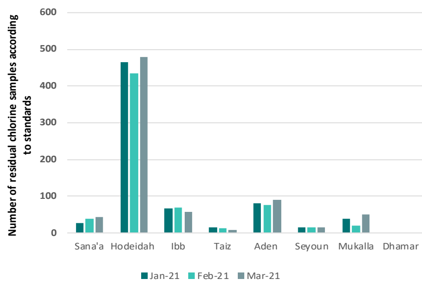
6. Number of service days of piped water supply per month (day/month)



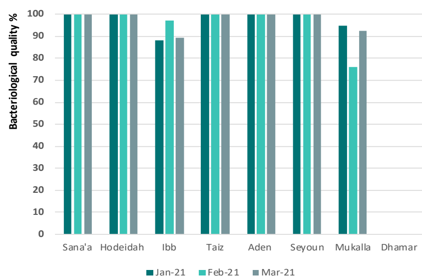
7. Number of residual chlorine samples taken (No./month)



8. Number of residual chlorine samples according to standards (No./month)



9. Proportion of bacteriological quality samples of distributed water according to standards = Number of residual chlorine samples according to standards per total number of samples taken %



b. Service Coverage and Quality - Sewerage

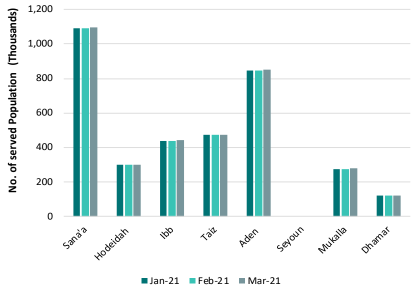
All the reported LCs (except for Seyoun) have conventional sewage systems, serving an average of 44% of the population. The remaining population discards their waste in privately owned cesspits, and it is filtered and absorbed by the soil or pumped out with vacuum trucks, either by the LC or by the private sector without the approved technical standards.

It is worth mentioning that none of the LCs are making any obvious attempts to increase the scale of sewerage coverage given high urbanization rates, lack of investment for sewer network expansion and infrastructure rehabilitation, etc. All are representing critical factors that constrain the LCs' ability to effectively collect, treat, dispose and/or reuse wastewater. It is also evident that the amount of sewage that is collected by some Wastewater Treatment Plants (WWTPs) is higher and beyond the design capacity. Therefore, WWTP failures effectively mean that sewage effluent is being discharged without proper treatment into open areas, waterways, and irrigation fields, constituting obvious health risks to residents and huge affected areas.

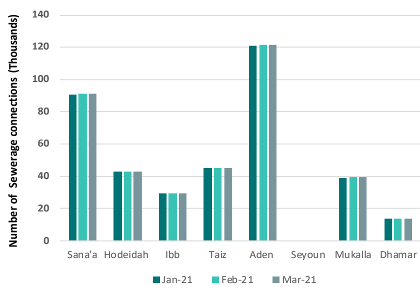
The surrounding poor conditions of insufficient power supply, lack of maintenance and the high volume of wastewater flows that have exceeded the capacity of the WWTPs have imposed poor quality of wastewater treatment to comply with the national standards. However, this report depends on the BOD_5 (a measure of organic pollution) of wastewater, since the majority of the WWTPs' laboratories are either not equipped or dysfunctional to measure all test parameters. Additionally, the increase in BOD_5 concentration is an evident implication of water scarcity and low production and supply frequency.

To demonstrate the wastewater treatment efficiency of the WWTPs using BOD_5, the samples tests according to standards by Sana'a WWTP are 100%, and the treatment efficiency of effluent is 55% on average. However, the BOD_5 concentrations in the incoming wastewater are higher (1,173 mg/l average) than the BOD_5 design load (500 mg/l). The average treatment efficiency of effluent by WWTPs of Hodeidah, Ibb and Dhamar is 79%, 66% and 87%, respectively, with an overall average of 80% of the BOD_5 samples according to standards. As for the WWTPs of Aden, Mukalla and Taiz, there have long been no tests for BOD_5 since the laboratories are damaged or out of operation (lacking the requisite equipment and materials).

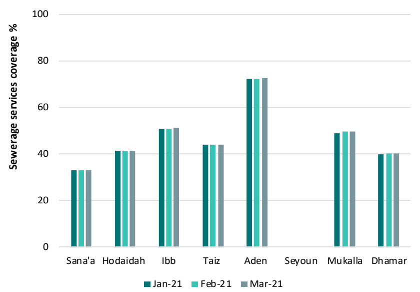
10. Number of population served with sewerage connections (capita)



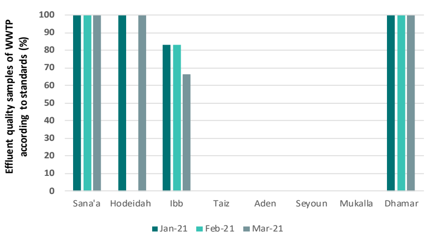
11. Number of sewerage connections (No.)



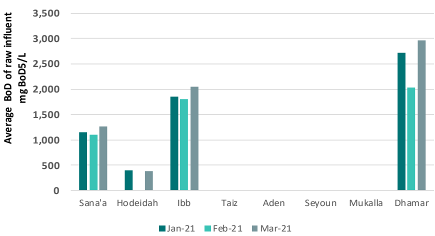
12. Sewerage connection coverage (%)



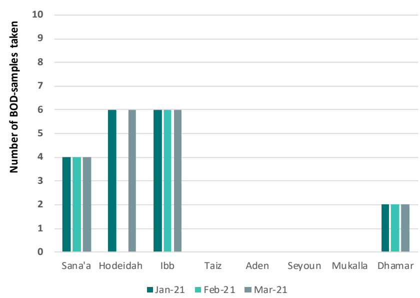
15. Proportion of effluent quality samples of wastewater treatment plants according to standards %



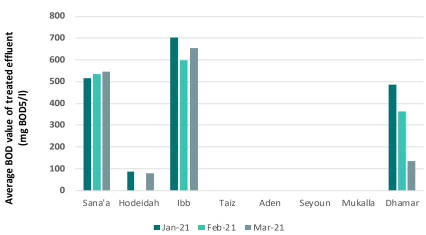
16. Average BOD value of raw influent at WWTP (mg BOD_5/l)



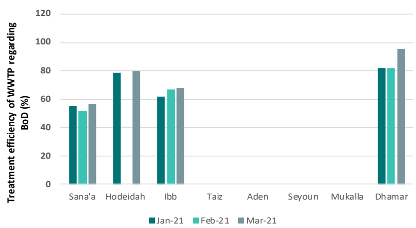
13. Number of BOD-samples of effluent of WWTP taken per month (No./month)



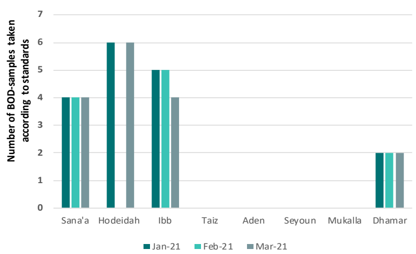
17. Average BOD value of treated effluent at WWTP (mg BOD_5/l)



18. Treatment efficiency of WWTP regarding BOD_5 (%)



14. Number of BOD-samples of effluent of WWTP according to standards per month (No./month)



c. Production and Consumption

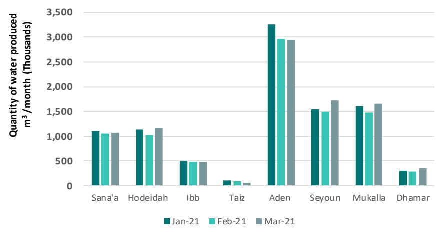
The production indicators have been used to measure the average daily share per person 'l/c/d' of the total water supplied for distribution. Therefore, the adequacy of demand management as well as the possibility of expanding coverage depends on the availability of sufficient water production capacity in the service area relative to the resident population.

As reported in this quarter, there are significant variations in the amount of water supplied by LCs, which ranges from a minimum of 7 to 132 l/c/d. In southern LCs (Aden, Seyoun, and Mukalla), the average daily share exceeds 120 l/d for each person connected in the service area.

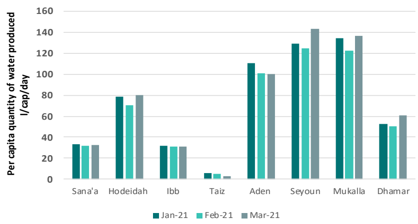
On the other end, the LCs of Hodeidah and Dhamar have the highest rates with an average of 76 and 55 l/c/d, respectively, while Sana'a and Ibb have the lowest at an average ~ 30 l/c/d, although the situation in Taiz is rather more alarming with an average of 7 l/c/d.

The storage capacity of functional reservoirs indicates sufficient shares per capita with an average of 111 l/cap in the LCs of Aden and Dhamar, including Taiz (with consideration of current supply capacity). Attention is required to Ibb LC, suffering from acute storage capacity, with 8 liters per capita per day. In this regard, the LCs must plan for the rehabilitation and/or expansion of the storage facilities to secure storage and production capacity, frequent demand for water supply, and the ability to respond effectively to urgent circumstances.

19. Total quantity of water produced (m³/ month)[2]



20. Per capita quantity of water produced (l/cap/day)[3]



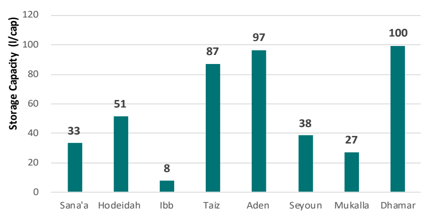
21. Storage capacity (m³)

Energy costs per m³ water produced[4]

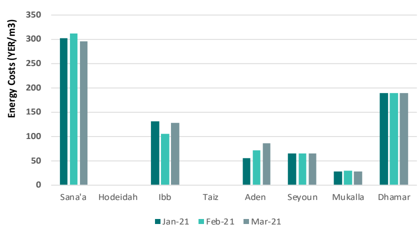
For a thorough assessment of cost coverage, the analysis of the energy costs in this report was based on distinguishing the actual costs incurred by the LCs from those subsidized by the humanitarian organizations. The LCs were, therefore, requested to split and report their energy cost accounts without computing the cost of subsidized fuel as operating costs. For instance, energy costs account for 0% of the total operating costs in the LCs of Taiz and Hodeidah LCs, since fuel is totally supplied and paid for via the UNICEF.

As a result of the fluctuant supply of fuel subsidies by the international community, several LCs have become largely self-reliant and are forced to shoulder more running costs in addition to other financial obligations. However, depending on the dynamic market prices of fuel in every region, some LCs have recorded substantial variations in energy costs per m³ of water produced, such as in Mukalla and Sana'a, with an average of 28 and 303 YER/m³, respectively.

22. Storage capacity share per capita (l/cap)



23. Energy costs per m³ water produced (YER/m³)



2. The water quantity represents the production, not the billed water.
3. The calculation of per capita share of the water produced is based on LCs figures. The water supply provided by the private sector and/or humanitarian agencies was not monitored by the LCs and hence was not calculated in this report.
4. 1 Euro € ≈ 703 YER
   1 US $ ≈ 575 YER (March, 2021)
   Source: InfoEuro (http://ec.europa.eu/budget/graphs/inforeuro.html)

Effluent treated in the WWTPs

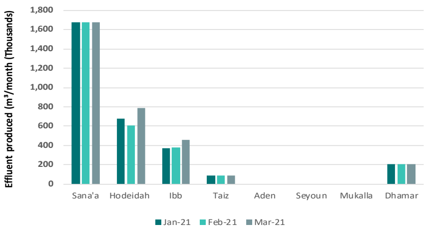
The treatment efficiency of generated effluent varies among the LCs and depends on the WWTP types and various stages of treatment for processing wastewater before disposal. Additionally, the available figures regarding the inflowing wastewater were estimated by the LCs since all the installed flow meters are either damaged or dysfunctional.

In this quarter, the WWTPs of Sana'a, Hodeidah, and Dhamar have processed almost 97% of the produced effluent with an average of 51, 77, and 56 l/cap/day, respectively. The design capacity (17,000 m3/day) of Taiz WWTP is underutilized and currently receiving only an average inflow of 3000 m3/day (56 l/cap/day effluent).

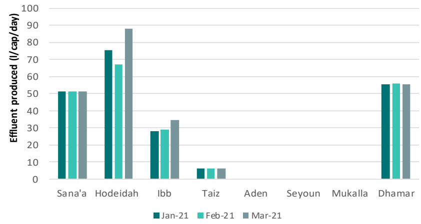
The existing capacity of Ibb WWTP is 5,300 m^3/day of sewage collection with an average effluent generation of 15,300 m^3/day, presenting about 60% overload and 64% efficiency of effluent treatment.

The WWTP labs of Aden and Mukalla LCs are out of service, causing the entire termination of regular measurement of treated wastewater and quality. Anyhow, mapping existing WWTP operations and particular processes is crucial to outline the current performance and identify the appropriate rehabilitation measures.

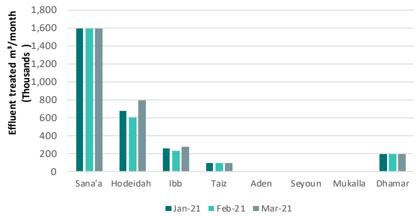
24. Effluent produced (m^3/month)



25. Effluent produced (l/cap/day)



26. Effluent treated in wastewater treatment plant (m^3/month)



#	WWTP	No. of WWTP	Nominal WWTP capacity m^3/day	Effluent produced m^3/day (Q1 2021)	Treatment system
1	Sana'a WWTP	2	50,500	56,000	Activated sludge
2	Ibb WWTP	1	5,300	13,361	Activated sludge
3	Hodeidah WWTP	1	54,000	22,978	Stabilization pond
4	Taiz WWTP	1	17,000	3,000	Oxidation pond
5	Aden WWTP	3	110,000	NA	Stabilization pond
6	Mukalla WWTP	1	15,000	NA	Bio-oxidation pond
7	Seyoun WWTP	Under Construction			
8	Dhamar WWTP	1	12,000	6,760	Stabilization pond

Treatment systems and capacity of the WWTPs

d. Performance of pumps and generators

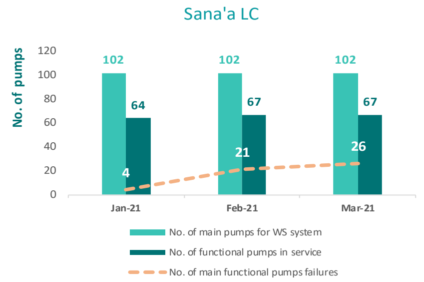
Most LCs have attempted with external fuel subsidies to overcome the power shortage by deploying additional electric generators to maintain the water supply. At the same time, full dependence on standby power has taxed excessive operating expenses beyond the LCs' financial capabilities. The solar water pumping system, on the other hand, has been a paradigm shift in recent years, successfully deployed in some areas to relieve stressful operational costs while generating questions about the future implications of renewable energy use on the local water resources.

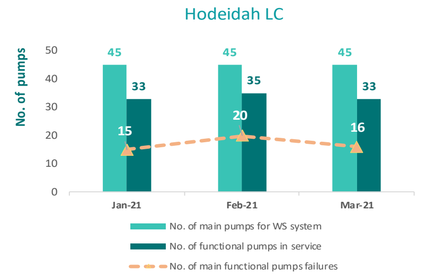
Due to a lack of maintenance and frequent pump failures, the majority of LCs were unable to sustain effective pumping operations. In general, the LCs of Ibb, Seyoun, Mukalla, and Dhamar have maintained over 80% of their main pumps, followed by the LCs of Sana'a, Hodeidah, and Aden with an average ranging from 65 to 75%. Taiz LC was unable to considerably improve water production by running just 34% of the main pumps owing to the safe access and other operational constraints.

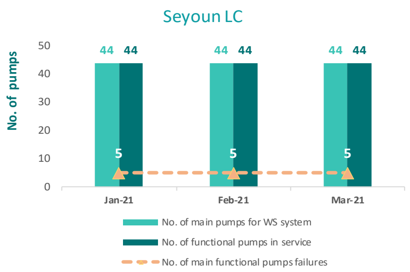
27.Total number of main pumps for the water supply system (No.)[5]

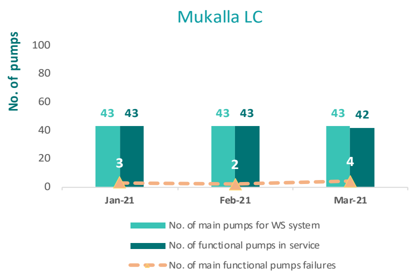
28. Number of functional water pumps in service (No.)

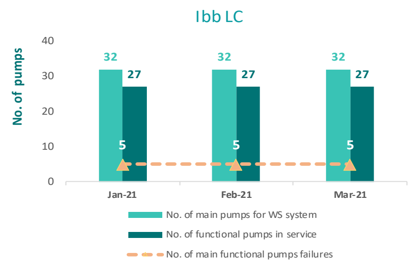
29. Number of main functional pump failures due to technical reasons (No./month)

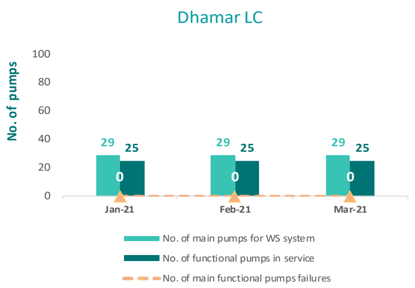


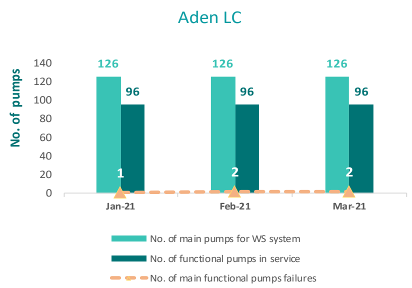


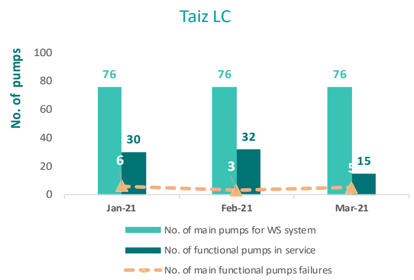




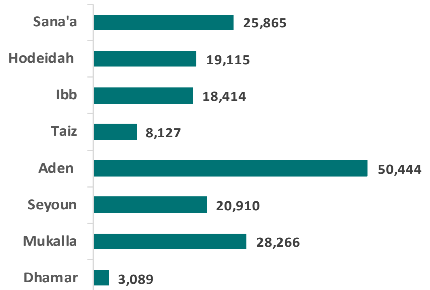




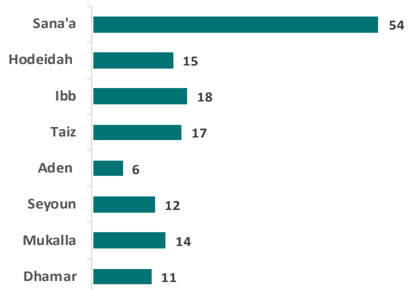




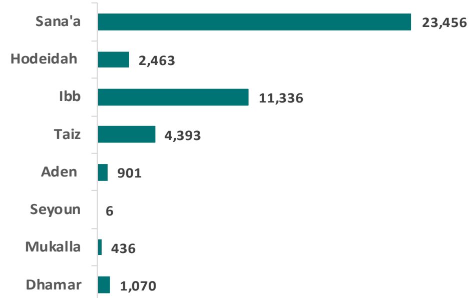
30. Number of working hours of all operating pumps of the water supply system (h/month)



31. Number of working generators in the operation of pumps (No.)



32. Number of working hours of all operating generators (h/month)



5. The number of pumps represent the pumps in well fields and pumping stations.

e. Financial Viability

The LCs are typically aware of the distinctions between billing the customers and getting paid. Most of the blame for poor collection efficiency goes to the customers, but the LCs also have responsibility for inadequate services, delayed or incorrect billings, poor customer relation, and belated efforts to collect overdue accounts. Likewise, most of the LCs bear high revenue expenditure due to high operation and maintenance costs of providing the service, while there is low revenue income; hence, cost recovery is low.

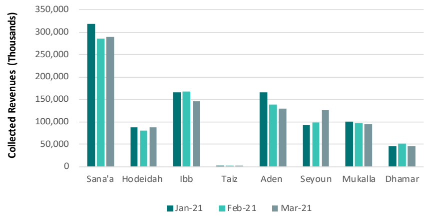
As a consequence of ongoing efforts to improve their financial resources, the LCs in Sana'a and Ibb have the highest efficiency in collection rate, respectively at 74% and 84% on average. This improvement was associated with the support of the GIZ Water Program through the introduction of mobile water meter reading using "Personal Digital Assistants (PDAs)" devices as an innovative approach to improve the quality of the revenue collection system. For the majority of other LCs, the collection efficiency fluctuates between 41% and 60%, while the recurring scenario of poor collection efficiency (1%) by Taiz LC openly reveals collapsing management of customers and revenues under the pretext of security unrest in the city.

The cost coverage varies significantly in this quarter among the LCs due to differences in operating contexts and various factors contributing to unsatisfactory financial management, such as improper tariff structures and abnormally high energy and staff expenditure. The LCs with the best performance are Ibb and Dhamar, where the O&M coverage is at an average of 96% and 84%. The results achieved by the LCs of Sana'a (42%), Seyoun (51%), and Mukalla (37%), have ranked these LCs in distress to cover their operating costs.

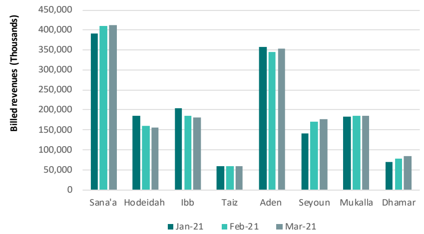
Last but not least, though Hodeidah LC remains on the edge of critical performance at 44%, they have made progress by an 18% increase in this quarter compared to the last quarter of 2020. In contrast, the LCs of Aden and Taiz continue to be among the worst performers, with respective averages of 19% and 1%, despite the fact that energy and labor costs are largely subsidized.

These findings seem to indicate that the LCs in question must devote further efforts to improving collection efficiency and tariff structure, as well as reducing water losses and O&M expenses, as a means of achieving financial resilience.

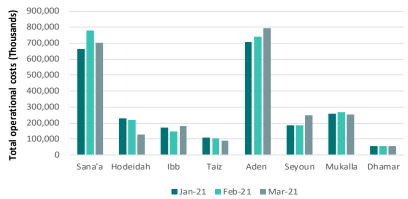
33. Total collected operational revenues (YER/month)[6]



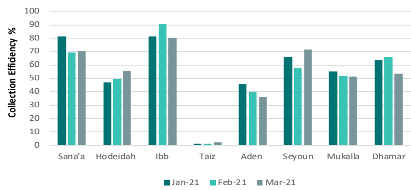
34. Total billed operational revenues (YER/month)



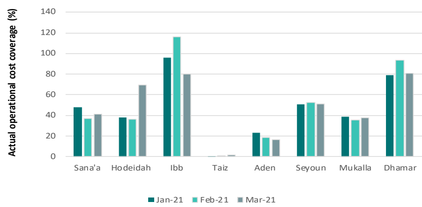
35. Total operational costs (YER/month)



36. Collection efficiency = Collected revenues vs. Billed revenues (%)



37. Actual operational cost coverage (%)

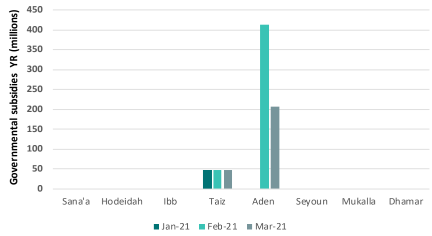


6. Revenues including domestic, commercial & governmental collection

Monthly governmental subsidies

Given the deteriorating economic and financial conditions, the investment support from the government has dropped dramatically since 2015. The LCs of Aden and Taiz are amongst a few public institutions receiving regular monthly allocations in kind of financial subsidies from the Ministry of Finance in Aden to pay basic staff salaries. The other LCs depend merely on water sales.

38. Monthly governmental subsidies (YER/month)

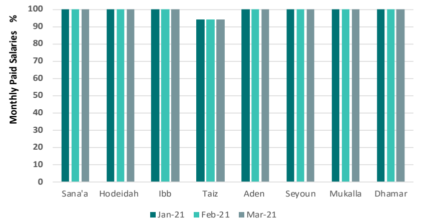


Percentage of basic monthly salaries paid

The eventual impact of external support and subsidies has gradually empowered the LCs in managing the salary expenses of employees. It should be noted that payroll is reported for the actual payments received monthly by the employees, regardless of the fact that some LCs reimburse late payments of the basic salaries retroactively.

Though most of the LCs were capable of paying 100% of the base salaries in this quarter, they were frequently in profound distress and vulnerable to securing the salaries and other heavy entitlements under volatile conditions and unpredictable continuity of external assistance.

39. Percentage of basic monthly salaries paid (%)



5 Resilience factors[7]

Disruptions of water supply and sanitation services can be caused by adverse effects on any one of the components that make up the service: people (e.g., skilled staff), hardware (e.g., infrastructure, equipment), and consumables (e.g., fuel, equipment, spare parts). None of these components are sufficient on their own. Indeed, it is moot to have the spare parts required to repair electric generators, for instance, if the only technical staff able to install them lacks the necessary capacities and skills.

The LCs must increasingly strive to become more resilient and maintain services during and post-conflict. Therefore, they must address long-standing vulnerabilities to mitigate the cumulative effects of the conflict and gradually reduce their dependence on short-term external assistance.

At present, external assistance programs, instead of sporadic crisis interventions, must seek to intervene in technical and investment measures. While these interventions may be essential during relief efforts, the resumption and strengthening of the LCs' capacity are synonymous with building resilience. The resilience allows the LCs to maintain the reliable delivery of services in the short, medium, and long term. The table beside presents the identified resilience factors with their expected impact after implementing related activities.

Main Activity	Resilience Factor	Impact
Technical Assistance – Capacity building	Improve governance and management skills on top level.	• Support and guide the LC management during the crisis in the decision making of required actions and measures. • Enable managers and key staff to prepare and introduce customized policies and procedures to increase the performance of the utility. • Enhance the coordination and cooperation among the different stakeholders (donors). • Enhance monitoring, evaluation and accountability of the LC to increase the performance.
Technical Assistance – Capacity building, Financial support, Consultancy support, equipment support	Enhance the work capacity and skills of the employees. Human resource development	• Operate the utility more efficient and organized. • Improve coordination and cooperation among different departments. • • Improve and increase the service for customers. • • Manage professionally the exceptional work. Environment and the new technologies. • • Reduce administrative water losses and increase revenue collection.
Technical Assistance – Financial support, Awareness building; Coaching, Investments	Strengthen the financial capacity of the utility.	• Ensure financial means at least to cover the minimum needs for operation of the utility. • Enable urgently needed repair and maintenance of the infrastructure. • Initiate pro-poor projects. • Keep motivated staff. • Enhance financial sustainability.
Technical Assistance – Awareness building, Operation Management Support	Improve customer management and customer relation.	• Increase service coverage and numbers of customers. • Enhance billing and collection procedures. • Increase collection efficiency and revenues. • Establish good customer relation to improve payment moral.
Investment – Rehabilitation, Maintenance, Extension	Increase water service coverage and supplied quantities.	• Increase water availability for urban residents. • Improve water supply condition. • Reduce physical water losses. • Increase number of customers. • Improve water quality.
Investment – Rehabilitation, Maintenance, Extension	Improve and extend sewer system.	• Improve hygiene and health situation for urban residents. • Protect environment and water sources. • Increase number of customers.
Investment	Provide renewable energy system (Photovoltaic).	• Operate water and sanitation facilities sufficiently. • Operate LC offices during working hours. • Reduce operation and maintenance costs.

7. GIZ IDWS/Damage Assessment Study DAS Stage 3 – Part 1: Resilience Strategy Report – Enhancing the Resilience of the LCs during Conflict and in Post-conflict Scenario - 2018

Annex 1 Resilience Emergency Indicators Sheet Jan-Mar 2021

Urban Water Sector - Sana'a LC, Aden LC, Hodeidah LC, Ibb LC, Taiz LC, Dhamar LC, Mukalla LC and Seyoun LC

No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
1	عدد السكان في المراكز الحضرية المخدومة من قبل مزود الخدمة (شهري في نهاية الشهر) Total population in service area	Sana'a	No.	3,296,342	3,296,342	3,296,342
		Hodeidah		719,146	719,146	719,146
		Ibb		861,770	861,770	861,770
		Taiz		1,074,748	1,074,748	1,074,748
		Aden		1,170,362	1,170,362	1,170,362
		Seyoun		581,969	583,614	585,258
		Mukalla		554,430	555,916	557,402
		Dhamar		301,920	302,549	303,178
2	عدد النازحين الى مناطق امتياز مزود الخدمة (شهري في نهاية الشهر) Number of IDPs in service area	Sana'a	No.	248,967	248,967	248,967
		Hodeidah		58,386	58,386	58,386
		Ibb		51,117	51,117	51,117
		Taiz		103,698	103,698	103,698
		Aden		89,992	89,992	89,992
		Seyoun		4,538	4,538	4,538
		Mukalla		4,405	4,405	4,405
		Dhamar		48,998	48,998	48,998
3	إجمالي عدد توصيلات المياه فى نهاية الشهر - يشمل المنزلي، التجاري، والحكومي وغيره Number of water connections	Sana'a	No.	91,741	91,836	91,933
		Hodeidah		69,454	69,515	69,582
		Ibb		34,290	34,451	34,580
		Taiz		33,604	33,604	33,604
		Aden		140,041	140,167	140,428
		Seyoun		56,889	56,973	57,194
		Mukalla		57,226	57,640	57,859
		Dhamar		21,038	21,157	21,241
4	عدد السكان المخدومين بالمياه من قبل مزود الخدمة (شهري في نهاية الشهر) Number of population served through water supply network	Sana'a	No.	1,100,892	1,102,032	1,103,196
		Hodeidah		486,178	486,605	487,074
		Ibb		514,350	516,765	518,700
		Taiz		352,842	352,842	352,842
		Aden		980,287	981,169	982,996
		Seyoun		398,223	398,811	400,358
		Mukalla		400,582	403,480	405,013
		Dhamar		189,342	190,413	191,169
5	نسبة عدد السكان المخدومين بالمياه من قبل مزود الخدمة من اجمالي السكان (شهري في نهاية الشهر) Water supply service coverage = population served through water supply network vs total population in service area	Sana'a	%	31	31	31
		Hodeidah		68	68	68
		Ibb		60	60	60
		Taiz		33	33	33
		Aden		84	84	84
		Seyoun		68	68	68
		Mukalla		72	73	73
		Dhamar		63	63	63

No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
6	عدد ايام تزويد الخدمة خلال الشهر (تزويد المياه من خلال شبكة التوزيع) Number of service days of piped water supply per month	Sana'a	day/month	2	2	2
		Hodeidah		25	25	25
		Ibb		8	8	8
		Taiz		4	3	2
		Aden		30	30	30
		Seyoun		31	28	31
		Mukalla		13	13	13
		Dhamar		8	8	8
7	إجمالي عدد عينات الكلور المأخوذة من شبكة المياه خلال الشهر Number of residual chlorine samples taken	Sana'a	No./month	26	39	44
		Hodeidah		464	434	479
		Ibb		75	72	65
		Taiz		15	13	7
		Aden		80	75	90
		Seyoun		16	16	16
		Mukalla		40	25	54
		Dhamar		0	0	0
8	إجمالي عدد عينات الكلور الإيجابية المأخوذة من شبكة المياه والتي تتوافق مع المعايير Number of residual chlorine samples according to standards	Sana'a	No./month	26	39	44
		Hodeidah		464	434	479
		Ibb		66	70	58
		Taiz		15	13	7
		Aden		80	75	90
		Seyoun		16	16	16
		Mukalla		38	19	50
		Dhamar		0	0	0
9	درجة نقاوة المياه المزودة بكتريولوجيا Proportion of bacteriological quality samples of distributed water according to standards = Number of residual chlorine samples according to standards per total number of samples taken	Sana'a	%	100	100	100
		Hodeidah		100	100	100
		Ibb		88	97	89
		Taiz		100	100	100
		Aden		100	100	100
		Seyoun		100	100	100
		Mukalla		95	76	93
		Dhamar		0	0	0
10	عدد السكان المخدومين بشبكات الصرف الصحي من قبل مزود الخدمة (شهري في نهاية الشهر) Number of population served with sewerage connections	Sana'a	Cap	1,090,440	1,093,548	1,095,552
		Hodeidah		298,669	298,942	299,194
		Ibb		437,115	439,770	441,945
		Taiz		473,109	473,162	473,183
		Aden		847,903	848,540	850,115
		Seyoun		-	-	-
		Mukalla		272,174	276,724	277,774
		Dhamar		120,897	121,707	121,932

No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
11	إجمالي عدد توصيلات الصرف الصحي - يشمل المنزلي، التجاري، والحكومي وغيره Number of sewerage connections	Sana'a	No.	90,870	91,129	91,296
		Hodeidah		42,667	42,706	42,742
		Ibb		29,141	29,318	29,463
		Taiz		45,058	45,063	45,065
		Aden		121,129	121,220	121,445
		Seyoun		-	-	-
		Mukalla		38,882	39,532	39,682
		Dhamar		13,433	13,523	13,548
12	نسبة عدد السكان المخدومين بشبكات الصرف الصحي من قبل مزود الخدمة (شهري في نهاية الشهر) Sewerage connection coverage = population served through sewerage network vs total population in service area	Sana'a	%	33	33	33
		Hodeidah		42	42	42
		Ibb		51	51	51
		Taiz		44	44	44
		Aden		72	73	73
		Seyoun		-	-	-
		Mukalla		49	50	50
		Dhamar		40	40	40
13	عدد عينات الـ (بي أو دي) المجمعة من محطات المعالجة خلال الشهر Number of BOD-samples of effluent of WWTP taken per month	Sana'a	No./month	4	4	4
		Hodeidah		6	0	6
		Ibb		6	6	6
		Taiz		0	0	0
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		2	2	2
14	عدد عينات الـ (بي أو دي) المجمعة من محطات المعالجة المطابقة لمعيار التدفق خلال الشهر Number of BOD-samples of effluent of WWTP according to standards per month	Sana'a	No. / month	4	4	4
		Hodeidah		6	0	6
		Ibb		5	5	4
		Taiz		0	0	0
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		2	2	2
15	كفاءة المعالجة في محطات معالجة الصرف الصحي Proportion of effluent quality samples of wastewater treatment plants according to standards = Number of BOD samples according to standards per total number of samples taken	Sana'a	%	100	100	100
		Hodeidah		100	-	100
		Ibb		83	83	67
		Taiz		0	0	0
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		100	100	100

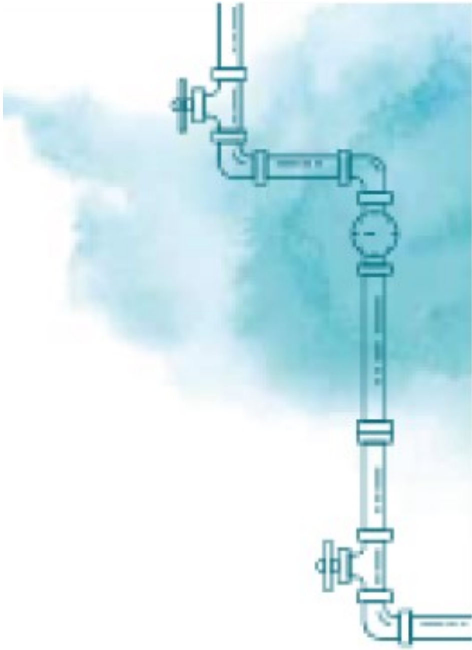
No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
16	متوسط قيمة ال (بي أو دي) للمياه المتدفقة (الخام) الى محطة معالجة مياه الصرف الصحي Average BOD value of raw influent at WWTP	Sana'a	mg BOD_5/L	1,149	1,101	1,268
		Hodeidah		400	-	390
		Ibb		1,855	1,804	2,043
		Taiz		0	0	0
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		2,720	2,040	2,965
17	متوسط قيمة ال (بي أو دي) من المياه المعالجة (الخارجة) من محطة معالجة مياه الصرف الصحي Average BOD value of treated effluent at WWTP	Sana'a	mg BOD_5/L	515	534	546
		Hodeidah		85	-	80
		Ibb		705	599	655
		Taiz		0	0	0
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		486	364	136
18	كفاءة المعالجة لمحطة مياه الصرف الصحي فيما يخص ال (بي أو دي) Treatment efficiency of WWTP regarding BOD	Sana'a	%	55	51	57
		Hodeidah		79	-	79
		Ibb		62	67	68
		Taiz		0	0	0
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		82	82	95
19	إجمالي كمية المياه المنتجة Total quantity of water produced	Sana'a	m^3/month	1,108,010	1,048,626	1,074,758
		Hodeidah		1,142,349	1,024,934	1,168,786
		Ibb		490,696	477,715	487,115
		Taiz		103,159	82,021	48,305
		Aden		3,251,807	2,960,231	2,949,423
		Seyoun		1,540,015	1,490,255	1,721,038
		Mukalla		1,616,611	1,478,478	1,662,817
		Dhamar		300,752	285,907	347,159
20	نصيب الفرد من المياه المنتجة Per capita quantity of water produced	Sana'a	l/cap/day	34	32	32
		Hodeidah		78	70	80
		Ibb		32	31	31
		Taiz		10	8	5
		Aden		111	101	100
		Seyoun		129	125	143
		Mukalla		135	122	137
		Dhamar		53	50	61

No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
21	الطاقة التخزينية الشهرية المتاحة Storage capacity	Sana'a	m^3	36,550	36,550	36,550
		Hodeidah		25,000	25,000	25,000
		Ibb		4,000	4,000	4,000
		Taiz		49,000	49,000	49,000
		Aden		94,700	94,700	94,700
		Seyoun		15,313	15,313	15,313
		Mukalla		10,900	10,900	10,900
		Dhamar		18,850	18,850	18,850
22	نصيب الفرد من الطاقة التخزينية المتاحة Storage capacity share per capita	Sana'a	l/cap	33	33	33
		Hodeidah		51	51	51
		Ibb		8	8	8
		Taiz		139	139	139
		Aden		97	97	96
		Seyoun		38	38	38
		Mukalla		27	27	27
		Dhamar		100	99	99
23	تكلفة الطاقة لكل متر مكعب منتج من المياه خلال الشهر Energy Costs per m^3 water produced	Sana'a	YER/m^3	303	312	296
		Hodeidah		0	0	0
		Ibb		132	106	128
		Taiz		0	0	0
		Aden		56	72	86
		Seyoun		65	65	65
		Mukalla		28	30	27
		Dhamar		190	190	190
24	كمية المياه المنتجة (م 3 في الشهر) - المعالجة أو غير المعالجة - التي تتدفق من محطة معالجة الصرف الصحي Effluent produced	Sana'a	m^3/month	1,680,000	1,680,000	1,680,000
		Hodeidah		674,900	603,500	789,650
		Ibb		366,678	380,320	455,531
		Taiz		90,000	90,000	90,000
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		202,106	203,564	202,724
25	كمية المياه المنتجة (لتر / فرد / يوم) - المعالجة أو غير المعالجة - التي تتدفق من محطة معالجة الصرف الصحي Effluent produced	Sana'a	l/cap/day	2	2	2
		Hodeidah		75	67	88
		Ibb		28	29	34
		Taiz		6	6	6
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		56	56	55

No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
26	كمية مياه الصرف الصحي المعالجة (م 3 في الشهر) التي تتدفق من محطة المعالجة Effluent treated in wastewater treatment plant	Sana'a	m³/month	1,590,000	1,590,000	1,590,000
		Hodeidah		674,900	603,500	789,650
		Ibb		252,424	228,193	273,318
		Taiz		90,000	90,000	90,000
		Aden		0	0	0
		Seyoun		-	-	-
		Mukalla		0	0	0
		Dhamar		194,922	193,599	189,251
27	إجمالي عدد المضخات الرئيسية Total number of main pumps for the water supply system	Sana'a	No.	102	102	102
		Hodeidah		45	45	45
		Ibb		32	32	32
		Taiz		76	76	76
		Aden		126	126	126
		Seyoun		44	44	44
		Mukalla		43	43	43
		Dhamar		29	29	29
28	عدد المضخات الرئيسية العاملة والتي تضخ المياه خلال الشهر Number of functional pumps in service	Sana'a	No./month	64	67	67
		Hodeidah		33	35	33
		Ibb		27	27	27
		Taiz		30	32	15
		Aden		96	96	96
		Seyoun		44	44	44
		Mukalla		43	43	42
		Dhamar		25	25	25
29	عدد ساعات عمل (تشغيل) المضخات (كل المضخات العاملة والتي تضخ المياه) في الشهر Number of working hours of all operating pumps of the water supply system	Sana'a	h/month	25,865	25,038	28,991
		Hodeidah		19,138	17,278	19,115
		Ibb		18,414	13,608	18,414
		Taiz		9,580	8,127	3,870
		Aden		54,693	50,248	50,444
		Seyoun		20,910	20,910	20,910
		Mukalla		698	631	673
		Dhamar		3,089	2,802	3,356
30	عدد الأعطال الناتجة عن أسباب فنية خلال الشهر للمضخات الرئيسية العاملة في ضخ المياه Number of main functional pumps failures due to technical reasons	Sana'a	No./month	4	21	26
		Hodeidah		15	20	16
		Ibb		5	5	5
		Taiz		6	3	5
		Aden		1	2	2
		Seyoun		5	5	5
		Mukalla		3	2	4
		Dhamar		0	0	0

No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
31	عدد المولدات العاملة في تشغيل المضخات Number of working generators in the operation of pumps	Sana'a	No.	55	52	54
		Hodeidah		15	15	16
		Ibb		18	18	18
		Taiz		21	23	7
		Aden		6	6	6
		Seyoun		12	12	12
		Mukalla		14	14	14
		Dhamar		10	12	12
32	عدد ساعات عمل (تشغيل) المولدات (كل المولدات العاملة المستخدمة في تشغيل المضخات لضخ المياه) خلال الشهر Number of working hours of all operating generators used to run the functional pumps of the water supply system	Sana'a	h/month	24,485	23,460	22,422
		Hodeidah		2,247	2,120	3,021
		Ibb		11,594	10,821	11,594
		Taiz		6,265	5,425	1,488
		Aden		570	929	1,204
		Seyoun		6	6	6
		Mukalla		308	475	524
		Dhamar		996	998	1,217
33	قيمة الإيرادات الشهرية المحصلة Total collected operational revenues	Sana'a	YER/month	317,694,216	285,274,901	288,749,850
		Hodeidah		86,810,356	79,515,518	87,133,445
		Ibb		165,411,189	168,164,433	145,028,866
		Taiz		777,404	534,851	1,154,993
		Aden		164,928,357	138,459,472	128,395,318
		Seyoun		93,712,120	98,466,698	126,305,777
		Mukalla		100,766,264	96,011,388	95,556,277
		Dhamar		44,855,141	50,925,703	45,210,464
34	قيمة الإيرادات الشهرية المفوترة (قيمة مبيعات المياه الشهرية المفوترة) Total billed operational revenues	Sana'a	YER/month	390,836,239	410,640,910	411,455,685
		Hodeidah		185,546,936	160,416,170	156,032,894
		Ibb		204,085,441	185,642,793	180,743,690
		Taiz		58,619,550	58,619,550	58,619,550
		Aden		358,621,898	345,409,665	354,232,669
		Seyoun		141,406,844	170,827,536	176,294,026
		Mukalla		182,874,398	186,110,009	185,517,372
		Dhamar		70,441,000	77,076,692	84,913,661
35	إجمالي التكاليف التشغيلية Actual operational cost	Sana'a	YER / month	662,320,389	778,045,008	702,250,743
		Hodeidah		227,121,392	218,383,032	125,796,245
		Ibb		171,623,882	144,647,529	181,259,457
		Taiz		109,842,880	102,187,330	90,412,480
		Aden		706,079,591	742,884,060	792,934,881
		Seyoun		185,861,623	187,559,688	246,774,342
		Mukalla		260,335,706	269,845,940	253,259,321
		Dhamar		56,681,240	54,252,278	56,034,705

No.	Data / Indicator	LC	Unit	1st Q 2021		
				Jan-21	Feb-21	Mar-21
36	نسبة التحصيل Collection Efficiency = Collected revenues vs Billed revenues	Sana'a	%	81	69	70
		Hodeidah		47	50	56
		Ibb		81	91	80
		Taiz		1	1	2
		Aden		46	40	36
		Seyoun		66	58	72
		Mukalla		55	52	52
		Dhamar		64	66	53
37	التغطية التشغيلية المحصلة للكلفة Actual operational cost coverage	Sana'a	%	48	37	41
		Hodeidah		38	36	69
		Ibb		96	116	80
		Taiz		1	1	1
		Aden		23	19	16
		Seyoun		50	52	51
		Mukalla		39	36	38
		Dhamar		79	94	81
38	قيمة الإعانات (المعونات) الحكومية الشهرية لمزود الخدمة Monthly governmental subsidies	Sana'a	YER / month	0	0	0
		Hodeidah		0	0	0
		Ibb		0	0	0
		Taiz		46,828,589	46,828,589	46,828,589
		Aden		0	414,052,624	207,026,312
		Seyoun		0	0	0
		Mukalla		0	0	0
		Dhamar		0	0	0
39	نسبة الرواتب الأساسية الشهرية المدفوعة للموظفين Percentage of basic monthly salaries paid	Sana'a	%	100	100	100
		Hodeidah		100	100	100
		Ibb		100	100	100
		Taiz		94	94	94
		Aden		100	100	100
		Seyoun		100	100	100
		Mukalla		100	100	100
		Dhamar		100	100	100



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