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STAGE FOUR

Yemen Water Sector

Yemen Water Sector - Damage Assessment Report of the Urban Water Supply and Sanitation Situation in Yemen – Stage IV

Part 2: Situational Assessment Report

Annex 1 Technical Assessment Report for Saiyun

Imprint

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Abbreviations

ABR	Anaerobic Baffled Reactor
BMZ	German Ministry of Economic Cooperation and Development
BoD	Board of Directors
BoQ	Bills of Quantities
CAC	Cooperative Agricultural Credit (Bank)
CBO	Community Based Organization
COCA	Central Organization for Control and Auditing
DAS	Damage Assessment Study
DCI	Ductile Cast Iron
DI	Ductile Iron
EM	Electro-mechanical
EUR	Euro
FC	Financial Cooperation
GI	Galvanized Iron
GDP	Gross Domestic Product
GIZ	Gesellschaft für Internationale Zusammenarbeit GmbH
GoY	Government of Yemen
HR	Human Resources
HRDU	Human Resource Development Unit
INGO	International Non-Governmental Organization
ICRC	International Committee of the Red Cross
IDP	Internally Displaced People

IT	Information Technology
JAR	Joint Annual Review
KfW	Kreditanstalt für Wiederaufbau
LAC	Local Advisory Committee
LC	Local Corporations
MoCS	Ministry of Civil Service
MoF	Ministry of Finance
MoM	Minutes of Meeting
MWE	Ministry of Water and Environment
NRC	Norwegian Refugee Council
NRW	Non revenue water
NWRA	National Water Resource Authority
NWSA	National Water and Sanitation Authority
NWSSIP	National Water Sector Strategy and Investment Plan
OMS	Operation Management Support
O&M	Operation and Maintenance
PIIS	Performance Indicator Information System
PVC	Polyvinylchloride
QF	Questionnaire forms (DAS Stage III)
St, ST	Steel
TA	Technical Assistance
TFPM	Task Force on Population Movement
UN	United Nations
USD, U$	American Dollar
WASH	Water, Sanitation and Hygiene
WFP	World Food Programme
WSP	Water Sector Programme in the Republic of Yemen
WSLC	Water and Sanitation Local Corporation
WU	Water Utilities
WWTP	Wastewater Treatment Plant
YER, YR	Yemen Rial

Units

LS	lump sum
m	meter
Mio	million
masl	meter above sea level
mg/l	Milligram per litre
m^3/d	Cubic meters per day
lpcd	litre per capita per day

no, nosnumber (numerical figure)

Executive Summary for LC Seiyun

In 2022, Seiyun LC is serving a catchment area of about 40,213 km2 and 430,560 people (69 % of the total) are connected to the public water supply system, while 21 % are connected to private sector and none to the sanitation system because the station is suspended due to the incomplete implementation of sewage networks. Except that 3 % of people are served by Number of sewage connections served from the institution by a suction tanker. The LC obtains the water from the currently 46 operating wells. The LC was visited by the Consultant in 24 -27 /5/2023. The governorate remains in a precarious state. At present, the water production and distribution adequately meet the needs of the population.

A. Institutional Assessment and Recommended Technical

Assistance Measures (TA Plan) for Seiyun LC

The Seiyun LC, established in 2001, is managed by the General Director, "Omar Abdulbari Al-Eidros.". The utility employs in its 11 departments plus auxiliary unit in total 602 staff members, 58 of them are contracted workers and dayworkers. Customer complaint procedure is installed and used through the Maintenance Management System application.

The identified shortcomings and respective recommendation for urgent and non-urgent measures can be summarized in the following table. A Technical assistance plan based on the identified measures showing the amounts needed for the urgent, high, medium and low priorities is attached as Appendix A-1.

Department	Obstacles	Recommendations	Implementation
Governance / Management / Organizational structure / Resilience	-The organizational structure needs updating - Business planning and performance monitoring need updating - The institution does not have specific plans or schemes for partnerships with the private sector -The institution operates as a service-oriented local entity - no representation of women on the Board of Directors/Advisory Committee	Capacity building of management and BoD - Regular meeting and coordination between LC and BoD	Urgent High
Human resource and capacity building management	- Hiring needs - Low qualification and skills of some employees - need to reactivate training programs - Internet Connectivity for Online Meetings and Training	- Professionalize overstaff (training) and reorganize departments to be effective - Analyses of staffing to determine detailed HR requirements - Preparation of staffing plan	Urgent High High

Finance management/	- Suspension of government support and investment program. -Suspension of UNICEF's diesel support affects the financial resources of the institution. -Need for completing office automation. -Need for training and qualifying the financial staff. -Non-closure of accounts in 2022 and lack of monthly closure, displaying the financial position. -Accumulation of government and household debt. -Rise in commodity prices.	-Financial plans to develop the LC/AU/ Branch's resources -- Follow up on unpaid bills. -Introduce reporting standards and forms for financial reports	High High High
Customer service and relation management	-The reading of the water produced is not entered into the billing system to determine the amount of water loses - Shortage of invoice printers and digital devices - Training and qualification needed - Weakness in security aspects during the war period - Delay in connecting services for subscribers due to absence of meters	- Joint coordination between Commercial Department and financial management -Joint coordination between security authorities and local authorities in controlling violators - Raise the community awareness of the important of paying the bills of water consumption - Policies and strategies of developing and strengthening the relationship between the LC/AU/Branch and the Consumers - Providing invoice printers for five branches of the institution. - Implementing automated programs for procedures related to service requests in subscriber accounts. - Developing automated programs for taking readings. - Implementing automated field collection programs along with providing associated devices. - Supplying motorcycles for meter readers. -Conducting training courses for employees in subscriber accounts	High Meduim High Medium Urgent High High High Urgent High
Water and Sanitation Service management	-No sanitation network system -Shortage of equipment, emergency vehicles and assembly parts - Operating system for some wells and a GIS program	-Establish GIS unit - Find the necessary support to complete the construction of the stalled wastewater treatment plant	High Urgent
IT infrastructure	-Interruption of wireless networks between branches due to natural disasters -Shortage of automatic equipment such as computers, printers, and invoice printers. -Absence of development plan of the IT Department and the used systems.	--Inclusive training of staff - Capacity building for IT department - IT management procedures and operations	Urgent High Medium
Gender perspective	- There is no database classified by gender - There is no specific budget allocated for the Women's Management - The Women's Management does not currently participate in planning policies	- Giving priority for female recruitment	High

Table 1: Obstacles and recommendations for institutional measures

To enable the implementation of the above proposed recommendations the following Technical Assistance interventions grouped into six packages with related cost estimates have been identified[1]:

[1] Details on TA measures with cost estimation are given in Appendix A-1

Package	TA intervention	Estimated TA cost in USD			
		Urgent	High priority	Medium priority	Low priority
		(0-6 months)	(1 -2 years)	(3-5 years)	(>5 years)
TA1	Financial Support	1,050,000	1,000,000	800,000	0
TA2	Training Courses	205,000	160,000	110,000	0
TA3	Office equipment and IT	109,000	51,000	106,000	0
TA4	Coaching and Consultancy services	90,000	150,000	75,000	0
TA5	Operation Management Support	70,000	120,000	40,000	0
TA6	Public Relation and Awareness	0	50,000	40,000	10,000
Total TA cost:		1,524,000	1,531,000	1,171,000	10,000

Table 2: Cost estimates on TA interventions

The total required amount for the technical assistance measures has been estimated to around USD 1,524,000 for critical priority intervention, USD 1,531,000 for high priority intervention, 1,171,000 for medium priority intervention and USD 10,000 for low priority interventions.

B. Infrastructure Assessment and Recommended Rehabilitation Measures (Investment Plan) for LC Seiyun

The buildings and reservoirs are facing some damage through age deterioration and lack of maintenance. The LC faced indirect damage, mostly through the electricity cuts, economic crisis, and rising prices.

Water supply system

The water infrastructure comprises 46 wells, 46 of them operational, 33 ground reservoirs with total capacity of 19313 m3, no elevated tank, 3 water sterilization facilities, 1 water laboratory and 2,022km of water supply network. According to the LC, from the 55,492 house water connections about 53820 (97 %) have functional water meters installed. The water production increased since 2017 by 18 % to currently 57614 m3/day in average. The customers are supplied by the 8 distribution zones through the pumping stations interconnected with the ground reservoirs. The water supply is continuously and one of the best in the country considering the provided amount of 88 lpcd. The LC is operating the wells and pumps mostly through the power plant of 9 and in addition by generators. The LC owns 17 fuel generators, all of them are used for the water supply system and none for sanitation. The LC asked for solar power for office and well pumps

The LC faces huge problems due to lack of power supply. They have to spend 4.3 M USD (3.53 % of total cost) for electricity (2022). There is lack of equipment and spare parts for the O&M of the water network. The LC is therefore not able to perform the regular maintenance of the facilities and equipment. The result is failure of generators, wells and pumping equipment. Due to the high content of dissolved salts the pipes are regularly blocked and need to be cleaned.

The required materials comprise submersible and centrifugal pumps for the water supply, new generators, water meters and various small materials for the maintenance of the network and facilities. Besides transformers for well operation and laboratory equipment is needed. The LC requested also vehicles for operation and maintenance water system.

Sanitation system

In 2022, there are only 2676 Wastewater collection points, which covers 12 km2 of the total area, and are basic holes, where wastewater is filtered and absorbed by the soil or pumped out through a network of 31,000 m with a LC vacuum pump of sewage trucks.

Investment needs

The identified measures have been prioritized according to feasibility and urgency in urgent measures, high priority, medium and low term measures grouped into 9 investment packages as shown in Table 4. The period indicates the proposed commencement of the investments, starting from 2024.

The required estimated budget has been calculated for:

- Critical measures: 88,010,142 USD
- High-priority measures: 13,010,000 USD
- Medium - priority measures: 330,000 USD
- Low- priority measure: 0 USD

The total needed amount for the rehabilitation, restoration and extension of the water and sanitation system, provision of solar systems and supply of required operation and maintenance materials has been estimated to about 102,150,142 million USD for the next 5 years.

Domains	Obstacles	Critical (0-6 months)	High (1-2 Years)	Medium (3-5 years)	Low (>5 years)
Building and Reservoirs	Damaged administrative building. Lack of office furniture and equipment. Lack of laboratory. Insufficient office work space. Insufficient material storage space. Leak and deterioration of some storage reservoir	Solar energy + computer + air conditioners + furniture + hangars + building renovation	Solar energy + computer + air conditioners + furniture + hangars + building renovation	-	-
Water Resource, use and balance	Shortage in water supply Low yield of the wells	Digging new wells & Rehabilitation	-		-
Water pipelines	Dilapidated water distribution network. Uncompleted rehabilitation of distribution networks Aging and dilapidation of the distribution networks Aging and corrosion of the pumping line.	Replacing asbestos and galvanizing networks	-Water Meter & valves - GIS network documentation program	-	-
Water Pumping/ lifting Stations	Insufficient pumping capacity	-Remote control system -Pump inspection devices -Pumps and motors -Pumping station -buildings with fittings -electrical transformers -Electric generators	-		-
Water sterilization facilities	-High Floride content in ground water. - Lack water and wastewater testing laboratory. - Lack of measuring kits for residual chlorine.	Repairing and re-operating old stations and installing and equipping new stations	-	-	-
Power generating/ auditing for water system	-Diesel power generator pumping station out of service and needs rehabilitation. - Raise of Diesel prices.		-	-	-
Operation and maintenance process of water infrastructures	-Lack of transport vehicles. -Lack of repair and maintenance tools for pipe works, pump and motor works. -Lack of tools and instruments for electrical works. -Lack of trench excavation equipment. -Lack of water meter maintenance workshop. - Lack of pump lifting equipment/wenches		-	-	-
Wastewater collection/ transportation pipelines	-Lack of repair and maintenance tools for pipe works, pump and motor works	-	-Maintenance and rehabilitation	-Network replacement	-
Electromechanical equipment for the sewerage system	-Lack of repair and maintenance tools for pipe works, pump and motor works	-Suction hose -unclogs hose -Mobile sewage pumps -Surface pumps -Safety equipment	-	-	-
Wastewater treatment facilities	Low efficiency of operational basins	Buying the following -BOD METER, -COD reactor, -DEIONIZER WATER PURFICATION SYSTEM, -turbidimeter	-		-
Power generating/ auditing for Water &wastewater system	-Diesel invoices is too high	improve and expand the energy sources required for the water and wastewater systems		-	-

Operation and maintenance process of water & wastewater facilities	Poor logistics for operation & maintenance	-Buying Small & medium vehicles Drilling machines, Crane - pumps & generators		-	-
Water & wastewater Laboratories	Poor logistics for operation	Buying chemicals, flame photometer, BOD Meter, Incubator, & COD reactor	Buying Drying oven, Turbidimeter& refrigerator	-	

Table 3: Brief description of recommended rehabilitation measures for water and sanitation infrastructures

Package	Measures	Urgent (0- 6 months) (USD)	High priority (1- 2 years) (USD)	Medium (3-5) years) (USD)	Low (>5 years) (USD)	Total (USD)
		2024	2024-2025	2025-2027	>2027	
1	Civil works on buildings and structures	800,00	3,700,000	0	0	4,500,000
2	Well rehabilitation and new construction	5,273,642	0	0	0	5,273,642
3	Water pumping station	6,000,000	0	0	0	6,000,000
4	Water network rehabilitation and extension	49,870,000	9,100,000	0	0	58,970,000
5	WWTP and sewage pumps	2,002,500	0	0	0	2,002,500
6	Sewer network rehabilitation and extension	0	100,000	330,000	0	430,000
7	Vehicles, machines, tools	4,300,000	0	0	0	4,300,000
8	Electric materials and solar systems	19,000,000	0	0	0	19,000,000
9	Laboratory equipment	1,564,000	110,000	0	0	1,674,000
Total (USD)		88,010,142	13,010,000	330,000	0	102,150,142

Table 4: Cost estimation on investment measures

1. Background

1.1 Hadramaout Governorate and Seiyun LC

Hadramout Governorate with a total population of 1,028,556 (2017) million is located in the east of Yemen on the Arabian Sea with a total area of 193,032 km2 (36% of Yemen total area) and 28 directorates. Al Mukalla is the capital of Hadramout Governorate and about 620 km of Sana'a City, the Capital of Yemen Republic. The Al Mukalla city is located at Latitude: 14.33 and Longitude: 49. 10. Al Mukalla city altitude is 10 m above sea level. The climate is comparable to coastal climate (typical Arab sea costal area climate) - hot in summer with an average temperature of 32 C° and mild in winter with an average temperature of 26 C°. The rainfall is little in winter.

The area of Seiyun District is about 804 square kilometers. The district is located in the central part of Hadhramaut Governorate and Wadi Hadhramaut, at a longitude of 48.46 degrees east and a latitude of 15.57 degrees north. The district consisting of a relatively flat plain surface that forms part of Wadi Hadhramaut and is surrounded by mountain ranges on the northern and southern sides, which lead to the northern and southern plateaus.

1.2 General information of the LC/AU/ Branch

The utility/branches under the management of (the LC/NWSA).	Name of the utility/ branch
Local Corporation for Water and Sanitation M / Hadramout Valley and Desert Regions (Seiyun)	Seiyun Branch
Local Corporation for Water and Sanitation M/ Hadramout Valley and Desert Regions (Seiyun)	Tarim Branch
Local Corporation for Water and Sanitation M / Hadramout Valley and Desert Regions (Seiyun)	Shibam Branch
Local Corporation for Water and Sanitation M/ Hadramout Valley and Desert Regions (Seiyun)	Al-Qatn Branch
Local Corporation for Water and Sanitation M/ Hadramout Valley and Desert Regions (Seiyun)	Sah area

Table 1.1: List of affiliated utilities and branches to NWSA/LC serving in the same geographical area (governorate)

However, the LC services covers Seiyun city in addition to 4 autonomous utilities in Tarim, Al-Qatn, Sah and Shibam towns. Figure1.1 provides an overview map of Hadramout Governorate with directorates in concern.

The population growth through period from 2017 to 2022 in LC Seiyun is shown in Table 1.2. The annual growth rate during the period from 2017 to 2022 was constant and equal to 3.7%. However, There are displaced people, but there is no documentation of the number and locations

Year	2017	2018	2019	2020	2021	2022
Population	525,234	543,083	561,540	580,626	600,362	620,772

Table 1.2: Population Growth in LC Seiyun City

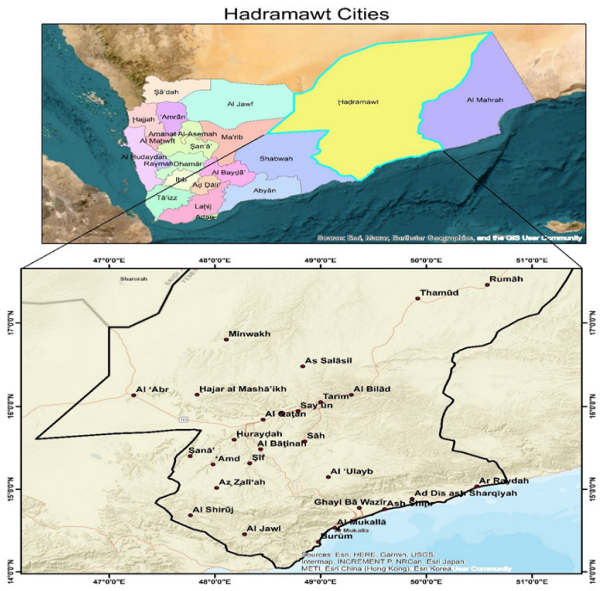

Figure 1.1: LC Seiyun Location Map

1.3 methodology of assessment

The water and sanitation authority NWSA is responsible on the water and sanitation services in LC Seiyun. and administratively belongs to the general water and sanitation corporation. The main objectives of the situational assessment report for NWSA in Seiyun are as follows;

- Assessment of the current water and sanitation services; this covers both technical (water and sanitation infrastructure) and institutional (offices, staffing and equipment) aspects.
- Prepare list of actions to improve the water and sanitation services with cost estimate
- Prepare investment plan for GIZ and other donors

For this purpose, two questionnaires were prepared based on DAS III list of required information; Questionnaire A for institutional issues while questionnaire B for technical issues. In addition, the field team prepared checklist for the problems and challenges faced the LC.

The questionnaires were prepared with close coordination with GIZ and the NWSA representatives through carried out the workshops in Yemen. The questionnaires were distributed to LC's and NWSA for filling the requested data and the consultant field team was working with LC and

NWSA representatives on filling gaps and getting the LC and NWSA certification for collected data.

Part A is covering all institutional subjects: management, governance, human resources, customer management, financial management, and IT management while Part B covers water supply, water and wastewater infrastructure, and managements. The questionnaires were distributed in March 2023. Interviews were conducted with the General Manager, Deputy General Manager for technical affairs, the Financial Manager, the Human Resource Manager, the Technical Manager, the Customer Manager and IT Manager. The field team verified and certified the questionnaires from LC and NWSA in August 2023.

In addition, the field team held several telephone conferences with the responsible members of the LC and NWSA respectively to ask for clarification of data. All provided data were analyzed and respective results incorporated in this report.

The sections below summaries the assessment outcomes of the water and sanitation services of LC and NWSA management capacity. The outcomes are summarized into an investment plan which include actions and measures to improve the services with cost estimate.

2. Assessment of LC Organization and Management

The LC'S in Yemen were established based on Republican Decree no. (02) for the year 2001. The legal procedures and laws are still in operation during the conflict; the LC is following the financial and civil service laws, law for procurement and water law.

The LC emphasizes on the following:

- Good interaction with the Ministry of Water and Environment, the Board of Director and the Local Council cooperation during the crisis.
- Work is carried out according to the approved organizational structure
- The organizational structure is proportionate to the size of the institution/branch by 90%
- There is a discrepancy between the approved organizational structure and the current situation in the institution/branch with some additions and exclusions

2.1 Organizational Structure

2.1.1 Board of Directors/Advisory Committee

- There is an established organizational structure for the Board of Directors/Advisory Committee with clear defined functions and tasks.
- The Chairman of the Board serves as the Deputy Minister of Hadhramout for Valley and Desert Affairs.
- There is no representation of women on the Board of Directors/Advisory Committee.
- There is a dedicated department for women in the institution, focusing on assisting subscribers and data input for billing.
- The Board held meetings to approve plans, budgets, investment programs, tariff amendments, and to assist the institution in engaging with donor agencies and the ministry.
- Immediate needs of the institution/branch were not specified.
- The method of addressing immediate needs was not specified.
- The Board takes responsibility for both ethical and financial accountabilities.
- The Board forms assisting committees with specific roles and responsibilities when needed.
- Women participate in these assisting committees.

2.1.2 Organization Structure and Governance

There is a clear indication of the organization's compliance with a range of critical laws and decisions. It demonstrates unwavering adherence to key legal frameworks governing establishment decisions, financial regulations, and the operation of public institutions, companies, and authorities. Additionally, the organization aligns with civil service laws, ensuring proper governance of its workforce. Furthermore, it complies with laws pertaining to job systems, salaries, and allowances, as well as those governing the collection of public funds. The organization also upholds regulations concerning insurances and pensions, while demonstrating adherence to laws governing tenders, auctions, and water management. This comprehensive compliance underscores the organization's commitment to legal and regulatory integrity across various operational domains.

The operational departments/units within the organization during the period of 2017-2022 is as follows:

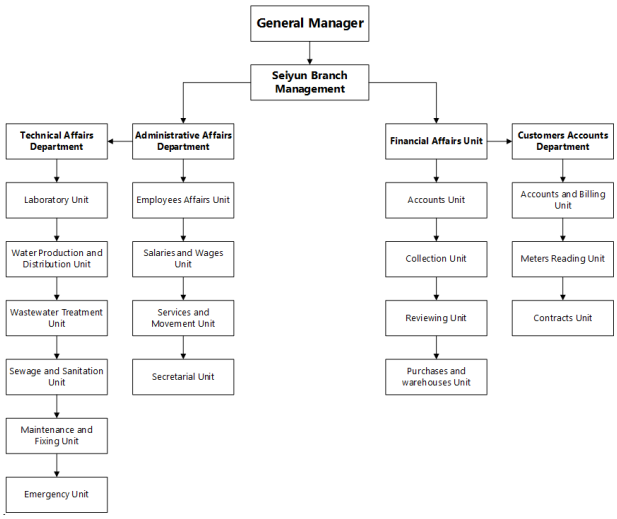

Figure 2.1: Seiyun NWSA Organizational Structure

The institution views the following as the most pressing governance and organizational issues requiring change:

- Meetings and the mechanism for monitoring Board/ Advisory Committee decisions are not a concern.
- The organizational structure needs updating, as it has remained unchanged since 2005.
- No changes are deemed necessary in relation to internal regulations and rules.
- Workflow and data flow do not require any modifications.
- Business planning and performance monitoring need updating for better effectiveness.
- Automation and the utilization of modern technology for administrative procedures and operations require improvement.
- Internal and external audit and inspection processes are considered satisfactory.
- The institution/branch identifies a need to update the incentives and rewards policy as an important administrative concern.

2.1.3 Governance criteria

The operational practices and policies of the institution or its branch indicate various aspects of their compliance and procedures, and are as follows:

- The institution undergoes annual financial audits and inspections by relevant authorities.
- The institution ensures stakeholders have the right to access information.
- Reliable and timely information provision is a commitment of the institution.
- The institution has transparency and disclosure rules and instructions in place.
- The institution maintains a website for disclosing required information.
- The institution has mechanisms for consultation and engagement with beneficiaries.
- There is a mechanism for stakeholders to hold the institution accountable.
- The institution possesses documented strategic plans.
- The institution has a code of conduct for behavior and values.
- The code of conduct is adhered to and implemented within the institution.
- The institution has a performance monitoring and evaluation system.
- There are established processes for providing relevant documents to supervisory and funding authorities for performance assessment.
- The institution does not have specific plans or schemes for partnerships with the private sector.
- The institution has not currently implemented any such plans or schemes.
- The institution adheres to national/international environmental regulations when operating and maintaining water supply and sanitation systems.
- The institution operates as a service-oriented local entity and does not pursue profit-making objectives.

2.1.4 Strategic resilience

The institution, tasked with water and sanitation services, faces multifaceted challenges during ongoing crises. Notable issues encompass fuel shortages, power disruptions, unauthorized connections, and financial constraints. Although lacking formal risk assessment plans, the institution swiftly establishes ad-hoc operations rooms to address immediate exigencies. The crises have led to stalled projects, revenue shortfalls, and difficulties in procuring maintenance requisites. To sustain operations, the institution actively seeks external support, particularly in augmenting critical resources. Furthermore, the institution strategically redistributes water resources and collaborates with local authorities to meet augmented demand, demonstrating adaptability in the face of adversity.

2.2 Assessment of Staffing Needs

2.2.1 Staff Situation and Salary

The LC employs a total staff of 602 including no day (temporary) workers and 58 contracting staff. The number of employees increased by 14% since 2017, with 11.76 employees (incl. day workers) per 1,000 water connections. The percentage of female staff amounts to 0 % of total staff throughout the six years.

The table below summarizes the staff according to gender, working condition and in relation to the number of water connections. Comprehensive details on the assessment of staffing situation of the LC are given in Table 2.1.

Staff situation	2017	2018	2019	2020	2021	2022
Total no. of permanent staff	510	529	530	531	541	544
Total nos. of contracting staff	17	5	15	24	34	58
Total nos. of day workers (temporary worker)	0	0	0	0	0	0
Total no. of staff	527	534	545	555	575	602
Total nos. of staff male actual working	500	521	522	526	535	538
Total nos. of staff male not actual working	0	0	0	0	0	0
Total nos. of staff female actual working	0	0	0	0	0	0
Total nos. of staff female not actual working	0	0	0	0	0	0
% of female to total	0	0	0	0	0	0
Nos. of water connections	44797	46571	48195	50145	52230	53820
Nos. of staff per 1,000 connections	11.76	11.46	11.31	11.07	11.01	11.12

Table 2.1 Staff number and attendance

According to the LC all employees are currently working.

All the departments of the LC are still in operation; below figure presents the distribution of staff for the different departments reflecting the figures obtained from the LC.

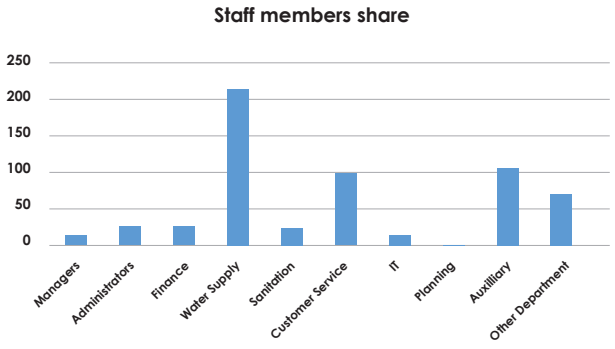

Figure 2.1: Staff Distribution across departments in (2022)

The number of managers is 33 represents 5.4 % of total staff, which is acceptable for the size of the LC.

From the figures above it can be further concluded that the number of staff per department is appropriate. The staff of technical departments (water supply, sanitation, planning) represents 70 % of total staff and the finance department – customer service - is representing 20 % of the total staff. Thus, the main departments represent 90 % of the total staff which indicates that the LC is aware of the importance of these departments, and this conclusion can be generalized on the period 2017 to 2021.

The total monthly salary for the 602 employees is 74.6 million YER.

2.2.2 HR general information, procedures and reporting

The LC follows the general procedure of public civil law and national salary scheme for employment and salary payment. The workflow procedures of human resource department are documented. In addition, the LC doesn't apply the fingerprint system for automatic attendance control and absence of employees

The LC applies the shiftwork for the technicians in order to minimize the operation cost during the crisis such as overtime and overnight allowances.

2.2.3 Staff qualification, training needs, and capacity development

The table below summarizes the LC employees regarding gender and qualification for the last six years.

Staff qualification	2017		2018		2019		2020		2021		2022	
	Nos.	% of total	Nos.	% of total	Nos.	% of total	Nos.	% of total	Nos.	% of total	Nos.	% of total
Staff professional level (university degree) male	73	14	75	14.5	76	14	79	14.5	81	14.5	88	15
Staff professional level (university degree) female	0	0	0	0	0	0	0	0	0	0	0	0
Staff technical level (high school. VT certificate etc.) male	142	27.5	138	27	138	26	152	28	162	29	175	30

Staff technical level (high school. VT certificate etc.) female	0	0	0	0	0	0	0	0	0	0	0	0
staff male lower qualification	301	58	301	58	318	59.5	306	57	315	56	321	54.5
staff female lower qualification	2	0.5	2	0.5	2	0.5	2	0.5	2	0.5	2	0.5
Total	518	100%	516	100%	534	100%	539	100%	560	100%	586	100%

Table 2.2: Staff qualification and gender data

The qualification is considered as important indicator for the employee performance. Based on the analysis result, the staff with university and higher degree represents only 14 % of the total employees. The employees with secondary degree and lower qualification represent subsequently 58 % of the workforce.

The application is made through candidates specialized in the field of the course in terms of the number required for training and coordination with the branches for that, but currently it has been stopped due to the lack of financial funds to hold courses and training programs, whether at the level or institution, the ministry and other parties, for the course programs unless any funding body adopts the implementation.

2.3 Capacity Building Plan

2.3.1 The most important problems related to improving human resources capabilities:

Hiring: The institution faces a need to fill various job positions due to shortages in certain departments. However, it can only address urgent needs, as the retirement process for 80 employees has been delayed by the end of 2022

Incentive Plans: The existing incentive plan, updated in October 2021, does not align with employee preferences. There is a necessity to re-evaluate tariff rates for different categories. Additionally, there is a debt of over 4 billion across various categories, including the government category.

Knowledge Exchange and Work Groups: In the past, the institution benefited from courses and workshops held at the Ministry of Water and Environment. However, currently, there is a need to reactivate training programs to enhance the experience and skills of the institution's employees, helping them overcome challenges in their daily work.

Available Resources and Equipment: The institution operates within the limits of the available resources. Training programs have been rarely available at the institutional, ministerial, and other levels.

Internet Connectivity for Online Meetings and Training: The institution lacks modern devices, which affects its ability to keep up with technological advancements. When online participation is possible, it is facilitated through the available Zoom program managed by the IT department.

These HR-related issues highlight the need for strategic adjustments in hiring processes, incentive plans, training programs, and resource allocation to improve the overall efficiency and effectiveness of the institution.

2.3.2 Planned technical assistance needs related to human resources

- The institution urgently needs to hire new employees, both through contracting and direct employment, due to a high number of employees approaching retirement and delays in the retirement process.
- Incentive plans need to be reviewed, and there is a need to create a unified set of regulations at the institutional level to standardize the tariff for the value of water sold to consumers.
- There should be a re-evaluation of training courses, workshops, and research programs, with a focus on knowledge exchange and skill development among all institution employees.
- Adequate internet connectivity and modern devices are needed to facilitate online meetings and training sessions for the benefit of the institution and its employees.

2.3.3 Proposed technical assistance needs related to improving human resources capabilities:

Unifying Incentive Regulations: Implement uniform incentive regulations across institutions nationwide, while considering regional variations.

Providing Required Job Positions: Assist the institution in filling necessary job positions to address existing needs. The institution is currently unable to fulfill commitments due to program suspension and non-payment of debt exceeding 4 billion.

Completing Retirement Cases: The ministry should engage with the General Authority for Insurance and Pensions to expedite the completion of retirement cases for employees referred for retirement within a specific timeframe.

Reviewing Water Tariff Value: Consider reevaluating the current water tariff value, taking into account rising production costs and the expense of delivery to consumers. Maintaining the current pricing in the face of escalating petroleum product prices may lead to financial difficulties for the institution.

Capacity building and training

Training Area	Targeted Positions	Expected Number of Participants	
		Male	Female
Modern Planning and Organization Techniques	Financial, Administrative, Technical Department Managers; HR Department Heads; Branch Managers	20	
Workforce Planning and Performance Evaluation	HR and Financial Affairs Managers; HR Department Heads; HR Unit Managers	25	
Public Relations and Administrative Communication	Public Relations Managers; Subscribers Accounts Heads	20	
Time Management and Prioritization	Financial, Administrative, Technical Department Managers; HR Department Heads; Branch Managers; Salary and Wage Department Head	25	
Modern Techniques in Investigations and Disputes	Financial, Administrative, Technical Department Managers; HR Department Heads; Branch Managers; Legal Affairs Head	15	
Employee Loyalty and its Impact on Performance	All Staff (General Management, Branches, and Sah Area)	25	
Electronic Archiving and Secretarial Work	Archive, Secretarial, and Printing Department Heads; Archive Unit Heads	20	
Advanced Financial Management	Financial Affairs Managers, Audit; Financial Department Heads; Audit Unit Heads	15	
Modern Financial Analysis Techniques	Financial Affairs Managers, Audit; Financial Department Heads; Audit Unit Heads	15	
Developing Work Mechanism in Stores and Procurements	Financial Affairs Managers, Audit; Financial Department Heads; Audit Unit Heads; Procurement and Stores Department Heads	15	
Principles and Organization of Stores, Development Methods, Safety Procedures	Financial Affairs Managers, Audit; Financial Department Heads; Audit Unit Heads; Procurement and Stores Department Heads	20	
Managing Loans with Funded Entities	Deputy GM for Financial and Administrative Affairs; Deputy GM for Technical Affairs; Financial Affairs Managers, Audit; Procurement and Stores Department Heads	12	
Budgeting and Planning	Financial Affairs Managers, Audit, Administrative; Technical Department Heads (Salaries and Wages, Employee Affairs, Stores, Technical); Financial Unit Heads	20	
Customer Relations	Deputy GM for Financial and Administrative Affairs; Deputy GM for Technical Affairs; Financial Affairs Managers, Audit; Customer Relations Department Heads; Meter Reading and Replacement Unit Heads; Disconnection Campaign Head	20	
Personnel Management and Modern Methods in Reducing Debt	Deputy GM for Financial and Administrative Affairs; Deputy GM for Technical Affairs; Financial Affairs Managers, Audit; Customer Relations Department Heads; Meter Reading and Replacement Unit Heads; Disconnection Campaign Head	83	
Problem Analysis and Decision Making	Financial, Administrative, Technical Department Managers; HR Department Heads; Branch Managers; Audit Department Heads; Audit Unit Heads	10	
Financial Analysis and Performance Indicators	Financial Affairs Managers, Audit, Administrative; Technical Department Heads (Salaries and Wages, Employee Affairs, Stores, Technical); Audit Department Heads; Audit Unit Heads	12	
Development of Administrative and Leadership Skills	Financial, Administrative, Technical Department Managers; HR Department Heads; Branch Managers; Audit Department Heads; Audit Unit Heads	15	
Modern Trends in Internal Audit	Financial Affairs Managers, Audit, Administrative; Technical Department Heads (Salaries and Wages, Employee Affairs, Stores, Technical); Audit Department Heads; Audit Unit Heads	10	
Field Visits for Similar Institutions	Financial Affairs Managers, Audit, Administrative; Technical Department Heads (Salaries and Wages, Employee Affairs, Stores, Technical); Audit Department Heads; Audit Unit Heads	8	
GIS Program	Deputy GM for Technical Affairs; Technical Department Heads and Projects; Engineers	15	
Water Network Design	Deputy GM for Technical Affairs; Technical Department Heads and Projects; Engineers; Surveyors	16	
Management and Planning (Primavera)	Deputy GM for Technical Affairs; Technical Department Heads and Projects; Engineers	15	
Design of Solar Energy System for Wells and Pumping Stations	Deputy GM for Technical Affairs; Technical Department Heads and Projects; Engineers; Electricians; Well Operators	20	
Electromechanical Maintenance of Pumps, Motors, and Generators	Deputy GM for Technical Affairs; Technical Department Heads and Projects; Engineers; Electromechanical Technicians; Pump Operators	20	

Computer Networks and Maintenance	Deputy GM for Technical Affairs; IT Systems Manager; Head of Maintenance and Networks Department; Head of IT Department; Technical Department Heads	10	
Oracle Specialist	Deputy GM for Technical Affairs; IT Systems Manager; Head of Maintenance and Networks Department; Head of IT Department; Technical Department Heads and Projects; Engineers	15	

Table 2.3: Capacity building and training

3. Financial Capacity

3.1 Financial management

3.1.1 General data on Financial management

The institute/branch applied the key financial management practices. Here are the main points:

- Audited Financial Reports: The institution/branch prepares annual financial reports that are independently audited, including details on profits and losses.
- Periodic Reports: There are no detailed financial reports generated on a periodic basis (monthly, quarterly, semi-annually). Reports are primarily compiled at the end of the fiscal year.
- Control Reports: Control reports on financial and accounting activities are produced quarterly through the Internal Audit Department at the branch level.
- Fixed Assets Record: The institution maintains a detailed and regularly updated record of fixed assets, displaying their current status and actual values for both the institution and its branches. This record is utilized during fiscal year-end closures and annual inventories.
- Financial and Accounting Computer Programs: The institution utilizes various automated programs for financial and accounting purposes, covering areas such as accounts, assets, warehouses, collections, invoices, salaries, and wages.
- Program Usage and Data Updates: The financial and accounting computer programs are actively used, with data being systematically updated under the supervision of the program designer.

These practices demonstrate a structured approach to financial management, including rigorous auditing, periodic controls, and the use of automated tools for efficient accounting processes. The institution places a strong emphasis on maintaining accurate records of fixed assets, contributing to transparent financial reporting.

According to the financial law, disbursement is regulated through the accounts in the Central Bank, thus direct disbursement from the revenue through cash is prohibited. But since the Ministry of Finance decided in 2017 to disburse only 50% of the balance or deposited amounts to the LC accounts at the Central Bank, the LC stopped depositing amounts to the bank and disbursed directly from revenues through cash fund (LC cashier).

Here are the key points regarding budget management and expenditures for institution or branch:

Budget Inclusion: The institution/branch consistently includes its expenses in the annual budget, following the financial regulations of the state.

Capital and Investment Costs: The budget encompasses both capital and investment costs. It outlines projects for asset maintenance and development over a five-year period. Notably, a study by Cox Company is mentioned.

Revenue Adequacy: Current revenues do not adequately cover the rising production and operational costs. The financial tariff falls short of covering fuel expenses and electricity costs, which account for a significant portion (30%) of total expenses.

Tariff Adjustments: The tariff has been adjusted four times within the last ten years, indicating a degree of flexibility in financial planning.

Liquidity for Monthly Expenses: The institution maintains sufficient cash liquidity to cover monthly operational and production expenses. However, some specific high-cost items, such as electricity expenses, pose a challenge.

Savings for Short-Lived Assets: The institution does have saved funds to cover costs for short-lived assets for the next two years, including items like prepaid rent.

Source of Funding for Expansion: For long-term development and expansion of water and sanitation systems, the primary revenue source is the water system. It's emphasized that this should not disrupt the accompanying revenue generated by selling water.

Capital Improvement Plan: The institution employs a multi-source funding approach (self, government, and external) for sustainable projects. Close collaboration with funding entities is a key strategy to bolster infrastructure.

Overall, the information reveals a comprehensive financial management approach, addressing budgeting, revenue generation, and strategic planning for capital improvement projects. The institution is actively engaged in seeking diverse funding sources for sustainable development initiatives.

3.2 Budget (Revenues, expenses, Aid and Liabilities)

3.2.1 Recurrent Budget

The annual total recurrent budget overview is used as monitoring tool to identify the LC's performance in utilizing the allocated and received budget. In addition, the deviations of the expenses to the approved or received budget from the funding sources - recurrent or investment budget – are identified.

The table below provides an overview of the recurrent requested budget and received amounts from the government.

Recurrent budget	2017	2018	2019	2020	2021	2022
Total recurrent budget requested in YER	N/A	1,574,888,000	1,819,711,000	2,033,458,000	2,848,189,000	3,196,844,000
Total recurrent budget approved in YER	N/A	N/A	N/A	N/A	N/A	N/A
In % of requested	xxx	xxx	xxx	xxx	xxx	xxx
Total recurrent budget received in YER	1,285,716,230	1,466,205,880	1,793,411,602	2,030,394,322	3,007,811,828	3,318,558,982
In % of requested	xxx	93	98.5	99.8	105	104
Total recurrent budget disbursed in YER	1,580,377,248	1,767,512,689	2,036,213,089	1,993,195,672	2,488,717,780	3,179,066,937
In % of received	xxx	112	112	98	87	99

Table 3.1: Recurrent budget for the last six years

The LC did not receive any budget from the Ministry of Finance. No recurrent or investment budget has been approved by the Parliament after 2014. According to the financial law, the latest approved budget shall be applied for the following years. Thus, the approved budget for 2014 is applying for 2015 until now. However, it is impossible to use it for monitoring and controlling or identifying deviations in expenses and revenues due to increase of prices for diesel and operation and maintenance cost during the crisis.

3.2.2 Revenues, Expenses and Liabilities

The table below presents an overview of the annual amount of operation and maintenance cost for the LC according to different categories for the past six years.

Revenues / Expenses	2017	2018	2019	2020	2021	2022
Total revenue in YER	-294,661,018	-301,306,809	-242,801,487	37,198,650	519,094,048	139,492,045
Total cost without depreciation in YER	1,192,449,619	1,379,450,057	1,634,206,651	1,669,371,875	2,192,531,991	2,877,174,192
% total cost versus total revenue	-4.047	-4.578	-6.731	44.877	4.224	20.626
Salaries, allowances, incentives and others in YER	574,479,853	669,863,033	797,834,861	663,444,996	814,505,672	895,718,787
% Salaries, etc. of total revenue	xxx	xxx	xxx	1791	157	642
% Salaries, etc. of total cost	36.35	37.90	39.18	33.29	32.73	28.18
Fuel, oil in YER	99,771,731	147,222,800	146,214,612	148,804,401	351,348,720	648,730,285
% Fuel, oil, of total revenue	xxx	xxx	xxx	400	67.7	465
% Fuel, oil, of total cost	6.31	8.33	7.18	7.47	14.12	20.41
Electricity in YER	301,355,037	326,642,362	354,359,964	650,588,455	752,558,609	952,508,025
% Electricity total revenue	xxx	xxx	xxx	1749	144	683
% Electricity of total cost	19.07	18.48	17.40	32.64	30.24	29.96
Maintenance, spare parts, other O&M expenses in YER	110,802,728	153,183,351	209,834,894	129,970,220	164,842,139	280,056,102
% Maintenance, other O&M of total revenue	xxx	xxx	xxx	349	318	201
% Maintenance, other O&M of total cost	7.01	8.67	10.31	6.52	6.62	8.81
Other expenses in YER	106,040,270	82,538,511	125,962,320	76,563,803	109,276,851	100,160,993
% Other expenses of total revenue	xxx	xxx	xxx	206	21	72
% Other expenses of total cost	6.71	4.67	6.19	3.84	4.39	3.15
Depreciation in YER	387,927,629	388,062,632	402,006,438	323,823,797	296,185,789	301,892,745
% Depreciation of total revenue	xxx	xxx	xxx	870	57	216
% Depreciation of total cost	24.55	21.96	19.74	16.25	11.90	9.50

Table 3.2: Revenues, recurrent costs and depreciation

Revenues

- Data regarding revenues clarify that LC began making profits in 2020 to 2022.

Revenues versus Expenses

- The total expenses are very high compared to revenues in 2017 to 2019. They reached a percentage of 44 % in 2020.
- The salary and electricity represents the highest percentage of the total expenses. It represented about 60 % of the total expenses. The salary is considered as fixed costs which are not affected by increase or decrease in water production.

3.2.3 Financial Liability (Payable amount)

To identify the financial liabilities of the LC, the accumulated debts until 2022 have been assessed and are presented in the table below.

Financial liability	2022(YER)	% of total
Salaries and wages	N/A	N/A
Other dues for employee	48,514,391	1.2 %
Indebtedness of electricity	3,973,875,792	98.8 %
Fuel and oil	N/A	N/A
Insurance	N/A	N/A
Taxes	N/A	N/A
Local councils	N/A	N/A
Other financial obligation	N/A	N/A
Total	4,022,390,183	100 %

Table 3.3: Financial liabilities in 2022

3.3 Financial Data

3.3.1 Financial Efficiency and Support

Compared to 2017, the revenue in 2022 increased by 348.1 (savings without depreciation) million which presents 3.73 % of revenue in 2017. The table below summarizes the financial overview of the LC since 2017.

Description	2017 (YER)	2018 (YER)	2019 (YER)	2020 (YER)	2021 (YER)	2022 (YER)
Total revenue	-294,661,018	-301,306,809	-242,801,487	37,198,650	519,094,048	139,492,045
Total cost without depreciation	1,192,449,619	1,379,450,057	1,634,206,651	1,669,371,875	2,192,531,991	2,877,174,192
Depreciation	387,927,629	388,062,632	402,006,438	323,823,797	296,185,789	301,892,745
Total cost with depreciation	1,580,377,248	1,767,512,689	2,036,213,089	1,993,195,672	2,488,717,780	3,179,066,937
Deficit / savings with depreciation	-294,661,018	-301,306,809	-242,801,487	37,198,650	519,094,048	139,492,045
Deficit / savings without depreciation	93,266,611	86,755,823	159,204,951	361,022,447	815,279,837	441,384,790
Support (USD)	N/A	747,479	268,888	92,833	46,800	1105099

Table 3.4: Financial Overview for (2017-2022)

3.3.2 Bank Account Data and Cash Flow

The table below presents an overview of the accounts for Seiyun

	Account Type	Connections Account	Income Account	Expenditure Account	Depreciation Account
2017	first period balance (YER)	14,497,308	280,282,882	10,129,423	344,244,850
	Total Deposits (YER)	122,914,244	874,920,202	745,568,236	1,100,000
	Total withdrawals and transfers (YER)	127,951,783	893,389,263	751,673,806	-
	end period balance (YER)	9,459,768	261,813,822	4,023,853	345,344,850
2018	Total Deposits (YER)	211,284,840	1,117,774,320	954,691,807	750,000
	Total withdrawals and transfers (YER)	116,586,797	1,180,367,076	951,635,484	-
	end period balance (YER)	104,157,811	199,221,065	7,080,175	346,094,850
2019	Total Deposits (YER)	233,227,329	1,314,475,492	997,330,656	900,000
	Total withdrawals and transfers (YER)	29,257,061	1,293,775,457	994,055,961	150
	end period balance (YER)	44,812,080	219,921,101	10,354,871	346,994,700
2020	Total Deposits (YER)	102,717,066	1,158,992,493	853,513,894	300,000
	Total withdrawals and transfers (YER)	115,042,391	1,011,734,271	856,475,435	-
	end period balance (YER)	32,486,755	367,179,323	7,393,330	347,294,700
2021	Total Deposits (YER)	612,112,348	1,649,626,133	1,366,837,016	650,000
	Total withdrawals and transfers (YER)	346,798,447	1,703,496,622	1,367,911,167	-
	end period balance (YER)	297,800,656	313,308,834	6,319,179	347,944,700

2022	Total Deposits (YER)	404,144,767	1,728,921,005	1,473,061,835	500,000
	Total withdrawals and transfers (YER)	642,741,204	1,795,379,968	1,463,454,739	-
	end period balance (YER)	59,204,219	246,849,871	15,926,275	348,444,700

Table 3.5: Bank Account Details

Once post-conflict condition applies, the actual situation (particular regarding physical damage) of the LC has to be reviewed and the cash flow requirements updated respectively. In addition, the financial support has to be controlled through the MoF and in accordance with their regulations.

3.3.3 Financial sources, subsidies and support

The table below presents an overview of the received funding subsidies in the past five years.

Funding organization	Kind of support (USD)	Year
UNICEF	747,479	2018
	Total 2018 747,479	
UNICEF	268,888	2019
	Total 2019 268,888	
GIZ	52,268.5	2020
UNICEF	23,064	2020
Ministry of Water	17,500	2020
	Total 2020 92,833	
GIZ	46,800	2021
	Total 2021 46,800	
UNICEF	489,951.9	2022
GIZ	600,613.3	2022
Local authority	14,534.51	2022
	Total 2022 1,105,100	
Total		

Table 3.6: Financial subsidies from donor relief organizations

3.3.4 Budget required for post-conflict scenarios

The institution anticipates an increase in expenses if the current crisis persists, primarily due to rising costs of fuel, transportation, and goods and services. This is exacerbated by irregularities in debt repayment, leading to a shortage of reserve funds.

In the event of a post-crisis reconstruction scenario, the institution expects to request a budget similar to the current year, primarily because many expenses, such as salaries, wages, and regulatory requirements, are fixed. Additionally, the prices of fuel, oils, and electricity remain crucial factors in budget considerations. The institution also expresses the intention to gradually transition to solar energy reliance to stabilize costs.

Overall, the institution recognizes the importance of financial planning and anticipates potential budget adjustments based on the evolving circumstances.

4. Customer Services

4.1 Customers Data and Reporting

The table below summarizes the number of connections per customer category for the water and sewer system. The total number of water connections in 2022 is 61,102 connections, with an increase of 11069 connections over the year 2017, most of which are in the domestic sector (53,820 connections).

The total number of sewerage connections in 2022 is 2,676 with an increase of 326 compared to 2017.

Connections	Domestic connections	Government connections	Commercial connections	Total connections
No of Water connections	53,820	496	2,480	61,102
No of Sewer connections	2,389	59	187	2,676
No of installed water meters	55,492	594	6,874	64,422
%installed water meter to total connection	103	120	277	105
No of functional water meters	53820	496	5377	61102
% of functional water meter to total	97	84	78	95
No of zero Reading	N/A	N/A	N/A	9,581
% of zero Reading water meter to total	N/A	N/A	N/A	15

Table 4.1: Water and Sewer connections per customer category

The total number of installed water meters amounts to 64,422meters with 95% functioning water meters. The

respective customers with non-functioning water meters are charged for either an estimated consumption or a fixed amount per month.

In addition, there exist 9,581 zero reading water meters, representing 15 % of the total connections which indicates that the respective customers are charged only for the minimum consumption of 5 m³ per month.

The LC charges 97 % of the customers for the consumption from the actual water meter readings.

4.2 Invoicing, Collection, and Complaint Procedures:

The company has a comprehensive approach to customer database maintenance, utilizing various mechanisms, tools, and applications to ensure it is kept up-to-date. However, specific details about invoice printing were not provided. Additionally, the company employs external collection centers, offering services such as mail, exchange shops, and commercial stores for convenient customer interactions. Field operations are managed by 39 meter readers, while there are no designated field revenue collectors. Interestingly, the company does not currently utilize digital collection aids. An incentive system is in place for both field and office staff involved in customer service and relations, with rewards tailored to the nature of the work and the effort exerted. Documented guidelines are available for service connection procedures, particularly for customer accounts. Notably, all mentioned procedures were implemented in 2022. Both electronic and printed copies of invoicing and collection procedures are accessible to the team. Finally, the company follows special procedures to effectively address and resolve customer complaints and grievances.

4.2.1 Billing and Collection Procedures

Reading Meters:

- Readings are manually recorded for each reader according to a schedule.
- Readings are entered into statements exported from the billing program.

Issuing and Distributing Invoices:

- Invoices are finalized at the end of each month using the billing program.
- Invoices are distributed to readers, and readings are consolidated for the next month.

Payment Methods:

- Payment methods include post offices, exchange offices, and commercial shops.

Resolving Payment Disputes:

- Disputes are resolved in two scenarios:
  - If the subscriber is present, they may choose to settle the debt through installments, which are scheduled for payment.
  - If the subscriber is absent, the service is disconnected, and payment can be settled either in full or through convenient installments.

Handling Billing Complaints:

- Specialists address problems as soon as they are discovered.
- Subscribers can also file complaints through Customer Relations to the branch manager.

Addressing Service Delivery Issues

- Customer Relations and specialists work together to resolve issues related to low or non-delivery of services.

Inspecting Violations:

- Violations related to consumption, such as tampering or damage to meters, are recorded by readers.
- Customer Relations takes necessary actions in accordance with the regulations.

Meter Maintenance:

- Faulty meters are either replaced or repaired.
- If only a part of the meter is replaced due to a shortage of new meters, a monthly consumption rate is calculated.

4.2.2 The key challenges and development needs related to subscriber management processes:

Billing Process:

- Shortage of invoice printers and need for equipment updates.
- Training and qualification needed for subscriber accounts and readers.
- Requirement for digital devices to record and transfer readings directly.

Collection Process and Debt Monitoring:

- Low individual income during the war period.
- Weakness in security aspects during the war period.

Subscriber Meters:

- Most used meters are old and overdue for replacement due to unavailability of new meters.

Service Provision for Subscribers:

- Delay in connecting services for subscribers due to absence of meters.
- Issues related to the backhoe excavation process.

Workflow and Data Handling:

- No specific issues reported.

Planning and Performance Monitoring:

- Preparation of a plan for subscriber accounts, but discontinuation of employee performance evaluations in recent years.

Automation and Modern Technology Usage:

- Lack of digital devices for meter readings.
- Need for equipment updates and addressing shortages.

Employee Qualifications and Capabilities:

- Focus on qualification of the workforce in subscriber accounts.

Other Administrative Problems:

- Urgent need to update the current organizational structure and job descriptions through specialized consulting.

4.2.3 The technical assistance and investment needs identified for improving the management of subscriber services and relations:

- Providing invoice printers for five branches of the institution.
- Implementing automated programs for procedures related to service requests in subscriber accounts.
- Developing automated programs for taking readings.
- Implementing automated field collection programs along with providing associated devices.
- Supplying motorcycles for meter readers.
- Conducting training courses for employees in subscriber accounts.

4.2.4 Billing & Collection data

The LC takes monthly water readings and issues bills each month according to the procedure described above.

The domestic sector is the largest sector in water sales, with 88 %, of the total connections (53,820 out of 61,102), while it represents only 53 % of the total amount billed (1,275,539,373 of 2,416,993,117 YER) in 2022.

The government sector represents 0.8 % of total customers, only 496 connections, however it represents 21 % of the total amount billed (505,248,416 of 2,416,993,117 YER) in 2022. The commercial sector represents 4 % of consumers while it represents 7 % of the billed amount.

This indicates that the LC relies on the governmental sector in increasing or decreasing the collection efficiency, whereas in 2022 the collection efficiency of government was 5.4 % and the total efficiency presented of 407% excluding 10 % services fees, the biggest rate of collection efficiency is 2019 % in 429. This figure decreased in 2022 to 407 %.

The LC billed amount approximately 2,416,993,117 YER in 2022. From the issued bills, only 257,926bills were paid.

The details for the billing and collection for the last six years and depending on the customer type can be seen in the table below.

Customer category	2017			2018			2019			2020			2021			2022			
	Number of bills	Water and wastewater	coll. Eff.	Number of bills	Water and wastewater	coll. Eff.	Number of bills	Water and wastewater	coll. Eff.	Number of bills	Water and wastewater	coll. Eff.	Number of bills	Water and wastewater	coll. Eff.	Number of bills	Water and wastewater	coll. Eff.	period of debt - month
	No	YER	%	No	YER	%	No	YER	%	No	YER	%	No	YER	%	No	YER	%	Months
Domestic billing	7,841,480	735,649,998	89.1%	8,166,764	863,149,149	128%	9,609,483	1,027,972,991	86.6%	11,093,574	1,177,198,602	86.8%	18,362,640	1,261,388,730	87.3%	19,380,350	1,275,539,373	86.6%	N/A
Domestic collection	xxx	655,598,249		xxx	1,104,275,794		xxx	890,322,593		xxx	1,021,578,253		xxx	1,101,706,345		xxx	1,104,275,794		
Governmental billing	41,511,250	202,119,827	6.7%	39,279,750	209,004,942	13%	36,340,000	209,997,636	5.8%	40,463,000	211,159,478	10.1%	112,446,150	543,618,703	47%	113,607,200	505,248,416	5.4%	N/A
Governmental coll.	xxx	13,454,182		xxx	27,092,375		xxx	12,224,384		xxx	21,396,934		xxx	255,542,317		xxx	27,092,375		
Commercial billing	5,110,950	112,623,222	88.8%	5,879,100	116,988,771	145%	6,898,650	130,621,824	95.4%	6,382,650	137,735,835	92.7%	10,320,000	165,279,187	90.9%	10,129,980	177,233,472	95.8%	N/A
Commercial collection		99,999,535			169,864,762		xxx	124,671,345		xxx	127,742,571		xxx	150,225,107		xxx	169,864,762		
Total billing	51,953	1,300,151,263	421%	54,157	1,442,646,317	426%	56,300	1,631,080,310	429%	58,819	1,781,204,761	428%	61,283	2,335,416,568	418%	63,415	2,416,993,117	407%	N/A
Total collection	218,516	xxx		230,644	xxx		241,542	xxx		251,709	xxx		255,944	xxx		257,926	Xxx		

Table 4.2: Billing and collection amount per customer category

The accumulated debts of the three main categories are as follows:

- Domestic: 7,763,816,769.373 YER, corresponds to 72 months
- Governmental: 11,489,991,941,240 YER, corresponds to 72 months
- Commercial: 19,253,808,710,613 YER corresponds to 72 months

4.3 Tariff structure according to customer type and consumption

This Tariff took into account the poor customers or rationalization of consumption in the tariff of the domestic sector and mosques. The sewerage tariff services are calculated as 50 % of the water tariff and applies for customers connected to the sanitation services.

As shown in the table below the tariff is structured in different subcategories for each category of customer and presents the monthly fee per m3 water consumed.

Customer category	Amount of Consumption in m3/month	Water Tariff (YER/m3)	Sewerage Tariff (YER/m3)	Total Tariff YER
Domestic & Mosques	(0 -5)	200	100	300
	(6 - 10)	40	20	60
	(11 - 20)	80	40	120
	(21-30)	120	60	180
	(31- 9999999)	140	70	210
Government	(0 - 3)	3000	2100	5100
	(4 -999999)	1000	700	1700
Commercial & Other	(0 - 2)	600	420	1020
	(3- 9999999)	300	210	510

Table 4.3: Approved tariff structure

Obviously, the current tariff is insufficient to cover the total operation cost as stated hereinafter.

Production cost and tariff efficiency

The table below presents the analysis of the average production cost of water versus the average tariff charged for customers:

Description	2017	2018	2019	2020	2021	2022
Average cost of water produced YER/ m^3	91.27	98.23	105.67	98.52	117.26	151.18
Average cost of water sold YER/ m^3	110.87	118.39	127.3	134.14	170	171.46
Tariff recovery of water billed	67.72	67.72	66.49	65.63	64.76	67.03

Table 4.4: Water production cost versus tariff

The current tariff does not cover operation and maintenance cost. The losses in 2022 is about 22 % per cubic meter water billed, these figures must be incorrect since the operation and maintenance cost increased and subsequently the water production cost.

The LC should aim to increase its revenues and therefore improve their financial capacity through:

- Gradual increase of tariff structure;
- Increase number of connections;
- Minimize the Non-revenue water;
- Increase the collection efficiency from all customers and collected bills of domestic customers.

5. Assessment of IT infrastructure and management

5.1 IT and office resources

The Information Technology network status is as follows:

- There are 40 sites with an internal LAN network available in the main building with a line speed of 100MB. Additionally, the network is distributed across 2 buildings at the main administration site, utilizing LAN technology with a line speed of 100MB and there are 5 sites with an external Wireless connection, each operating at a line speed of 75MB, located far from the main site.

Status of communications networks is as follows:

- Available communication networks in the area include Yemen Net, Yu, Sabafone, and Yemen Mobile.
- Yemen Net is identified as providing higher quality services and better coverage compared to other networks in the area.
- Yemen Net, Yu, Sabafone, and Yemen Mobile are the mobile phone companies offering 4G internet service.
- Both wired and wireless internet services are available.
- The quality of connections allows for active participation in online meetings and training sessions.
- Power supply sources comprise of UPS, government electricity, and solar energy, all considered reliable.
- Electricity is available 24/24 for system operations.
- There are no reported adverse effects on the communication network due to power supply.
- All employees, departments, and services have access to the internet. If access is limited, specific details were not provided in the original information.

5.2 Data security and management

The institution or branch currently does not employ an antivirus program. Furthermore, the utilization of the antivirus software is not uniformly practiced across all computer users, and there exist no established protocols to ensure its consistent application.

In terms of power management, the institution employs gel batteries alongside Online UPS systems for voltage stabilization. This choice of equipment serves to maintain operational continuity.

Regarding data backup procedures, a designated individual is entrusted with the responsibility of executing backup tasks. The backups are stored at two distinct locations within each instance, thereby ensuring redundancy and safeguarding against data loss.

Both manual and automated backup methods are integrated into the institution's data management protocol. However, there is no recent record of data restoration from a backup source, indicating a notable absence of critical data loss incidents.

The management of user access and permissions is conducted under the purview of specific designated personnel. This approach ensures a structured and controlled user access environment, contributing to heightened security measures.

Furthermore, the institution has established comprehensive plans for the recovery and reactivation of IT systems in cases of emergencies and disasters. These contingency plans incorporate a data exchange protocol between the central administration server and the server located at the Trim branch.

5.3 Needs for IT and related office equipment

Item	Request Reasons	Description/ Specifications	Quantity	Priority
Desks	Shortage	-	32	Medium Priority
Chairs	Shortage	-	42	Medium Priority
Split Air Conditioners	Shortage	-	19	Medium Priority
Desktop Computers	Shortage	-	50	High Priority
Laptop Computers	Shortage	-	14	Medium Priority
Servers	Shortage	-	3	Critical Priority
Invoice Printers	Shortage	-	5	Critical Priority
Electrical Organizers	Shortage	-	70	Medium Priority
Backup Batteries	Shortage	-	12	High Priority
Electrical Chargers	Shortage	-	10	Medium Priority
Routers for linking between Branch and Main Center	Shortage	-	5	Medium Priority
Local Network Switches in the Branch	Shortage	-	5	Medium Priority
Internal Wireless Modems	Shortage	-	7	Medium Priority
Network Firewall	Not Available	Consider compatibility with Windows XP, Vista, 7, 8, 10, 11	2	Critical Priority
Software Updates	-	-	-	High Priority
New Software or Replacement		Archives and Secretariat	2	High Priority
Other Requirements for IT Infrastructure, Hardware, Software, etc.	Not Available	Surveillance Cameras + DVR	15	Medium Priority

Table 5.1: Information technology and office needs for devices and equipment

5.4 Proposed TA measures for improving IT management

Needs	Priority	Target Categories and Details
IT management procedures and operations?	High	IT Management and Information Systems team in the General Directorate and branches
Hardware Maintenance Courses	Critical	IT Management and Information Systems team in the General Directorate and branches
Local and Wireless Network Courses	High	IT Management and Information Systems team in the General Directorate and branches

Table 5.2: Proposed TA measures

6. Gender Cross Cutting Issues

6.1 Administrative and organizational status of gender

The administrative and organizational status of the Women's Management within the water institution is as follows:

- The organizational structure includes a Women's Management.
- There is a job description for positions within the Women's Management.
- The Women's Management is active and engaged in its activities.
- The Women's Management does not currently participate in planning and updating strategic policies due to its recent establishment.

- Female employees and managers from the Women's Management have not participated in water and environmental meetings or women's networks, as invitations have not been received.
- An action plan specific to the Women's Management has not been developed yet, but it is planned for the future.
- The Manager of the Women's Management also works in the Customer Service Department and assists in resolving disputes when necessary.
- The Manager of the Women's Management has not moved to other departments.
- There is no database classified by gender.
- There is no specific budget allocated for the Women's Management in the institution/branch.

7. Assessment of Water and Sanitation

Water Supply and Infrastructure System General Situation:

The LC indicated that there is partially damage on buildings and reservoirs, but all of that was due to the deterioration over the years.

On the other hand, there are many indirect negative impacts caused by the crisis: power cuts, financial constraints (decrease in revenues), increase of the operation and maintenance cost and lack of materials due to the lack of an investment program granted from the national budget (Ministry of Finance) since 2015.

The methodology for the data collection and assessment has been presented already in Chapter 1.3 in this report. The questionnaire forms for Part B, comprised questions regarding the technical condition, availability, parameters and physical status of the utilities infrastructure. The assessment focused on the following infrastructure:

- Building and Administrative Facilities
- Water Supply System and Sources
- Sanitary Sewer System
- Energy Sources for Water and Sanitary Sewer Systems
- Operation and Maintenance Management

7.1 Buildings, administrative and technical facilities

7.1.1 Information on administrative buildings

The General Administration Building, located in Sayun - A'idid, is owned and constructed with reinforced materials, spanning three floors with 30 offices. It is in good operational and current condition, having undergone painting, furniture placement, and restoration. Similarly, the Sayun Branch Building and Annex, also in Sayun - A'idid, is owned and constructed with a combination of reinforced and local materials. With two floors, 31 offices, and good operational status, it requires some renovation. The Tarim Branch Building and Annex, constructed with clay, is situated in Tarim - Ard Al Nahas and is owned. It features two floors, 22 offices, and is in regular use, but needs some renovation. The Shibam, Qatan, and Sah Branch Buildings and their annexes, all constructed with clay, are owned properties with one floor, varying numbers of offices, and are in use but require renovation. Overall, these buildings play essential roles and efforts are being made to maintain and improve their conditions for continued functionality

7.1.2 Information of technical buildings

The provided information summarizes the status and details of various buildings and technical structures. These structures are primarily related to water management and supply, such as pump buildings and well facilities, located in different areas. They are constructed using various materials, including reinforced structures and traditional designs with a huge difference in areas. The operational status varies, with some buildings used regularly while others are only partially utilized. Many of these structures are currently experiencing partial destruction and are in need of renovation to restore them to good condition, particularly those serving essential functions in wells and water management.

7.1.3 Investment requirements for buildings, administrative and technical facilities

Each building's energy source is needed to be primarily solar, with additional equipment such as computers, air conditioning, and maintenance tools specified as necessary. The estimated costs for these buildings range from $40,000 for the General Administration Building in Sayun to $1,800,000 for the Sah District Building. The expenses account for a variety of needs including solar energy installations, equipment procurement, furniture, hangars, and building renovations, depending on the specific requirements of each building. These initiatives demonstrate a commitment to incorporating sustainable energy solutions in the design and operation of these buildings.

7.1.4 Water production, distribution and supply system

As of 2022, 46 of the 47 existing water wells are operational. Production data overall was consistent in the way it was provided in part B of the questionnaire forms. It does not reflect any effect caused by the crisis. On the contrary, the water produced quantity increased in 2022 by 9 % compared to 2019 and by 21 % compared to 2017.

Additionally, the nominal water production capacity was constant throughout the years. The average nominal water production capacity provided by the LC is 53,454 m3/d in the six evaluated years. It seems that this calculation is

based on the yield capacity and pumps efficiency rather than on measurements.

The chart below demonstrates the increase in the actual/ current water production over the years.

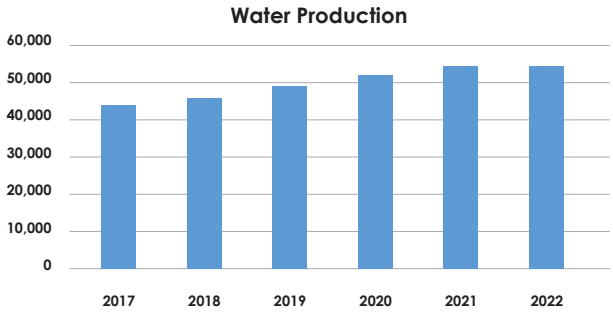

Figure 7.1: Average water production in m3/day for the years (2017 – 2022)

The LC keeps regular records on water quality tests. There is one water laboratory available for the testing and control of water. However, the laboratory is lacking necessary equipment, chemicals, and reagents, required for conducting proper testing and ensuring that the water is safe for its intended use.

The majority of wells and water resources are situated within protected areas, with only three exceptions. These three wells were hastily drilled to alleviate water scarcity issues in the Seiyun, Shibam, and Al-Qatn branches. Fortunately, the fields surrounding the wells do not face any immediate or potential sources of pollution. Additionally, the water quality is deemed satisfactory, and there are currently no plans to implement measures to counteract any potential decline in quality or to alter the treatment process. However, it is noted that the well field sites are susceptible to flooding. On a positive note, regular maintenance of the wells and sources is diligently carried out, ensuring their continued functionality and efficiency.

Water supply infrastructure and management

The following table is an overview of the available water infrastructure and facilities as of 2017 compared to 2022.

Description / Facility	Unit	2017	2022
Public water distribution points	No	0	0
Main source of water supply (SW or GW)		GW	GW
Number of distinct supply zones	No	5	5
Total number of boreholes	No	37	46
Boreholes in operation (=borehole pump no)	No	37	46
Ground Reservoirs	No /m3	32/14913	33/19313
Elevated Tanks	No /m3	0	0
Nominal water production capacity	m3/d	47,437	57,614
Water sterilization facilities	No.	3	3
Current water production capacity	m3/d	47,437	57,614
Total no. of domestic water meters installed	No	43	52
Total no. of functioning domestic water meters	m	43	52
Length of the water supply network	km	1,838,000	2,022,000
Total nos. of bulk water meter	No	6	6
Water Laboratory	No	xxx	1

Table 7.1: Overview of available water infrastructure

The water production wells are located in 4 water basin fields: Jathmah well field, 12 wells in Tarim field, 5 wells in Moushah field , 3 in Joujah field, 6 in Al-Hamdan field, 4 in Sah field, and 1 in Alhotah and Gharb Althanwyeah

The number of wells in 2022 is 47; 46 are operational and 1 out of services. The nominal production from these fields is 57,614 m^3/day, and the current production is 57,614 m^3/ day.

The depths of wells are in the range from 119 to 235 meter in Jathmah, and about 140 meter in Tarim.

The pumping station of Seiyun consists of two high pressure pumps with total pump quantity of 180 m^3/hour and the motors rated power 55 kW. The pumping station in mdawdweh consists of one high pressure pumps with a total quantity of 72 m^3/hour and the motors rated power of 55 kW.

The 33 reservoirs consist of 33 ground reservoirs with total capacity of 19,313 m^3. These reservoirs play a crucial role in water collection and storage across different locations. They are primarily constructed with reinforced materials, ensuring their durability and longevity. The majority of these facilities are reported to be in good condition and are utilized regularly for their intended purpose. Construction years span from as early as 1980 to the most recent facility completed in 2020. These storage facilities represent a vital component of the water infrastructure, contributing to the reliable supply and distribution of water resources in their respective areas.

Water consumption service areas data

The LC keeps regular records on water production, consumption and losses. Several water meters are installed at the wells and reservoirs. Furthermore, 6 bulk water meters are installed in the network. The average water consumption is 88 lpcd under normal supply condition. Compared to the average consumption in Yemen with 49 lpcd, the supply situation in Seiyun is one of the best.

However the table below shows that the water losses are very high with 33 % in 2022.

Description	2017	2018	2019	2020	2021	2022
water production(m3/year)	17,314,570	17,993,355	19,269,696	20,232,194	21,223,129	21,028,966
water consumption (m3/year) (billing)	11,726,189	12,185,171	12,813,076	13,278,440	13,743,888	14,096,739
Nos of connection	50,033	52,300	54,238	56,802	59,180	61,102
Nos. of supplied population	358,376	372,568	385,560	401,160	417,840	430,560
water consumption lpcd	90	88	89	90	90	88
NRW in m3/year	5,588,381	5,808,184	6,456,620	6,953,754	7,479,241	6,932,227
% of total water losses (NRW)	32	32	34	34	35	33

Table 7.2: Water balance for (2017-2022)

There was considerable change in the water production during the assessed years which decreased by 21%, but the impact of crisis is not considerable on the consumption per capita per day which decreased from 90 lpcd in 2017 to 88 lpcd in 2022, as well as the water losses which increased from 32% in 2017 to 33 % in 2022.

Ground and elevated water reservoirs

The provided information details various reinforced concrete tanks located in different facilities. These tanks serve as collection points for water from several wells. The capacities of these tanks range from as low as 22 to as high as 4000. The construction material used for these tanks is reinforced concrete, ensuring durability and stability. The majority of these tanks, constructed between 1980 and 2022, are reported to be in good condition and are utilized regularly. Notably, the "New Tank," built in 2020, boasts a capacity of 600. However, some entries lack specific construction years. Overall, this summary highlights a network of strategically placed tanks that play a crucial role in aggregating water resources from multiple wells, contributing to sustainable water management in the respective regions.

Water supply network

The water supply network at LC Seiyun is 2,022,000 meters long with diameters of 300 and 500 mm, and comprises 53820 water house connections.

The network and transmission line from 1986 are suffering from the repeated blockages because the pipes are almost dilapidated. The following table presents the details of the water supply network.

Pipe Category	Size DN	Material	Length
	mm		m
Distribution	450-500	Ductile + galvanized + plastic + asepto + polyethylene	603,790
Distribution	450-500	Ductile + galvanized + plastic + asepto + polyethylene	440,650
Distribution	450-500	Ductile + galvanized + plastic + asepto + polyethylene	297,775
Distribution	450-500	Ductile + galvanized + plastic + asepto + polyethylene	263,636
Distribution	450-500	Ductile + galvanized + plastic + asepto + polyethylene	13,674

Table 7.3: Details of existing water supply network

Water Distribution

From the 620,772 residents in LC Seiyun, about 69 % respective Seiyun people are supplied through the public network and about 21 % are served by private sector. The water supply is 24 hours per day. According to the LC the number of functioning water meters is 52.

In LC Seiyun, there are 5 water supply zones in the city; all of them are actually served.

Electro-mechanical (EM) facilities for the water supply system (water resources and pumping station)

All water supply systems utilize a direct supply method and are equipped with European-manufactured motors. They operate on electricity supplemented by generators. The motors have varying power outputs, ranging from 37 to 55 kW. Voltage requirements are consistent at 380 volts, with cable diameters measuring 35mm. However, certain units are grappling with issues such as corrosion and frequent malfunctions, leading to their current status being categorized between levels good to corroded, and their performance levels ranging from good to frequent malfunctions. These systems play a vital role in providing water supply, with some stations exhibiting minor operational challenges.

7.1.5 Water Quality

- Water disinfection and treatment units: There are no water sterilization units
- Water laboratories information and operational capacity

The institution has a water laboratory. However, there is no dedicated building for the laboratory. They have the necessary equipment and facilities for qualitative and quality tests of drinking water, but some materials and consumables, particularly heavy metals, are not readily available due to their high cost. While there is a power source for the laboratory, there is no alternative in case of electricity outage. They have a partially specialized staff for the laboratory. Occupational safety tools and emergency requirements are available. Laboratory waste is disposed of appropriately - liquid waste through sewage channels and biological waste is sterilized and then disposed of through sewage. The laboratory equipment is calibrated periodically. Both biological and chemical tests are conducted in the laboratory, encompassing a range of parameters including heavy metals, nitrates, and biological indicators like coliforms.

7.1.6 Assessment Results for Water Supply System

The constraints the LC faces in operation and maintenance water supply facilities can be summarized as following:

- Huge demand on electricity to operate the wells and pumping stations.
- The LC has to carry out an additional task of power generation due to the interruption of supply from the public network.
- High prices of diesel and other operation and maintenance cost.
- The difficulties to implement the contingency plan in case of crisis escalation since all the wells are far away of the cities supply is by pressurized system.
- Operating the generator and pumps 24 hours per day in hot and humid climate; this decreases the life span of the generators by 3 to 5 years.

Besides, the LC staff maintains the equipment and network only after failure of pumps, pipes or after appearance of leaks etc. There is no preventive maintenance procedure in place, due to lack of O&M material, but also because of inadequately resourced LC, i.e. insufficient O&M staff.

The needed material and equipment and O&M material comprise:

- Telemetric remote operating system
- horizontal centrifugal pumps for water pumping stations and spare parts
- new diesel generators and spare parts
- domestic water meters;
- pipes of different material and diameters;
- valves of different sizes and types;
- bulk water meters of different types and diameters;
- wide range of workshop tools;
- new equipment and spare parts;
- transformers;
- laboratory equipment; and disinfection unit;
- vehicles;

Only with adequate material and equipment the utility is able to carry out effective maintenance of the network and EM equipment. Domestic water meters are needed to enable billing according to consumption quantity and establish correct regular water balances. The new EM equipment and spare parts are needed for the efficient operation of pumps and transformer

7.2 Sanitation system

7.2.1 General data of the waste water system, sewer network

Seiyun wastewater treatment plant is suspended due to the incomplete implementation of sewage networks. The sewage collection and transmission network in the Seiyun area includes various components such as plastic pipes and fittings. both plastic pipes and fittings were installed between 2004 and 2005, with a total quantity of 31,000 and 6,500 respectively with a diameter of 6 to 10 inch. both components are almost dilapidated and partially working.

The treatment plant in Tarim is under construction

Description / Facility	unit	2017	2018	2019	2020	2021	2022
Total population	Nos	525,234	543,083	561,540	580,626	600,362	620,772
Total served population (by network)	Nos	0	0	0	0	0	0
Nos of wastewater connection by Sewage trucks	Nos	2350	2421	2469	2557	2691	2676
Total served population by the institution/branch	Nos	16450	16947	17283	17899	18837	18732
wastewater service coverage	%	3.1	3.1	3.1	3.1	3.1	3.0
Length of the wastewater supply network (collection & transmission)	m	22,000	22,000	22,000	31,000	31,000	31,000

Table 7.5: Overview of available wastewater infrastructure

There is no Electromechanical equipment for the wastewater system. The collected wastewater is pumped and pouring at a location outside the city. The rest of people is using septic holes, where wastewater is filtered and absorbed by the soil.

7.2.2 Sanitation laboratories information and operational capacity

The institution/branch does not have a dedicated sewage laboratory. Instead, sewage water samples are tested in the water laboratory upon request. Unfortunately, there is no suitable place for the laboratory, and some essential equipment for specific tests like Boron and Chemical Oxygen Demand (COD) is unavailable, along with incubators. While some materials were supplied with the equipment, not all necessary materials, consumables, and chemicals are readily available. The laboratory lacks a sufficient power source, and there is only partial availability. Fortunately, there is a specialized staff on hand for the laboratory. However, occupational safety tools and emergency requirements are lacking. The method of laboratory waste disposal was not specified. Equipment calibration is performed periodically. Biological and chemical tests are conducted, but only upon request, covering parameters such as Ammonia, Phosphate, Electrical Conductivity (EC), pH, and Oxygen levels (O2).

7.2.3 Assessment Results for the Sanitation System

Similar to the water infrastructure, there is no preventive O&M for the available sewer network. The LC requires O&M materials as well as procedures to enable them to maintain their equipment on regular basis.

The coverage of the population to the sewerage network with only 3 % should be increased by extending the sewerage network, considering the economic point of view. The possibility for decentralized systems has to be investigated for the future planning.

7.2.4 Required investment measures for water and waste water laboratories

Statement	Required for/ Installation Location	Technical Specifications	Unit	Quantity	Estimated Unit Cost (in USD)	Total Estimated Cost (in USD)	Priority
Flame Photometer	General Administration Lab	* Sensitivity: 0.5ppm or better * Linearity: better than ± 2% * Less than 0.5% interference * Automatic Selection of filters * Multi points calibration	EACH	2	12,000	24,000	Critical
Bench Top Turbidimeter	General Administration Lab	* Turbidity range: 0 to 1000 NTU * Microprocessor Control * Direct digital readout in NTU * Voltage 220-240V 50/60Hz	EACH	2	10,000	20,000	high priority (1-2 years)
Electronic bureles	General Administration Lab	Electronic	EACH	4	4,000	16,000	high priority (1-2 years)
Lab refrigerator	General Administration Lab	Chemicals	EACH	2	2,000	4,000	high priority (1-2 years)
NitraReagent P.P for 10ml Sample CPK11000	General Administration Lab	Chemicals	EACH	5	10,000	50,000	Critical
Nitrit Reagent P.P for 10ml Sample CPK11000	General Administration Lab	Chemicals	EACH	4	200	800	Critical
Sulfate Reagent P.P for 10ml Sample CPK11000	General Administration Lab	Chemicals	EACH	4	100	400	Critical
Eron Reagent P.P for 10ml Sample CPK11000	General Administration Lab	Chemicals	EACH	5	100	500	Critical
EDTA standard solution 0.01m	General Administration Lab	Chemicals	EACH	3	200	600	Critical

Table 7.4: Investment needs for water laboratories

7.3 Operation and Maintenance

7.3.1 Operation and Maintenance (O&M) management

Water Supply Operations Management:

- There is a production plan based on demand management policy and actual needs assessment.
- The specified procedures in the water production plan are followed.
- There are procedures for monitoring and supervising the operation of the water production and distribution system according to the prepared plan.
- There is a documentation system for the operation of machines and equipment used in water production and distribution.
- There are no automatic systems like SCADA for controlling the operation of machines and equipment, but there are historical operation records for important equipment.
- There is a qualified staff to operate and manage the machines and equipment used in water production and distribution.
- The operating team faces challenges with the operating system of some wells and the GIS program.

Water Supply Maintenance Management:

- There is a documented comprehensive maintenance plan for all electromechanical equipment, auxiliary means, and assets used in water production and distribution operations.
- There is a sufficiently qualified staff to execute various maintenance operations necessary for the equipment and machines used in water production and distribution.
- There is a dedicated maintenance workshop for the water system.
- The workshop is equipped with most necessary tools, inspection and measurement devices, but some tools and equipment are needed.
- Copies of technical drawings for the water network, as well as operation and maintenance documents for the equipment and machines used in the water system, are available in both hard copy and electronic form.
- Manufacturer recommendations regarding preventive maintenance for key equipment in the water system are implemented.
- There is a coding system for the machines and equipment used in the water system, and there are special cards for each machine and equipment.
- There is a historical documentation system for various maintenance operations (emergency - preventive) for machines and equipment used in water production and distribution.
- The average time taken to provide the requirements for executing emergency maintenance operations related to the water system, from receiving the request to starting the execution, is short.
- Preventive maintenance activities related to the water system are carried out on schedule.
- Quality, efficiency, and effectiveness standards are taken into consideration when carrying out maintenance activities in the water system.
- Safety materials, equipment, and tools need updating for the workers in the water system.
- Professional safety standards and instructions are followed when conducting maintenance activities in the water system.
- The maintenance team faces challenges related to a shortage of equipment, emergency vehicles, and installation parts.

Sewage System Operation Management

- There is a plan for collecting and transporting sewage water based on an actual needs assessment, and a copy of the plan is available.0
- The specified procedures in the sewage water collection and transportation plan are being followed.
- Procedures for monitoring and controlling the operation of the sewage system are in place, but there are areas for potential improvement.
- There is a documentation system for the operation of machinery and equipment, with both manual records and an automated system in place.
- There are no automated systems like SCADA used for controlling operations, but there are historical operation records available.
- There is a qualified staff available to operate and manage the machinery and equipment used in sewage water collection and transportation operations.
- The operating team faces issues with documentation of old networks, network clogging and safety equipment for workers.

7.3.2 O&M process data

Maintenance Data for the Water System

Description / Facility	unit	2017	2018	2019	2020	2021	2022
Meters of wells requiring calibration	No.	15	20	5	30	--	11
Meters of wells calibrated	No.	12	20	5	25	--	11
Meters of tanks requiring calibration	No.	4	3	--	--	7	6
Meters of tanks calibrated	No.	4	3	--	--	7	6
Water pumps inspected	No.	6	3	2	--	1	1
Well pumps malfunctioned	No.	5	2	2	--	--	5
Well pumps repaired	No.	--	--	--	--	--	--
Pumps replaced	No.	5	2	2	--	1	5
Generators inspected	No.	3	3	--	2	4	5
Generator failures	No.	3	3	--	2	4	5
Generators repaired	No.	3	2	--	2	4	5
Generators replaced	No.	--	--	--	--	--	--
Leaks detected	No.	6	4	8	4	3	2
Leaks repaired	No.	6	4	5	7	3	2
Total length of main pumping and distribution lines consumed	km	120	132	132	142	150	160
Total length of main pumping and distribution lines replaced	km	12	13	--	--	10	8
Total length of main pumping and distribution lines rehabilitated	km	--	10	--	--	--	2.5
Water connections rehabilitated	No.	--	--	--	200	--	50

Table 7.5: water system maintenance data

Maintenance Data and Indicators for the Sewage Collection and Treatment System

Statement	Unit	2017	2018	2019	2020	2021	2022
Compound flow meters in the sewage system	No.	--	--	--	2	2	2
Compound flow meters in the sewage system calibrated	No.	--	--	--	2	2	2
Breaks and collapses in the main lines of the sewage network	No.	--	--	--	--	--	--
Sewer blockage sites	No.	3	5	6	8	8	10
Total recorded blockages in the sewage network	No.	35	40	55	62	75	71
Total blockages in the sewage network that were opened	No.	35	40	55	62	75	71
Incidents of sewage water overflow	No.	--	--	--	--	--	--
Average frequency of sewage water overflow	No.	--	--	--	--	--	--
Areas prone to sewage water overflow in the city	No.	4	4	4	3	5	5
Total manhole covers and inspection rooms	No.	2	1	--	2	--	2
Manhole covers and inspection rooms replaced	No.	1	--	--	1	--	--
Full-time staff with recent vaccination certificates for sewage-related diseases	No.	--	--	--	--	--	--
Work-related injuries resulting in death or chronic illnesses due to non-compliance with occupational safety regulations	No.	--	--	--	--	--	--

Table 7.6: Sewage collection maintenance data

Inventory of machinery, heavy equipment, means of transportation, and logistical support for the operation and maintenance of water supplies and sewerage systems

Equipment Name/Number	Manufacturer Model	Year of Manufacture	Quantity	Department/ Section (Water/ Sewage)	Service Life/ Start Date of Operation	Current Status	Performance Level	Reasons for Out-of-Service (if applicable)
Excavator x 6	Case and Fiat	2003	6	Water	20 years	dilapidated	poor and frequent malfunctions	Requires maintenance and connection to machines
Small Dump Truck	Daihatsu	2000	10	Water	20 years	dilapidated	poor and frequent malfunctions	Requires maintenance and potential replacement
Crane	Caterpillar	1986	1	Water	25 years	dilapidated	poor and frequent malfunctions	Requires replacement
Suction Pump	Mercedes	2004	4	Sewage	18 years	dilapidated	poor and frequent malfunctions	Requires replacement
Large Dump Truck	Fiat	1999	1	Water	22 years	dilapidated	poor and frequent malfunctions	Requires replacement

Table 7.7: Heavy automotive machinery and equipment

7.4 Energy sources and supply for the water and sanitation systems, and energy efficiency

7.4.1 General information and data on energy sources for water and sanitation systems

Statement	Unit	2017	2018	2019	2020	2021	2022
Number of Electric Motors and Pumps Installed for Water Supply System	No.	40	41	42	42	44	46
Total Capacity of Electric Motors and Pumps Installed for Water Supply System	Kilowatts	2,200	2,255	2,310	2,310	2,420	2,530
Total Electrical Energy Requirement for All Water Production and Distribution Systems	Kilowatt-hours	52,800	54,120	55,440	55,440	58,080	60,720
Total Number of Generators Installed for Water Supply System	No.	14	14	14	15	16	17
Total Capacity of Generators Installed for Water Supply System	Kilovolt-Amperes	6,000	6,000	6,000	6,200	7,200	8,200
Number of Operating Generators for Water Supply System	No.	14	13	12	13	15	15
Total Capacity of Operating Generators Installed for Water Supply System	Kilovolt-Amperes	6,000	6,000	6,000	6,200	7,200	8,200
Number of Hours of Operation for Operating Generators for Water Supply System	Hour	2,190	2,190	2,190	2,190	2,555	2,920
Total Electrical Energy Produced by Institution/Branch Generators for Water Supply System	Kilowatt-hours	36,000	36,000	36,000	37,200	43,400	65,600
Quantity of Diesel Consumed by Operating Generators for Water Supply System	Liters	1,080,000	1,080,000	1,080,000	1,116,000	1,736,000	1,854,000
Total Cost of Diesel Consumed for Generators for Water Supply System	Riyals	270,000,000	270,000,000	648,000,000	669,600,000	1,649,200,000	1,761,300,000
Number of Solar Power Systems for Water Supply System	Number	0	0	0	0	0	3 wells
Total Capacity of Solar Power Systems for Water Supply System	Kilowatts	0	0	0	0	0	1,085
Number of Hours of Operation for Solar Power Systems for Water Supply System	Hours	0	0	0	0	0	7
Total Electrical Energy Produced by Solar Power Systems for Institution/Branch Water Supply System	Kilowatt-hours	0	0	0	0	0	1,085
Total Number of Electric Transformers for Water Supply System	No.	38	39	40	42	44	46

Total Electrical Energy Supplied from the Public Grid to Operate Water Supply System	Kilowatt-hours	762,850	782,925	803,000	843,150	883,300	923,450
Cost of Electrical Energy Supplied from the Public Grid to Operate Water Supply System	Riyals	22,885,500	54,804,750	80,300,000	84,315,000	264,990,000	304,738,500
Electrical Energy Purchased from the Private Sector for Water Supply System	Kilowatt-hours	N/A	N/A	N/A	N/A	N/A	N/A
Cost of Electrical Energy Purchased from the Private Sector for Water Supply System	Riyals	N/A	N/A	N/A	N/A	N/A	N/A

Table 7.8: Electrical power of water supply system

7.4.2 Energy consumption data

The table below summarizes the electricity and Diesel consumption for 2022 compared to 2017 situation:

Energy Source	Description	Unit	2017 Quantity	2022 Quantity	Change (%)
Public Electricity Supply	Water Pumped or Treated	m^3	12,985,928	7,823,265	-39.8
Total Electricity Consumed	kWh	-	7,999,065	5,425,270	-32.2
Cost of Electricity Consumption	YER	-	599,929,875	1,085,054,000	+80.9
Diesel Generators	Water Pumped or Treated	m^3	4,328,643	2,607,755	-39.8
Diesel Consumption	Liters	-	1,080,000	927,000	-14.2
Diesel Cost	YER	-	270,000,000	880,650,000	+226.5
Private Sector Electricity	Water Pumped or Treated	m^3	0	0	-

Table 7.9: Energy consumption for 2017 and 2022

The table below summarizes the available electricity equipment and related materials for 2017 to 2022 situation.

Description / Facility	Unit	2017	2018	2019	2020	2021	2022
Total electrical capacity required	kW	52800	54120	55440	55440	58080	60720
Total electrical capacity provided by public grid	kW	2200	2255	2310	2310	2420	2530
Total number of existing diesel generators	No.	14	14	14	15	16	17
Generator set installed for water supply	No.	14	13	12	13	15	15
Generator set in operation for water supply	No.	14	13	12	13	15	15
Generator set in operation for sanitation system	No.	0	0	0	0	0	0
Current daily fuel consumption for water system	l/d	2,959	2,959	2,959	3,058	4,756	5,079
Current daily fuel consumption for sanitation system	l/d	0	0	0	0	0	0
Transformer	No.	38	39	40	42	44	46

Table 7.10.: Electrical capacities and available equipment

The public electricity grid provided 100 % in 2017 and to 2022 of the LC total electrical capacity required.

The LC has in total 17 diesel generators. From the 17 generators installed for water supply 15 are operational.

The main energy consumption occurs in Jathma field where the lifted water needs to be pumped to the main reservoirs and then to the distribution network. High amount of energy is consumed

The LC had received subsidies from humanitarian relief organizations with regard to improving the power supply as follows: -

- Provide diesel for operating generators.
- Provide oils, lubricants and other spare parts for generators.
- Procure new generators.

In fact, this support was helping the LC considerably by continuing supplying water to customers.

7.4.3 Operational data of the LC / AU/ branch energy generation stations

The operational data for diesel generators from 2017 to 2022 reveals significant variations in usage patterns across different locations. Generators, ranging from Perkins to Caterpillar and Volvo models, exhibited diverse capacities and efficiencies. Some, like those in Jathma and Alhimdan, consistently operated, indicating sustained energy demands, while others in Alhota, bader, and Mdawdeh showed minimal activity, suggesting lower energy requirements during specific periods. Diesel consumption closely mirrored operational hours and generator

efficiency, highlighting potential areas for optimization. This data underscores the importance of aligning operational hours with actual energy needs and exploring more fuel-efficient generator models for cost-effective and environmentally conscious energy generation.

7.4.4 Required Investment measures for the improved efficiency and expansion of existing energy sources

Requirements	Required For	Installation Location	Technical Specifications (Brief)	Unit	Quantity	Estimated Total Cost (USD)	Priority
Solar power field operation for Jathmah well field	To operate Jathmah field wells	Jathmah	Establish a solar power station with a capacity of 1 MW	Number	1	$2,000,000	critical
Solar power field operation for Moshah well field	To operate the wells of the Mowashah field	Moshah Shibam	Establish a solar power station with a capacity of 450 kW	Number	1	$1,000,000	critical
Solar power field operation for Damoun well field	To operate Damon field wells	Damoun	Establish a solar power station with a capacity of 1 MW	Number	1	$2,000,000	critical
Solar power field operation for Al Khal'a well field	To operate the wells of the Al-Khala field	Sah	Establish a solar power station with a capacity of 450 kW	Number	1	$1,000,000	critical
Solar power field operation for Al Hamdan well field	To operate the wells of Al-Hamdan field	Al Qatan	Establish a solar power station with a capacity of 1 MW	Number	1	$2,000,000	critical
Solar power field operation for Jojeh well field	To operate the wells of the Jojeh field		Establish a solar power station with a capacity of 450 kW	Number	1	$1,000,000	critical
Operating lifting stations with solar energy	To operate branch lift pumps		Establish a solar power station with a capacity of 1 MW	Number	5	$10,000,000	critical

Table 7.11: Proposed needs to increase the efficiency of energy source

8. Investment Plan

8.1 Plan Structure

The assessment on the institutional situation of LC Seiyun with the water and sanitation condition of selected public institutions led to the conclusions and recommendations summarized in the tables below and the Technical Assistance Plan. The "Shortcomings" in the tables below provide an overview of the identified problems the LC is facing. The "Recommendations" next to the "Shortcomings" explain the proposed measures in order to remedy the problems. For those recommendations where external support is required, reference is made to respective TA package. The period for the realization of the respective recommended activities is in the "Implementation" column which refers to the urgency criteria outlined in the questionnaires as follows:

- Critical: no time frame; measures to be implemented as soon
- High: to be implemented within 1-2 years
- Medium: to be implemented within 3-5 years
- Low: to be implemented as long-term planning more than 5 years for development.

The estimated costs for the proposed nine investment measures are presented in Table 8.3.

8.2 TA measures

Institutional Assessment and Recommended Technical Assistance Measures (TA Plan) for Seiyun LC

The Seiyun LC, established in 2001, is managed by the General Director, "Omar Abdulbari Al-Eidros.". The utility employs in its 11 departments plus auxiliary unit in total 602 staff members, 58 of them are contracted workers and dayworkers. Customer complaint procedure is installed and used through the Maintenance Management System application.

The identified shortcomings and respective recommendation for urgent and non-urgent measures can be summarized in the following table. A Technical assistance plan based on the identified measures showing the amounts needed for the urgent, high, medium and low priorities is attached as Appendix A-1.

Department	Obstacles	Recommendations	Implementation
Governance / Management / Organizational structure / Resilience	■ The organizational structure needs updating ■ Business planning and performance monitoring need updating ■ The institution does not have specific plans or schemes for partnerships with the private sector ■ The institution operates as a service-oriented local entity ■ no representation of women on the Board of Directors/ Advisory Committee	■ Capacity building of management and BoD ■ Regular meeting and coordination between LC and BoD	■ Urgent ■ High
Human resource and capacity building management	■ Hiring needs ■ Low qualification and skills of some employees ■ need to reactivate training programs ■ Internet Connectivity for Online Meetings and Training	■ Professionalize overstaff (training) and reorganize departments to be effective ■ Analyses of staffing to determine detailed HR requirements ■ Preparation of staffing plan	■ Urgent ■ High ■ High
Finance management/	■ Suspension of government support and investment program. ■ Suspension of UNICEF's diesel support affects the financial resources of the institution. ■ Need for completing office automation. ■ Need for training and qualifying the financial staff. ■ Non-closure of accounts in 2022 and lack of monthly closure, displaying the financial position. ■ Accumulation of government and household debt. ■ Rise in commodity prices.	■ Financial plans to develop the LC/AU/Branch's resources ■ Follow up on unpaid bills. ■ Introduce reporting standards and forms for financial reports	■ High ■ High ■ High
Customer service and relation management	■ The reading of the water produced is not entered into the billing system to determine the amount of water loses ■ Shortage of invoice printers and digital devices ■ Training and qualification needed ■ Weakness in security aspects during the war period ■ Delay in connecting services for subscribers due to absence of meters	■ Joint coordination between Commercial Department and financial management ■ Joint coordination between security authorities and local authorities in controlling violators ■ Raise the community awareness of the important of paying the bills of water consumption ■ Policies and strategies of developing and strengthening the relationship between the LC/AU/Branch and the Consumers ■ Providing invoice printers for five branches of the institution. ■ Implementing automated programs for procedures related to service requests in subscriber accounts. ■ Developing automated programs for taking readings. ■ Implementing automated field collection programs along with providing associated devices. ■ Supplying motorcycles for meter readers. ■ Conducting training courses for employees in subscriber accounts	■ High ■ Meduim ■ High ■ Medium ■ Urgent ■ High ■ High ■ High ■ Urgent ■ High
Water and Sanitation Service management	■ No sanitation network system ■ Shortage of equipment, emergency vehicles and assembly parts ■ Operating system for some wells and a GIS program	■ Establish GIS unit ■ Find the necessary support to complete the construction of the stalled wastewater treatment plant	■ High ■ Urgent
IT infrastructure	■ Interruption of wireless networks between branches due to natural disasters ■ Shortage of automatic equipment such as computers, printers, and invoice printers. ■ Absence of development plan of the IT Department and the used systems.	■ Inclusive training of staff ■ Capacity building for IT department ■ IT management procedures and operations	■ Urgent ■ High ■ Medium
Gender perspective	■ There is no database classified by gender ■ There is no specific budget allocated for the Women's Management ■ The Women's Management does not currently participate in planning policies	■ Giving priority for female recruitment	■ High

Table 8.1: Obstacles and recommendations for institutional measures

8.3 Technical Assistance Plan

The required TA support for the Seiyun LC has been determined based on the outlined recommendations in above chapters. The respective needs for the improvement of the resilience of the LC have been grouped into the following four individual Technical Assistance Packages:

TA Package 1: Financial support
TA Package 2: Training Courses
TA Package 3: Office Equipment and IT
TA Package 4: Coaching and Consultancy Services
TA Package 5: Operation Management Support (OMS) including GIS
TA Package 6: Public Relation and Awareness

Most of the recommended measures are proposed to be

implemented as an integrated package and in parallel to strengthen the LC and increase their resilience during the period of conflict within the next one to two years. Less pressing measures, as additional training courses, office/ IT equipment, further coaching and consultancy support, OMS and additional awareness campaigns, can be implemented during post-conflict, i.e. the condition of peace is declared.

To enable the implementation of the above proposed recommendations the following Technical Assistance interventions grouped into six packages with related cost estimates have been identified[2]:

Package	TA intervention	Estimated TA cost in USD			
		Urgent	High priority	Medium priority	Low priority
		(0-6 months)	(1 -2 years)	(3-5 years)	(>5 years)
TA1	Financial Support	1,050,000	1,000,000	800,000	0
TA2	Training Courses	205,000	160,000	110,000	0
TA3	Office equipment and IT	109,000	51,000	106,000	0
TA4	Coaching and Consultancy services	90,000	150,000	75,000	0
TA5	Operation Management Support	70,000	120,000	40,000	0
TA6	Public Relation and Awareness	0	50,000	40,000	10,000
Total TA cost:	1,524,000	1,531,000	1,171,000	10,000	

Table 2: Cost estimates on TA interventions

The total required amount for the technical assistance measures has been estimated to around USD 1,524,000 for critical priority intervention, USD 1,531,000 for high priority intervention, 1,171,000 for medium priority intervention and USD 10,000 for low priority interventions.

8.4 Investment Measures

Infrastructure Assessment and Recommended Rehabilitation Measures (Investment Plan) for LC Seiyun

Domains	Obstacles	Recommendations for urgent prioritized measures	Recommendations for short term prioritized measures	Recommendations for med term prioritized measures	Recommendations for long term prioritized measures
Building and Reservoirs	Damaged administrative building. Lack of office furniture and equipment. Lack of laboratory. Insufficient office work space. Insufficient material storage space. Leak and deterioration of some storage reservoir	Solar energy + computer + air conditioners + furniture + hangars + building renovation	Solar energy + computer + air conditioners + furniture + hangars + building renovation	-	-
Water Resource, use and balance	Shortage in water supply Low yield of the wells	Digging new wells & Rehabilitation	-		-

[2] Details on TA measures with cost estimation are given in Appendix A-1

Water pipelines	Dilapidated water distribution network. Uncompleted rehabilitation of distribution networks Aging and dilapidation of the distribution networks Aging and corrosion of the pumping line.	Replacing asbestos and galvanizing networks	-Water Meter & valves - GIS network documentation program	-	-
Water Pumping/ lifting Stations	Insufficient pumping capacity	-Remote control system -Pump inspection devices -Pumps and motors -Pumping station -buildings with fittings -electrical transformers -Electric generators	-		-
Water sterilization facilities	-High Floride content in ground water. - Lack water and wastewater testing laboratory. - Lack of measuring kits for residual chlorine.	Repairing and re-operating old stations and installing and equipping new stations	-	-	-
Power generating/ auditing for water system	-Diesel power generator pumping station out of service and needs rehabilitation. - Raise of Diesel prices.		-	-	-
Operation and maintenance process of water infrastructures	-Lack of transport vehicles. -Lack of repair and maintenance tools for pipe works, pump and motor works. -Lack of tools and instruments for electrical works. -Lack of trench excavation equipment. -Lack of water meter maintenance workshop. - Lack of pump lifting equipment/ wenches		-	-	-
Wastewater collection/ transportation pipelines	-Lack of repair and maintenance tools for pipe works, pump and motor works	-	-Maintenance and rehabilitation	-Network replacement	-
Electromechanical equipment for the sewerage system	-Lack of repair and maintenance tools for pipe works, pump and motor works	-Suction hose -unclogs hose -Mobile sewage pumps -Surface pumps -Safety equipment	-	-	-
Wastewater treatment facilities	Low efficiency of operational basins	Buying the following -BOD METER, -COD reactor, -DEIONIZER WATER PURFICATION SYSTEM, -turbidimeter	-		-
Power generating/ auditing for Water &wastewater system	-Diesel invoices is too high	improve and expand the energy sources required for the water and wastewater systems		-	-
Operation and maintenance process of water & wastewater facilities	Poor logistics for operation & maintenance	-Buying Small & medium vehicles Drilling machines, Crane - pumps & generators		-	-
Water & wastewater Laboratories	Poor logistics for operation	Buying chemicals , flame photometer, BOD Meter, Incubator, & COD reactor	Buying Drying oven,Turbidimeter& refrigerator	-	

Table 8.2: Obstacles and recommendations for Infrastructure Assessment and Rehabilitation Measures

Investment needs

The identified measures have been prioritized according to feasibility and urgency in urgent measures, high priority, short-term and long-term measures grouped into 9 investment packages The period indicates the proposed commencement of the investments, starting from 2024.

Package	Measures	Urgent (0- 6 months) (USD)	Highpriority (1- 2 years) (USD)	Medium (3-5) years) (USD)	Low (>5 years) (USD)	Total (USD)
		2024	2024-2025	2025-2027	>2027	
1	Civil works on buildings and structures	800,00	3,700,000	0	0	4,500,000
2	Well rehabilitation and new construction	5,273,642	0	0	0	5,273,642
3	Water pumping station	6,000,000	0	0	0	6,000,000
4	Water network rehabilitation and extension	49,870,000	9,100,000	0	0	58,970,000
5	WWTP and sewage pumps	2,002,500	0	0	0	2,002,500
6	Sewer network rehabilitation and extension	0	100,000	330,000	0	430,000
7	Vehicles, machines, tools	4,300,000	0	0	0	4,300,000
8	Electric materials and solar systems	19,000,000	0	0	0	19,000,000
9	Laboratory equipment	1,564,000	110,000	0	0	1,674,000
Total (USD)		88,010,142	13,010,000	330,000	0	102,150,142

Table 8.3: Cost estimation on investment measures

The required estimated budget has been calculated for:

- Critical measures: 88,010,142 USD
- High-priority measures: 13,010,000 USD
- Medium - priority measures: 330,000 USD
- Low- priority measure: 0 USD

The total needed amount for the rehabilitation, restoration and extension of the water and sanitation system, provision of solar systems and supply of required operation and maintenance materials has been estimated to about 102,150,142 million USD for the next 5 years.

Appendix A-1:
Technical Assistance Plan for LC Seiyun

Appendix A-1:
Technical Assistance Plan for LC Seiyun

Package	TA intervention	Estimated TA cost in USD			
		Urgent	High priority	Medium priority	Low priority
		(0-6 months)	(1 -2 years)	(3-5 years)	(>5 years)
TA1	Financial Support	1,050,000	1,000,000	800,000	0
TA2	Training Courses	205,000	160,000	110,000	0
TA3	Office equipment and IT	109,000	51,000	106,000	0
TA4	Coaching and Consultancy services	90,000	150,000	75,000	0
TA5	Operation Management Support	70,000	120,000	40,000	0
TA6	Public Relation and Awareness	0	50,000	40,000	10,000
Total TA cost:		1,524,000	1,531,000	1,171,000	10,000

TA Package 1: Financial Support

ID	Financial support	Requirements	Urgent - total cost (USD)	High priority total cost (USD)	Medium priority - total cost (USD)	Low priority - total cost (USD)
1.1	Energy supply and consumables	Financial support	50,000	0	0	0
	Debt support (salaries & Electricity)	Financial support	1,000,000	1,000,000	800,000	0
Total TA Package 1:			1,050,000	1,000,000	800,000	0

TA Package 2: Training Courses

ID	Training Subject	Target Staff	Urgent - total cost (USD)	High priority - total cost (USD)	Medium priority - total cost (USD)	Low priority - total cost (USD)
2.1	Board of Directors Program	Board of Directors, Secretary of BoD	10,000	30,,000	10,000	0
2.2	Management & HR subjects	General Directors, Deputies, Planning and Project Manager, Financial Manager, HR Manager	50,000	30,000	30,000	0
2.3	Technical subjects	Deputy, Director of main departments, Key staff, engineers	50,000	20,000	25,000	0
2.4	Finance subjects	Finance department staff, Procurement department, Supervision & Inspection	30,000	10,000	0	0
2.5	Customer Relations and Services subjects	General director, director of main departments	30,000	30,000	25,000	0
2.6	IT, PIIS	IT manager, Finance, Planning department key staff	25,000	20,000	10,000	0
2.7	On-Job training	HR & IT department, Audit Section and Accounting Sections, Warhouse and procurement management staff	10,000	20,000	10,000	0
Total TA Package 2:			205,000	160,000	110,000	0

TA Package 3: Office Equipment and IT

ID	Item	Description/Specifications	Quantity	Urgent total cost (USD)	High Priority total cost (USD)	Medium Priority - total cost (USD)	Low Priority total cost (USD)
3.1	Furniture						
3.1.1	Desks	Wooden desk with drawers and a side table. Drawer dimensions: 40 cm width × 48 cm depth × 65 cm height. Desk dimensions: 200 cm width × 90 cm depth × 76 cm height. Side table dimensions: 88 cm width × 76 cm height × 40 cm depth.	32 Medium Priority			9,600	
3.1.2	Chairs	Medical mesh back and mid-movable chair	42			2,100	
3.1.3	Air Conditioner	1-ton, 1200 BTU, Energy-efficient control (40%, 60%, 80%), Dual Tropical Inverter Compressor, Fast cooling and energy-saving, Plasmaster™ IonizerPLUS, Smart ThinQ™ (Wi-Fi), Ten years warranty on the dual inverter compressor	19			5,700	
	Sub- total					17,400	
3.2	IT Equipment						
3.2.1	Desktop Computer	Specifications: Intel Core i7 Quad Core, 8GB RAM, 1TB HDD, 2GB Graphics Card, 19" LED Monitor, DVD+/-RW, Windows 7 or above.	50		45,000		
3.2.2	Laptop Computer	Specifications: Intel Core i7-8850H, 32GB RAM, 1-2TB HDD, 4GB Graphics Card, 15.6" FHD LED Monitor, DVD+/-RW, Windows Server.	14			21,000	
3.2.3	Server		3	21,000			
3.2.4	Invoice Printer	Sedco Magna L3200 C Line Matrix Printer. P8000/P7000 Standard life cartridge ribbon.	5	75,000			
3.2.5	Network Firewall	Real-time antivirus, online payment protection, performance improvement, unlimited high-speed VPN connection, data leak detection tool, identity protection features, virus scanning and removal by an expert	2	8,000			
	Sub- total			104,000	45,000	21,000	
3.3	Software						
3.3.1	New or Replacement Software	Anti- virus :10 original copies, Windows 11:5 original copies, Microsoft- office :5 original copies, ArcMap10		5,000			
	Sub- total			5,000			
3.4	Electric equipment						
3.4.1	Routers for Branch and Main Centers		5			10,000	
3.4.2	Voltage Regulator	20KVA / 16KW UPS, Input: 220-240V, Output: 220-240V, Three years warranty, Including maintenance.	70			140,000	
3.4.3	Backup Battery	Capacity: 100 Ampere, Type: Deep Cycle Gel	12		6,000		
3.4.4	Electric Charger	Three-stage charger, 10 Ampere	10			30,000	
3.4.5	Local Network Switches in the Branch	Cisco network switch 48 10/100/1000 Ports, Gigabit Ethernet Smart Switch, 2 Combo Mini-GBIC Ports, With Fiber Port	5			1,250	
3.4.6	Internal Wireless Modems	Tp-link TD-W8961N 500Mbps Wireless N ADSL2+ Modem Router	7			3.500	

3.4.7	Other IT Infrastructure and Tools	1. Ethernet Cable Network Cat6 – 350 meters. 2. RG45 - 100 units, and RG11 - 100 units. 3. PETECH EZ-RJ45 Crimp Tool for RJ-11, RJ-12 - 2 units 4. Network Wire Punch Down Impact Tool with Two Blades - 2 units. 5. Ethernet Network Tool Cable Tester RG45, RG11 - 2 units. 6. Repair tool bag 7. Surveillance Cameras + DVR	-			100 6,500 100 50 150 50 2,000	
	Sub- total			0	6,000	67,600	0
	Total TA Package 3:			109,000	51,000	106,000	

TA Package 4: Coaching and Consultancy services

ID	Intervention	Requirement	Urgent - total cost (USD)	High priority - total cost (USD)	Medium priority - total cost (USD)	Low priority - total cost (USD)
4.1	Coaching support	Institutional development support	15,000	50,000	0	0
4.2	Consultancy services	Update design, Feasibility study	75,000	60,000	35,000	0
4.3	External Auditor	Re-evaluation of audits and accounts	0	40,000	40,000	0
Total TA Package 4:			90,000	150,000	75,000	0

TA Package 5: Operation Management Support /GIS

ID	Intervention	Requirement	Urgent - total cost (USD)	High priority - total cost (USD)	Medium priority - total cost (USD)	Low priority - total cost (USD)
5.1	Establish pre-conditions	Satellite images, GIS software, customer survey, Customer Service Centre	70,000	40,000	40,000	0
5.2	Consultancy services	Team leader, experts, draughtsman	0	80,000	0	0
Total TA Package 5:			70,000	120,000	40,000	0

TA Package 6: Public Relation and Awareness

ID	Intervention	Requirement	Urgent - total cost (USD)	High priority - total cost (USD)	Medium priority - total cost (USD)	Low priority - total cost (USD)
6.1	Consultancy and committee support	Engage consultant, establish and maintain awareness committee	0	30,000	20,000	0
6.2	Public awareness campaign	Workshops, meetings, publications, media	0	15,000	20,000	10,000
6.3	Gender related awareness	Workshops for women, visit of marginalized, school visits	0	10,000	0	0
Total TA Package 7:			0	50,000	40,000	10,000

Total TA measures in USD:	1,524,000	1,531,000	1,171,000	10,000

Appendix A-2:

Investment Plan for LC Seiyun
Overview of required investment packages for LC Seiyun

Package	Measures	Urgent (0- 6 months) (USD)	High priority (1- 2 years) (USD)	Medium (3-5 years) (USD)	Low (>5 years) (USD)	Total (USD)
		2024	2024-2025	2025-2027	>2027	
1	Civil works on buildings and structures	800,00	3,700,000	0	0	4,500,000
2	Well rehabilitation and new construction	5,273,642	0	0	0	5,273,642
3	Water pumping station	6,000,000	0	0	0	6,000,000
4	Water network rehabilitation and extension	49,870,000	9,100,000	0	0	58,970,000
5	WWTP and sewage pumps	2,002,500	0	0	0	2,002,500
6	Sewer network rehabilitation and extension	0	100,000	330,000	0	430,000
7	Vehicles, machines, tools	4,300,000	0	0	0	4,300,000
8	Electric materials and solar systems	19,000,000	0	0	0	19,000,000
9	Laboratory equipment	1,564,000	110,000	0	0	1,674,000
Total (USD)		88,010,142	13,010,000	330,000	0	102,150,142

Package 1: Civil Works on buildings and structures

Code	Building/ Facility Purpose	Location	Brief Description of Needs/ Materials/Equipment	Unit	Quantity	Estimated Total Cost (USD)	Priority
B-1.3.1	General Administration Building	Sayoun - Aydeed	Solar energy + Computers + Air conditioners	Number	35	300,000	1
B-1.3.2	Sayoun Branch Building	Sayoun - Aydeed	Solar energy + Computers + Air conditioners + Furniture + Hangars + Building renovation	Number	28	500,000	1
B-1.3.3	Tarim Branch Building	Tarim - Ard Al-Nahas	Solar energy + Computers + Air conditioners + Furniture + Hangars + Building renovation	Number	28	500,000	2
B-1.3.4	Shabam Branch Building	Shabam - Al-Sahil	Solar energy + Computers + Air conditioners + Furniture + Hangars + Building renovation	Number	23	400,000	2
B-1.3.5	Al-Qatan Branch Building	Al-Qatan - Al-Masakib	Solar energy + Computers + Air conditioners + Furniture + Hangars + Building renovation	Number	23	400,000	2
B-1.3.6	Sah Area Building	Sah - Al-Sayqa	Administration building Solar energy + Computers + Air conditioners + Furniture + Hangars + Building renovation	Number	12	1,800,000	2
B-1.3.7	Jathima Field Building	Sayoun - Jathima	Solar energy + Maintenance equipment	Number	1	200,000	2
B-1.3.8	Moshah, Jujah, Al-Houta Field Building	Shabam	Solar energy + Maintenance equipment	Number	3	200,000	2
B-1.3.9	Khul'ah Field Building	Sah	Solar energy + Maintenance equipment	Number	1	200,000	2
	Sub-total Priority 1 - Urgent (0-6 months)					800,00	
	Sub-total Priority 2 - High (1-2 years)					3,700,000	
	Sub-total Priority 3 - Medium (3-5 years)					0	
	Sub-total Priority 4 - Low (>5 years)					0	
	Total Package 1:					4,500,000	

Package 2: Well rehabilitation

Code	Well Location/Field	Well Name or Number	Brief Description of Needs	Unit	Quantity	Estimated Total Cost (USD)	Priority
B-2.2.6.1	Shuhuh Field	6 Wells	Drilling new wells in Shuhuh	Number	6	770,416	1
B-2.2.6.2	Tarim Field	4 Wells	Drilling new wells in Tarim	Number	4	513,608	1
B-2.2.6.3	Harsa Field	3 Wells	Drilling new wells in Harsa with cotton cultivation	Number	3	385,206	1
B-2.2.6.4	Sah Field	2 Wells	Drilling new wells in Sah	Number	2	286,206	1
B-2.2.6.5	Moshah Field	3 Wells	Drilling new wells in Moshah	Number	3	388,206	1
B-2.2.6.6	All Fields	All Wells	Rehabilitation of wells	Number	4	1,680,000	1
B-2.2.6.7	All Fields	All Wells	Supply of investment pumps and spare parts	Number	30	250,000	1
B-2.2.6.8	Jathima Field	1 Well	Drilling a new well in Jathima	Number	1	250,000	1
B-2.2.6.9	All Fields		Remote telemetry operating system	Number	12	500,000	1
B-2.2.6.10	All Fields		GIS program for documenting all networks	Number	5	250,000	1
Sub-total Priority 1 - Urgent (0-6 months)						5,273,642	
Sub-total Priority 2 - High (1-2 years)						0	
Sub-total Priority 3 - Medium (3-5 years)						0	
Sub-total Priority 4 - Low (>5 years)						0	
Total Package 2:						5,273,642	

Package 3: Water Pumping Stations

Code	Requirements	Type of Water Supply Unit or Attachment	Unit Production or Pumping Station Code/ Name	Brief Technical Specifications	Unit	Quantity	Estimated Total Cost (USD)	Priority
B-2.6.3.1	Remote Control System	For all branches	For all branches	Remote control device for well control	Set	4	500,000	1
B-2.6.3.2	Pump Inspection Devices	For all branches	For all branches	Various inspection devices	Kit	4	300,000	1
B-2.6.3.3	Pumps and Motors	For all branches	For all branches	Pumps and motors with a power of 45-55 kW	Number	50	1,000,000	1
B-2.6.3.4	Pumping Station Buildings with Equipment	For all branches	For all branches	Concrete buildings for pumping stations	Number	5	600,000	1
B-2.6.3.5	Electrical Transformers	For all branches	For all branches	Electrical transformers with a capacity of 100 kW	Number	20	100,000	1
B-2.6.3.6	Electrical Generators	For all branches	For all branches	Generators with a power of 350-1000 kW	Number	15	3,500,000	1
Sub-total Priority 1 - Urgent (0-6 months)				6,000,000				
Sub-total Priority 2 - High (1-2 years)				0				
Sub-total Priority 3 - Medium (3-5 years)				0				
Sub-total Priority 4 - Low (>5 years)				0				
Total Package 3:				6,000,000				

Package 4: Water network rehabilitation and extension

Code	Installation Location/ Distribution Area	Brief Description of Required Items	Diameter	Material	Operating Pressure (Bar)	Unit	Quantity	Estimated Total Cost (USD)	Priority
B-2.5.2.1	Seiyun	Replacement of Asbutu and Galvanized Networks	6" to 1"	Asbutu + Galvanized	16 Bar	Meters	130	2,450,000	1
B-2.5.2.2	Tarim	Replacement of Asbutu and Galvanized Networks	4" to 3/4"	Asbutu + Galvanized	16 Bar	Meters	200	2,900,000	1
B-2.5.2.3	Shabam	Replacement of Asbutu and Galvanized Networks	4" to 3/4"	Asbutu + Galvanized	16 Bar	Meters	90	1,950,000	1
B-2.5.2.4	Al-Qatan	Replacement of Asbutu and Galvanized Networks	4" to 3/4"	Asbutu + Galvanized	16 Bar	Meters	220	4,300,000	1
B-2.5.2.5	Sah	Replacement of Asbutu and Galvanized Networks	4" to 3/4"	Asbutu + Galvanized	16 Bar	Meters	30	650,000	1
B-2.5.2.6	Seiyun	Pipes + Accessories, Various Types	12" to 1/2"	Ductile + UPVC + PE100	16 Bar	Number	25,000	5,500,000	1
B-2.5.2.7	Tarim	Pipes + Accessories, Various Types	12" to 1"	Ductile + UPVC + PE101	16 Bar	Number	30,000	5,400,000	1
B-2.5.2.8	Shabam	Pipes + Accessories, Various Types	8" to 1"	Ductile + UPVC + PE102	16 Bar	Number	25,000	10,500,000	1
B-2.5.2.9	Al-Qatan	Pipes + Accessories, Various Types	8" to 1"	Ductile + UPVC + PE103	16 Bar	Number	30,000	10,400,000	1
B-2.5.2.10	Sah	Pipes + Accessories, Various Types	8" to 1"	Ductile + UPVC + PE104	16 Bar	Number	9,000	2,620,000	1
B-2.5.2.11	Seiyun	Valves and Meters	16_1/2	Ductile + Brass	16 Bar	Number	10,000	1,750,000	2
B-2.5.2.12	Tarim	Valves and Meters	12_1/2	Ductile + Brass	16 Bar	Number	8,000	1,500,000	2
B-2.5.2.13	Al-Qatan	Valves and Meters	12_1/3	Ductile + Brass	16 Bar	Number	7,000	1,350,000	2
B-2.5.2.14	Shabam	Valves and Meters	12_1/4	Ductile + Brass	16 Bar	Number	6,000	1,200,000	2
B-2.5.2.15	Sah	Valves and Meters	8_1/6	Ductile + Brass	16 Bar	Number	3,000	800,000	2
B-2.5.2.16	All Fields	GIS Program for Network Documentation				Number	5	2,500,000	2
	Sub-total Priority 1 - Urgent (0-6 months)							46,670,000	
	Sub-total Priority 2 - High (1-2 years)							9,100,000	

Reservoirs

Code	Tank Name or Location	Brief Description of Needs	Estimated Total Cost (USD)	Priority	Notes
B-2.4.3.1	Shuhuh Tank - Sayoun	Due to high population density and increased number of displaced people	800,000	1	Tank capacity 4000 cubic meters
B-2.4.3.2	Damoun Tank - Tarim	Due to high population density and increased number of displaced people	800,000	1	Tank capacity 4000 cubic meters
B-2.4.3.3	Al-Houta Tank - Shabam	Due to high population density and increased number of displaced people	400,000	1	Tank capacity 1000 cubic meters
B-2.4.3.4	Moshah Tank - Shabam	Due to high population density and increased number of displaced people	400,000	1	Tank capacity 1000 cubic meters
B-2.4.3.5	Al-Qatan Tank	Due to high population density and increased number of displaced people	400,000	1	Tank capacity 1000 cubic meters
B-2.4.3.6	Additional Tank	Due to high population density and increased number of displaced people	400,000	1	Tank capacity 1000 cubic meters
	Sub-total Priority 1 - Urgent (0-6 months)	3,200,000			

	Sub-total Priority 1 - Urgent (0-6 months)	49,870,000			
	Sub-total Priority 2 - High (1-2 years)	9,100,000			
	Sub-total Priority 3 - Medium (3-5 years)				
	Sub-total Priority 4 - Low (>5 years)				
	Total Package 4:	58,970,000			

Package 5: WWTP and sewage pumps
Operational and Investment Requirements for Sewage Treatment Plants

Code	Requirements	Required for (Location)	Brief Description of Needs	Unit	Quantity	Estimated Total Cost (USD)	Priority
3.4.7.1	BOD Meter Hach Equivalent Model	Settling basins in extended courtyards	To determine the efficiency of the working basins	Number	2	38,000	1
3.4.7.2	Incubator Specification for BOD Tests	Settling basins in extended courtyards	To determine the efficiency of the working basins	Number	2	12,000	1
3.4.7.3	COD Reactor for COD Tests	Settling basins in extended courtyards	To determine the efficiency of the working basins	Number	1	2,500	1
3.4.7.4	Digital Bacteriological Incubator	Settling basins in extended courtyards	To determine the efficiency of the working basins	Number	2	15,000	1
3.4.7.5	Drying Oven	Settling basins in extended courtyards	To determine the efficiency of the working basins	Number	2	15,000	1
3.4.7.6	Bench Top Turbidimeter	Settling basins in extended courtyards	To determine the efficiency of the working basins	Number	1	20,000	1
3.4.7.7	Deionizer Water Purification System to Generate IC Grade	Settling basins in extended courtyards	To determine the efficiency of the working basins	Number	1	20,000	1
	Sub-total Priority 1 - Urgent (0-6 months)					122,500	

Code	Requirements	Installation Location	Station Name, Number, and Location	Technical Specifications (Brief)	Unit	Quantity	Estimated Unit Cost (USD)	Estimated Total Cost (USD)	Priority
B-3.5.7.1	Suction Pump	Sayoun	Sayoun	Suction mechanism with a capacity of 12m3	Number	6	200,000	1,200,000	1
B-3.5.7.2	Blockage Opening Pump	Sayoun + Trim	Sayoun + Trim	Mechanism for opening blockages	Number	2	150,000	300,000	1
B-3.5.7.3	Mobile Sewage Pumps	Sayoun + Trim	Sayoun + Trim	Pumps for suctioning sewage during maintenance	Number	4	70,000	140,000	1
B-3.5.7.4	Surface Pumps	Sayoun + Trim	Sayoun + Trim	Pumps for maintaining lifting stations	Number	2	50,000	100,000	1
B-3.5.7.5	Safety Equipment	Sayoun + Trim	Sayoun + Trim	Providing materials for worker safety	Number	2	70,000	140,000	1
	Sub-total Priority 1 - Urgent (0-6 months)							1,880,000	

	Sub-total Priority 1 - Urgent (0-6 months)				2,002,500	
	Sub-total Priority 2 - High (1-2 years)				0	
	Sub-total Priority 3 - Medium (3-5 years)				0	
	Sub-total Priority 4 - Low (>5 years)				0	
	Total Package 5:				2,002,500	

Package 6- Sewer network rehabilitation and extension

Code	Sewage Network Requirements	Installation Area	Diameter	Material	Operating Pressure (Bar)	Brief Description of Needs	Unit	Quantity	Estimated Total Cost (USD)	Priority
B-3.2.2.1	Plastic Pipes	Seiyun	8 Inches	Plastic	6 Bar	Replacement of Networks	Meters	3,000	250,000	3
B-3.2.2.2	Connections	Seiyun	8 Inches	Plastic	6 Bar	Replacement	Number	500	80,000	3
B-3.2.2.3	Manholes	Seiyun	-	Concrete	-	Maintenance and Rehabilitation	Number	50	100,000	2
	Sub-total Priority 2 - High (1-2 years)					100,000				
	Sub-total Priority 3 - Medium (3-5 years)					330,000				
	Total Package 6:					430,000				

Package 7: Electric Equipment and Solar System

Code	Requirements	Required for (Location)	Installation Location	Technical Specifications (Brief)	Unit	Quantity	Estimated Unit Cost (USD)	Estimated Total Cost (USD)	Priority
B-4.5.1.1	Solar Power for Juthma Field	Operating Juthma Wells	Juthma	Establishing a solar power station with a capacity of 1 Megawatt	Number	1	2,000,000	2,000,000	1
B-4.5.1.2	Solar Power for Moshah Field	Operating Moshah Wells	Moshah, Shabwa	Establishing a solar power station with a capacity of 450 kilowatts	Number	1	1,000,000	1,000,000	1
B-4.5.1.3	Solar Power for Damoun Field	Operating Damoun Wells	Damoun	Establishing a solar power station with a capacity of 1 Megawatt	Number	1	2,000,000	2,000,000	1
B-4.5.1.4	Solar Power for Al-Khal'a Field	Operating Al-Khal'a Wells	Saa	Establishing a solar power station with a capacity of 450 kilowatts	Number	1	1,000,000	1,000,000	1
B-4.5.1.5	Solar Power for Al-Hamdhan Field	Operating Al-Hamdhan Wells	Al-Qatan	Establishing a solar power station with a capacity of 1 Megawatt	Number	1	2,000,000	2,000,000	1
B-4.5.1.6	Solar Power for Jawjah Field	Operating Jawjah Wells	Jawjah, Shabwa	Establishing a solar power station with a capacity of 450 kilowatts	Number	1	1,000,000	1,000,000	1
B-4.5.1.7	Solar Power for Pumping Stations	Operating Pumping Stations in all Fields	All Fields	Establishing a solar power station with a capacity of 1 Megawatt	Number	5	2,000,000	10,000,000	1
	Sub-total Priority 1 - Urgent (0-6 months)							19,000,000	
	Sub-total Priority 2 - High (1-2 years)							0	
	Sub-total Priority 3 - Medium (3-5 years)							0	
	Sub-total Priority 4 - Low (>5 years)							0	

	Total Package 6:				19,000,000	

Package 8: Vehicles, Equipment and Tools

Code	Statement	Technical Specifications	Unit	Quantity	Estimated Unit Cost (USD)	Estimated Total Cost (USD)	Priority
B-5.5.2.1	Supply of Spare Parts for Generators	Generators from 100-1000 kilowatts	Number	10	120,000	1,120,000	1
B-5.5.2.2	Supply of Work Tools	For conducting maintenance operations	Number	10	10,000	100,000	1
B-5.5.2.3	Supply of Pumps, Motors, and Spare Parts	Submersible pumps for wells with a capacity of (55-45) kilowatts and spare parts for protection devices, cables, as well as surface pumps for sewage, and motors	Number	50	30,000	1,500,000	1
B-5.5.2.4	Leak Detection Equipment Supply	For identifying and addressing leak locations	Number	5	20,000	100,000	1
B-5.5.2.5	Supply of Crane for Well Lifting	Crane with a lifting capacity of (10-12) tons	Number	4	150,000	600,000	1
B-5.5.2.6	Supply of Excavator Bucket	Excavator for digging and backfilling	Number	4	220,000	880,000	1
	Sub-total Priority 1 - Urgent (0-6 months)					4,300,000	
	Sub-total Priority 2 - High (1-2 years)					0	
	Sub-total Priority 3 - Medium (3-5 years)					0	
	Sub-total Priority 4 - Low (>5 years)					0	
	Total Package 7:					4,300,000	

Package 9:Laboratory equipment
Water sterilization facilities

Question Code	Requirements (1)	Required for/ Installation Location (2)	Brief Technical Specifications	Unit	Quantity	Estimated Total Cost (USD)	Priority (3)
B-2.7.4.1	Repair and Activate Stations	All Branches	Repair and reactivate old stations, install and equip new stations	Number	7	1,400,000	1
	Sub-total Priority 1 - Urgent (0-6 months)					1,400,000	

Water laboratories

Code	Statement	Required for/ Installation Location	Technical Specifications	Unit	Quantity	Estimated Unit Cost (USD)	Estimated Total Cost (USD)	Priority
B-6.2.1.1	Flame Photometer	General Administration Laboratory	* Sensitivity: 0.5ppm or better * Linearity: better than ±2% * Less than 0.5% interference * Automatic Selection of filters * Multi-points calibration	Each	2	12,000	24,000	1
B-6.2.1.2	Bench Top Turbidimeter	General Administration Laboratory	* Turbidity range: 0 to 1000 NTU * Microprocessor Control * Direct digital readout in NTU * Voltage 220-240V 50/60Hz	Each	2	10,000	20,000	2

B-6.2.1.3	Electronic Burettes	General Administration Laboratory	Electronic	Each	4	4,000	16,000	2
B-6.2.1.4	Lab Refrigerator	General Administration Laboratory	Chemicals	Each	2	2,000	4,000	2
B-6.2.1.5	Nitrate Reagent P.P for 10ml Sample CPK11000	General Administration Laboratory	Chemicals	Each	5	10,000	50,000	1
B-6.2.1.6	Nitrite Reagent P.P for 10ml Sample CPK11000	General Administration Laboratory	Chemicals	Each	4	200	800	1
B-6.2.1.7	Sulfate Reagent P.P for 10ml Sample CPK11000	General Administration Laboratory	Chemicals	Each	4	100	400	1
B-6.2.1.8	Iron Reagent P.P for 10ml Sample CPK11000	General Administration Laboratory	Chemicals	Each	5	100	500	1
B-6.2.1.9	EDTA Standard Solution 0.01m	General Administration Laboratory	Chemicals	Each	3	200	600	1
	Sub-total Priority 1 - Urgent (0-6 months)						76,300	
	Sub-total Priority 2 - High (1-2 years)						40,000	

Wastewater laboratories

Question Code	Description (1)	Required for/ Installation Location	Technical Specifications	Unit	Quantity	Estimated Unit Cost (USD)	Total Estimated Cost (USD)	Priority
B-6.2.2.1	BOD meter HACH or equivalent model	Sewage Treatment Plant in Sayun and Sewage Treatment Plant in Tarim	* For holding 6 Samples 473ml or more * Includes bottles, Stirrer, Stirrer bars, Power supply cords, stop cock grease, BOD Buffer, and any other accessories * Voltage 220-240V 50/60Hz * Supplied with the instrument operation manual	EACH	2	12,000	24,000	1
B-6.2.2.2	Incubator Specification For BOD Tests	Sewage Treatment Plant in Sayun and Sewage Treatment Plant in Tarim	* For holding 6 Samples 473ml or more * Includes bottles, Stirrer, Stirrer bars, Power supply cords, stop cock grease, BOD Buffer, and any other accessories * Voltage 220-240V 50/60Hz * Supplied with the instrument operation manual	EACH	2	6,000	12,000	1
B-6.2.2.3	COD Reactor For COD Tests	Sewage Treatment Plant in Sayun and Sewage Treatment Plant in Tarim	* Temperature Stability: ±0.5 C * Timer: 0 to 120 minutes with audible alarm and automatic shutoff mode * Thermometer: 0 to 200 C, 1% accuracy, can be recalibrated, 2 C divisions * Power Requirements: Selectable 220/240V 50/60Hz	EACH	2	3,000	6,000	1
B-6.2.2.4	Digital Bacteriological Incubator	Sewage Treatment Plant in Sayun and Sewage Treatment Plant in Tarim	* Bench-Top Incubators * Microprocessor controller * Interior volume: about 30 liters * Stainless steel interior, exterior chamber, and inner face of door * Temperature range from: +5 C to +60C, Accuracy = 0.2, resolution: 0.1C * Voltage 220-240V 50/60Hz	EACH	4	4,000	16,000	1
B-6.2.2.5	Deionizer Water purification system to generate IC grade water	Sewage Treatment Plant in Sayun and Sewage Treatment Plant in Tarim	* One system to supply IC grade water of minimum sp Resistivity of 18.2M ohms with sterilizing features * Production: 3L/H or more * Voltage 220-240V 50/60Hz * Tow spare sets of membranes or cartridges * Supplied with the instrument operation manual	EACH	3	10,000	30,000	1

B-6.2.2.6	Drying Oven	Sewage Treatment Plant in Sayun and Sewage Treatment Plant in Tarim	"* Bench-Top oven * Microprocessor Control * Interior Volume: about 30 liters * Stainless steel interior, exterior chamber * Temperature range: +30C to +300C, accuracy= 0.2, resolution 0.1C * Continuous Operation * Internals: 2 perforated stainless steel shelves * stainless steel door with double locking and 4-point adjustment * Safety – approved * The offer shall include the installation, operation, and programming the microprocessor programs * Voltage 220-240V 50/60Hz"	EACH	2	35,000	70,000	2
	Sub-total Priority 1 - Urgent (0-6 months)				88,000			
	Sub-total Priority 2 - High (1-2 years)				70,000			
	Sub-total Priority 1 - Urgent (0-6 months)				1,564,000			
	Sub-total Priority 2 - High (1-2 years)				110,000			
	Sub-total Priority 3 - Medium (3-5 years)				0			
	Sub-total Priority 4 - Low (>5 years)				0			
	Total Package 9:				1,674,000			