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STAGE THREE

Yemen Water Sector

Damage Assessment Report of Twelve Water Supply and Sanitation Local Corporations (LCs) and their Affiliated Branch Offices and Utilities

Part 1: Resilience Strategy Report

Acknowledgment

Yemen is one of the most water-stressed countries with an availability of only about 125 m^3 per person annually. The already critical supply situation has been dramatically aggravated by the armed conflict and its escalation following the interventions of regional actors since 2015. In 2018, an estimated 16 million Yemenis need humanitarian assistance to establish or maintain access to safe water, basic sanitation and hygiene facilities, out of which 11.6 million are in acute need. Water supply and sanitation services in the major urban centres, including the capital Sana'a, are only to a very limited extent being maintained. Part of the infrastructure is destroyed, and the electric power supply is failing to a large extent.

The Local Water Corporations (LCs) are weakened financially and regarding their personnel; they are less and less able to secure the necessary financial and human resources. The remaining skilled workers and specialists in the LCs face difficulties to secure the necessary administrative procedures as well as to plan and implement measures for maintenance and rehabilitation of the destroyed infrastructure. Overall, Yemen urgently requires support from the international community to cope with the crisis-related challenges in the water sector.

In this complex and challenging environment, the Yemeni – German Water Sector Program, commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ), was destined to assist the LCs to restore water & sanitation services and build resilience by resuming the third sequential stage of the Damage Assessment Study 'DAS III'. The study went into more assessment details and a deep investigation on the institutional setup, condition and performance; as well as on the physical condition of the water and sanitation infrastructure of each LC. The assessment results with the respective recommended measures are outlined in the:

a) Technical Assistance Plans to enhance the staff capacity, improve the performance and financial capacity and investigate alternative options to the existing system; and

b) Investment Plans to restore, rehabilitate and extend the water and sanitation system and switch to renewable energy sources.

DAS III would not have been possible without the indispensable collaborative efforts of the Ministry of Water & Environment and the involved Water Supply and Sanitation Local Corporations and their Affiliated Branch Offices and Utilities, who have cordially contributed in the process of developing this study with the assistance of the international consulting firm 'Dorsch International Consultants'.

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Christine Werner
Program Director of the Institutional Development of the Water Sector in Yemen III – Addressing Basic Needs

STAGE THREE

Yemen Water Sector

Damage Assessment Report of Twelve Water Supply and Sanitation Local Corporations (LCs) and their Affiliated Branch Offices and Utilities

Part 1: Resilience Strategy Report – Enhancing the Resilience of the LCs during Conflict and in Post-conflict Scenario

Part 2: Situation Assessment Report and Development of Technical Assistance and Investment Plans for the Infrastructure Rehabilitation and Restoration of Water Supply and Sanitation Services

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Abbreviations

ACWUA	Arab Countries Water Utilities Association
AWD	Acute Watery Diarrhoea
AU	Autonomous Utilities
BMZ	German Federal Ministry of Economic Cooperation and Development
BOD	Biological Oxygen Demand
BoD	Board of Directors
CBO	Community Based Organization
CDG	Core Donor Group
CDM	Clean Development Mechanism
COCA	Central Organization for Control and Auditing
DAS	Damage Assessment Study
EUR	Euro
FC	Financial Cooperation
GARWSP	General Authority for Rural Water Supply Projects
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit GmbH
GoY	Government of Yemen
HA	Humanitarian Agency
HATC	High Authority for Tender Control
HTB	High Tendering Board
HRD	Human Resources Development
ICRC	International Committee of the Red Cross
IDA	International Development Association
IDP	Internally Displaced People
IFI	International Financing Institutions
INGO	International Non-Governmental Organisation
IT	Information Technology
JAR	Joint Annual Review
KfW	Kreditanstalt für Wiederaufbau
LAC	Local Advisory Committee
LC	Local Corporation
lpcd	liter per capita and day
MAI	Ministry of Agriculture and Irrigation
MIS	Management Information System
MEE	Ministry of Electricity and Energy
MoF	Ministry of Finance
MoM	Minutes of Meeting
MWE	Ministry of Water and Environment
M&E	Monitoring and Evaluation
MW	Megawatt
ND	National Dialogue
NGO	Non governmental organization
NRW	Non revenue water
NWRA	National Water Resource Authority
NWSA	National Water and Sanitation Authority
NWSSIP	National Water Sector Strategy and Investment Plan
OECD	Organisation for Economic Co-operation and Development
OMS	Operation Management Support
O&M	Operation and Maintenance
PEC	Public Electricity Corporation
PIIS	Performance Indicator Information System
PMIS	Procurement Management Information System
PV	Photovoltaic
QF	Questionnaire forms (DAS Stage III)
TA	Technical Assistance
TNA	Technical Need Assessment
UAE	United Arabic Emirates
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
USD, US$	American Dollar
UWSS	Urban Water Supply and Sanitation
WASH	Water, Sanitation and Hygiene
WEC	Water and Environment Center
WFP	World Food Programme
WHO	World Health Organization
WSLC	Water and Sanitation Local Corporation
WSP	Water Sector Programme in the Republic of Yemen
WSS	Water Supply and Sanitation
WSSP	Water Sector Support Program
WU	Water Utilities
WWTP	Wastewater Treatment Plant
YER, YR	Yemen Rial

Executive Summary

The current crisis situation in Yemen affects the key infrastructure and public services significantly since the start of the political crisis in 2015. The Local Corporations for Water Supply and Sanitation Services (LC) as well as the affiliated Autonomous Utilities (AU) and Centralized Branches are weakened by the crisis. All of the water utilities face difficulties in the sustainable operation and maintenance of their infrastructure. Most of them are incapable of providing sufficient water and sanitation service to the residents. Projects for network rehabilitation and extension, funded by donor organizations, have been suspended or were completely terminated because of the prolonged crisis. This leaves parts of the urban population without connection to the public services.

Due to the turbulences within the last few years, the actual condition of the water utilities in terms of prevailing institutional situation and extent of damage on the infrastructure remained vague. Therefore the Ministry of Water and Environment (MWE) and the local corporations asked for support to carry out an assessment study to investigate the prevailing condition. Together with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Damage Assessment Study (DAS) had been initiated and was carried out in three intermittent stages from 2015 to 2018. The purpose of the assignment is to develop a strategic approach to strengthen the resilience of 12 selected LCs[1] with its affiliated five branch offices and six utilities. The strategy shall support the development of technical assistance measures as well as the preparation of prioritized short to medium term investment packages.

The number of total population within the service areas of the LCs covered by the DAS Study is 7.4 million in 2017 (compared to 6.6 million in 2014), corresponding to 26 % of the total population (28.4 million) in Yemen. According to DAS I & II study 68 % of the urban population was connected to the public supply system and 51 % to the sanitation system before the crisis in 2014. Amran, Hajjah, Bajil, Sana'a and Ibb supplied water weekly and Taiz monthly. The other LCs supplied water on daily basis. The operational cost coverage reached in average 99 % and the collection efficiency was in average for all LCs at 84 %[2].

In order understand the status quo of the water sector in Yemen, the decrees and strategies developed during the water sector reform since the late 1990's were considered for the strategy. The evolved programmes, like the National Water Sector Strategy and Investment Program (NWSSIP) and the Establishment Decree (No. 237 for year 1997) for decentralization of the urban water sector were showing first positive results. The Performance Indicator Information System (PIIS) introduced in 2004, regularly monitoring the performance of the water utilities, indicated an increase of water and sanitation service coverage and higher revenues. The decentralization of the utilities enhanced their flexibility in responding to the challenges of the crisis and facilitated local council support to the utilities.

1 LCs include: Abyan, Aden, Amran, Dhamar, Hadramout (Mukalla), Hajjah, Hudaydah, Ibb, Lahij, Sa'ada, Sana'a, and Taiz.
Five branch offices include: Harad, Abs, Kahlan Afar, and Mabian (all a part of Hajjah LC) as well as Al-Turbah (part of Taiz LC).
Six utilities include: Al Shehr (Hadramout LC) as well as Zabid, Al-Mansouriah, Bajil and Bait Al-Faqi (Hudaydah LC) and Mukha (Taiz LC).

2 Source: Performance Monitoring of Urban Water Supply and Sanitation Utilities, Summary Report (January – December 2013 by GIZ)

The ongoing crisis is preventing the continuation of this positive progress. Due to frequent power cuts, the water utilities have to spend time and money to run costly fuel generators for pump operation. The decrease in cash collection worsens the liquidity situation of the corporations and makes them unable to pay salaries or procure materials and spare parts for urgently needed maintenance. In addition, the Board of Directors (BoD) and Local Advisory Committees (LAC) are often leaving the LCs without guidance, support and control.

The Water, Sanitation and Hygiene (WASH) Cluster coordinated by UNICEF and Humanitarian Relief Organizations are supporting the utilities during the crisis with fuel, maintenance materials, staff incentives and equipment funded by international donor organizations. This enables the utilities to maintain the service at a minimum level to supply the population with water and to operate the public sewer systems. However, such support is insufficient to strengthen the institutions in the long run. Comprehensive rehabilitation and restoration measures, the continuation of the suspended projects in combination with extensive technical assistance and capacity building measures have to be provided for establishing resilient utilities.

The constraints of the LCs with the corresponding resilience measures to remedy the shortcomings can be summarized as follows:

Constraints	Resilience Factor / Measure
Power cuts and increasing fuel prices lead to decrease in water production and supply	• *Financial support* • *Installation of solar systems* • *Installation of energy saving equipment*
Financial incapacity prevents LCs: → *to operate water and sanitation system sufficiently* → *to procure required O & M materials* → *to extend and maintain the water and sanitations system* → *to pay outstanding salaries and other liabilities* → *to install alternative regenerative power systems*	• *Financial support* • *Procurement of O & M materials* • *Contracting of civil works* • *Revision of tariff structure*
Damaged and looted domestic water meters prevents accurate reading and billing	*Procurement and installation of water meters*
Lack of office equipment, IT hardware and software as well as power cuts result in inefficient work performance	• *Procurement of equipment, solar system* • *Installation and updates of software* • *Training on new software*
Inability or refusal of customers to pay their fees	*Awareness building campaigns*
Lack of water and sanitation facilities at public places and institutions and power cuts	*Procurement and installation of required materials, equipment and structures.*
Termination of water and sanitation projects	*Resume terminated projects – Update of designs – Implementation of projects*
Lack of guidance through Board of Directors	*Capacity Building (training courses)*
Absence of human resource development weakened the staff capacity	*Capacity Building (training courses)*
Damage of facilities, looting of materials, misuse of wells weakened the LCs	• *Restoration of structures and networks* • *Procurement of materials*
Low coverage of population with public water and sanitation services	• *Provision of O & M materials* • *Implementation of projects* • *Investigation on optional water sources and wastewater reuse* • *Investigation on application of sustainable sanitation systems*

These measures can be categorized and grouped in:

a) Technical Assistance measures to enhance the staff capacity, improve the performance and financial capacity and investigate alternative options to the existing system; and

b) Investment Measures to restore, rehabilitate and extend the water and sanitation system and switch to renewable energy sources.

Both activities are aiming towards the same purpose: to strengthen the resilience of the LCs.

In the Part 2 report the Technical Assistance measures are partitioned in conflict and post-conflict activities and the investment measures prioritized in four categories according to urgency and feasibility (Urgent, High priority, Short-term and Long-term).

The proposed measures have to be coordinated with the active donor organizations to avoid overlapping of activities and achieve the most efficient implementation results. The intervention of each organization, time frame, method and monitoring processes should be discussed and agreed in a conference with the participation of all stakeholders.

In the long term and considering the post-crisis era, the utilities have to get prepared for the future challenges to convert to sustainable self-financing institutions within the new political regime and governance change in Yemen. Through the implementation of the identified “Conflict”, “Urgent” and “High Priority” measures, the foundation for that objective would be well established.

1 Introduction

The GIZ supported programme "Institutional Development of the Water Sector" as the so-called "Water Sector Programme (WSP) was developed jointly with Yemeni partners during the programme's progress review in June 2013. Due to the violent internal conflicts the original scope of the WSP changed to focusing on strengthening resilience and conflict preparedness of the urban water supply and sanitation sector. The Ministry of Water and Environment (MWE) requested the support for an assessment on the current situation regarding the governance, management, financial and technical requirements for twelve of the largest Local Corporations (LCs), with five affiliated Branches and six Autonomous Utilities (AU), as listed in Table 1 below. Subsequently, the GIZ initiated the Damage Assessment Study (DAS) to investigate the prevailing situation of the LCs and how to maintain and improve water and sanitation services. The ongoing project phase which started in 2016: "Institutional Development of the Water Sector III – Addressing Basic Needs, focus on the re-establishing of basic water and sanitation services and demonstration measures for implementation of basic water and sanitation services.

Stage III, "Inventory of Water Sector Support and Rehabilitation Measures for Selected Urban Areas in Yemen" is subject of this assessment with the following Objectives:

→ Develop a strategic approach to build up resilience of LCs in maintaining water and sanitation services for a (i) post conflict scenario and (ii) continued conflict scenario with and without further escalation;

→ Prepare technical assistance packages for capacity development at the institutional and human resource level for (i) post conflict scenario and (ii) continued conflict scenario and without further escalation;

→ Prepare a series of short-term (2 – 3 years) investment plans that take into consideration gender-specific needs / requirements for repair and rehabilitation of buildings, as well as for restoration of water supply and sanitation services of 12 selected LCs.

In carrying out this assignment, the assessment results of the DAS, Stage I and II study from 2014 / 2015, published in 2016, the KfW Technical Need Assessment (TNA) report and many other relevant reports from Non-Governmental Organizations (NGOs), the MWE and GIZ were reviewed and compared with the newly obtained data. Due to the crisis the situation of some of the utilities has changed substantially within the last two years. The available data was not comprehensive and complete. Thus a full update of the institutional and infrastructural condition was required and conducted from January to December 2017. The scope was to identify not only the physical damage to the water and sanitation infrastructure, but also the institutional problems within the utilities. The assessment results with the respective detailed recommendations are outlined in the subsequent report:

→ "Part 2: Situation Assessment Report and Development of Technical Assistance and Investment Plans for the Infrastructure Rehabilitation and Restoration of Water Supply and Sanitation Services."

The table below presents an overview of the assessed LCs, Branches and Utilities with the respective population figures. The assessed institutions cover 26 % of the total population of Yemen (28,401,089).

Nos.	Local Corporation / Autonomous Utility / Branch	Served cities	Population within service area (2017)[3]
1	Abyan LC	Zinjibar, Ja'ar, Al-Husn, Al-Kood, Al-Makhzan	108,406
2	Aden LC	Aden	957,171
3	Amran LC	Amran	74,610
4	Dhamar LC	Dhamar	228,487
5	LC Hadramout Coastal Area	Mukalla	351,427
6	Al-Shehr AU	Al-Shehr	120,124
7	Hajjah LC	Hajjah	77,602
8	Abs Branch	Abs	38,535
9	Harad Branch	Harad	30,030
10	Kahlan Afar Branch	Kahlan Afar	7,430
11	Mabian Branch	Mabian	52,500
12	Hudaydah LC	LC Hudaydah	622,019
13	Al-Mansouriah AU	Al-Mansouriah	18,164
14	Bajil AU	Bajil	80,793
15	Bait Al-Faqi AU	Bait Al-Faqi	65,143
16	Zabid AU	Zabid	41,173
17	Ibb LC	Ibb	349,298
18	Lahij LC	Al-Hawta, Tuban	163,800
19	Sa'ada LC	Sa'ada	79,029
20	Sana'a LC	Sana'a	3,234,000
21	Taiz LC	Taiz	654,330
22	Turbah Branch	Turbah	20,000
23	Al-Mukha AU	Al-Mukha	33,000
Total			**7,407,071**

TABLE 1: SERVED CITIES AND POPULATION OF THE ASSESSED LCS

3 Source: Population Projections in Districts – central Statistical Organization

2 Background

2.1 Political and Humanitarian Situation

The political situation in Yemen remains uncertain, since the conflict which started beginning of 2015 still continuous. The Humanitarian Response Plan by United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) announced in January 2017[4] that from the 27.4 million people in Yemen, 18.8 million Yemenis need humanitarian assistance to establish or maintain access to safe water, basic sanitation and hygiene facilities, including 10.3 million who acutely need support. The high concentration of IDPs – UNOCHA reported 2 million IDPs in Yemen in January 2017[3] – in certain locations is placing exceptional pressure on scarce water sources, especially in the governorates of Taiz, Al Jawf, Hajjah, Sana'a and Marib. Safe drinking water is identified as the 3rd priority need of IDPs, after food and shelter[5]. 19 % of the IDPs live either in collective centres or spontaneous settlements[4]. The majority of people living in urban areas experience a reduction or frequent interruption in the public water supply, such as in Sana'a, Aden, Taiz and Hudaydah. Poor performance of sewerage systems and waste water treatment is posing a serious health threat for people in densely populated areas as in Aden, Hadramout, Hajjah, Hudaydah, Ibb, Sa'ada, Sana'a and Taiz.

The result of this aggravated condition is the immense increase of suspected cholera cases / acute watery diarrhoea (AWD) in the country. By June 2017 UNOCHA reported 255,000 suspected cholera cases / AWD, with more than 1,500 casualties in the country[6].

Besides the direct destructive impact many Yemeni people are facing, most of the population is suffering from the deterioration in the economic situation caused by:

- Decline of the national income;
- Suspension of private business;
- Absence of investment projects;
- Depreciation of Yemen Rial against US Dollar;
- Increase of the prices of materials, goods and fuel;
- Inability of the government to pay salaries.

According to the Yemen Market Watch Report from December 2017, the cost for living increased by 47 % compared to pre-crisis situation. In particular, fuel prices have fluctuated considerably during the crisis. In December 2017 the prices for petrol, diesel, and cooking gas increased by 218 %, 235 %, and 207 %, respectively compared to pre-crisis situation.[7] The exchange rate Yemen Rial (YER) to US Dollar rose in December 2017 to 441 YER per 1 USD (exchange rate at Yemen banks), which is more than double from the pre-crisis rate (215 YER per USD).

4 Humanitarian Response Plan January to December 2017 (January 2017 by UNOCHA)

5 WASH Cluster Strategy Note – September 2016

6 UNOCHA Humanitarian Dashboard (January – June 2017)

7 Yemen Market Watch Report, December 2017 by World Food Programme

2.2 Power Supply Situation

2.2.1 Electricity Availability and Production

Electricity in Yemen mainly depends on oil power plants: 699 MW from diesel, 495 MW from steam and 341 MW from gas power plants was generated in 2013[8]. The total capacity of the national grid in 2013 was 1,535 MW. The resource is from local production and oil imports. The prices for electricity are highly subsidized which were a hindrance for the development of renewable energies in the past. Yemen's' energy supply is nearly fully covered by fossil fuels. Only 0.09 % is produced through solar energy.

Even before the crisis Yemen had the worst access to electricity in the region and the private and public sector had to obtain electricity also from fuel generators. With the exception of the Marib power plant (in operation since 2009) all electricity was generated by old and inefficient plants owned by the Public Electricity Corporation (PEC), causing frequent power cuts of several hours per day. The tariff for water pumping was 30 Rials / kWh in 2012.

Since 2014 the situation worsened due to the crisis. The supply in 2017 reduced dramatically to average 200 – 250 MW, most of which is supplied to the port cities Aden and Mukalla. Sana'a with a demand of around 500 MW is only supplied by 40 MW for a few hours a day. The rest of the country, including Al Hudaydah is lacking access to reliable public energy services. Total power generation in 2015, including from PEC and private generators dropped by 77 % compared to 2014[9]. The tariff increased to 110 Rials in Sana'a city while in Aden, Hadramout, Abyan, and Lahij the PEC continued applying the old tariff.

Before the crisis there were already uncountable number of diesel generators owned by the private and public sector for optional or additional power supply. When the situation aggravated in 2015 and with the high prices on fuel, households, commercial sector and industry sector invested huge amounts in Photovoltaic (PV) systems. The business with PV systems flourished and an increasing number of small-scale electronic retailers dealing with PV systems registered in Yemen.

The Local Corporations switched to or additionally supported the poor public power supply with numerous costly fuel generators with the support of donor organizations. The result was an increasing demand on fuel to operate the generators and high maintenance efforts. So far, solar systems have been only installed as a pilot project for few wells in Sa'ada and Dhamar LCs. The LCs have neither the financial nor the human capacity to invest in the costly technology and install the equipment by themselves. Other energy options have apparently not been investigated by the LCs.

2.2.2 Renewable Energy Potentials

Several studied including the Clean Development Mechanism (CDM) potential in Yemen have indicated favourable condition for the four renewable energy sources: solar, wind, geothermal and biomass. These energy sources are available in abundance in Yemen and should be utilized in the future. The Ministry of Electricity and Energy (MEE) has carried out a study on the various aspects of potentiality on five types of renewable energy in Yemen. Due to the water scarcity and difficult terrain for accessing it the Hydropower seem not to be an option.

The Regional Center for Renewable Energy and Energy Efficiency has estimated the theoretical (t) and practical (p) potential for renewable energy and the target of implemented renewable energy by 2025 as outlined in the table below[10]. The advantages and disadvantages of the four systems have been analysed through a separate study.[11]

8 Source: Evaluating the Energy System in Yemen by Al-Barashi, Ibrahim, Abo El-Zahab

9 Restoring and Expanding Energy Access, World Bank, June 2017

10 Source: Regional Center for Renewable Energy and Energy Efficiency, 2012

11 Source: Evaluating the Energy System in Yemen by Al-Barashi, Ibrahim, Abo El-Zahab

Resource	Energy potential	Target 2025	Advantage	Disadvantage
Solar	2,446,000 MW (t) / 18,600 MW (p)	4 MW	Renewable Clean Long lifetime	Depend on sunshine High capital cost Space
Wind	308,722 MW (t) / 34,286 MW (p)	400 MW	Renewable Clean Sufficient level of maturity Competitive in cost	Competing land use Not reliable Causes environmental and ecological impact
Geothermal	304,000 MW (t) / 2,900 MW (p)	200 MW	Stable Clean	Complex management Not sustainable
Biomass	10 MW (t) / 6 (p)	6 MW	Free resource Availability of conversion technology	Competing land use Complex management
Hydropower	12 – 31 MW (t) / 0 (p)			Not feasible

TABLE 2: POTENTIAL RENEWABLE ENERGY SOURCES

In terms of institutional support for renewable energy the following was achieved in the past[12]:

→ In 2002, the Renewable Energy Department under the Ministry of Electricity and Energy (MEE) was established with the goal of promoting and supporting renewable energy projects in Yemen. In 2009 the department was extended and reorganized into two departments: Solar Energy and Wind Energy.

→ Yemen has published a wind map based on satellite data, but no detailed wind atlas is developed yet.

→ For public and private wind projects, land has been identified only in Al-Mocha project. For other private projects, land has not been identified or allocated yet.

→ No detailed solar atlas published.

→ Land for large-scale projects is not allocated for private development.

The National Strategy for Renewable Energy and Energy Efficiency, published by the Ministry of Electricity and Energy in June 2009, considers the following options to meet the challenge of sufficient power supply:

- Interconnection with national grids of neighbouring Arab and East-African countries;
- Diesel power generation;
- Natural gas generation;
- Renewable energy power generation;
- Energy efficiency and demand side management.

The MEE has formulated strategies that enhance market development of renewable energy technologies and energy efficiency measures as well as remove barriers to renewable energy development and energy conservation.

2.3 Performance of the LCs before the Crisis

The performance of the LCs before the crisis (2013), measured by performance indicators like the frequency of water supply, Non-revenue water, operational cost coverage and collection efficiency can be described as moderate. The data taken from Performance Monitoring of Urban Water Supply and Sanitation Utilities Summary Report (January – December 2013) GIZ – Water Sector Program Area 1 Policies, Strategies & Coordination, summarized in Table 3, show the following results:

→ All utilities, except Taiz provide water at least one time per week;
→ The water losses were in the range between 13 % and 45 %;
→ The operational cost coverage could be nearly reached for most LCs;
→ The collection efficiency varies considerably among the LCs.

12 Source: Regional Center for Renewable Energy and Energy Efficiency, 2012

ID	LC / Utility	Frequency of Water Supply	Non-revenue water (Average)	Operational actual cost coverage (Average)	Collection Efficiency %		
					Domestic (Average)	Government (Average)	Commercial (Average)
1	Aden	Daily	37 %	71 %	51 %	59 %	89 %
2	Amran	Weekly	15 %	103 %	98 %	22 %	102 %
3	Dhamar	Daily	45 %	80 %	79 %	93 %	76 %
4	Mukalla	Daily	40 %	96 %	84 %	75 %	87 %
5	Al-Shehr	Daily	32 %	77 %	71 %	52 %	74 %
6	Hajjah	Weekly	13 %	98 %	90 %	95 %	215 %
7	Hudaydah	Daily	36 %	66 %	62 %	52 %	72 %
8	Al-Mansouriah	Daily	22 %	104 %	86 %	9 %	75 %
9	Bait Al-Faqi	Daily	25 %	85 %	85 %	212 %	94 %
10	Bajil	Weekly	28 %	130 %	90 %	175 %	93 %
11	Zabid	Daily	19 %	93 %	92 %	19 %	85 %
12	Ibb	2 days / week	24 %	136 %	91 %	85 %	87 %
13	Sana'a	Weekly	33 %	90 %	87 %	81 %	93 %
14	Taiz	Monthly	37 %	71 %	78 %	54 %	63 %
15	Al-Mukha	Daily	24 %	183 %	100 %	49 %	100 %
Average			**29 %**	**99 %**	**83 %**	**75 %**	**94 %**

TABLE 3: OVERVIEW TABLE ON LCS PERFORMANCE IN 2013[13]

2.4 Donor Activities

2.4.1 Support Strategy before Crisis

The donor interventions in urban water sector had significantly improved since the nineties. The organizations supported the Yemen urban water sector reform through financing of infrastructure projects, institutional programs and capacity building measures. The core funding players in urban water sector before crisis were the German government, the World Bank, Arab funds, Netherland government, Islamic Bank and Gulf funding organizations such as Saudi, Abu Dhabi and Oman funds. In addition to this small investments were provided by OPEC Fund. Each organization has an executive agency which is responsible towards their countries' ministerial level to set out the fundamentals of the interventions and follow up on the process of implementation; whether during preparation of studies, designs or during executing the physical works.

The donor activities were focused on achieving the NWSSIP and the Millennium Development Goals (MDG) and objectives. The strategic approach of funding organizations before the crisis was to implement big development projects as a complete set, from study, design, tendering to implementation.

The reciprocal provisions and preconditions of all donor organizations to invest in selected water and sanitation projects are: the priority needs, population to be served, feasibility, community's willingness, the impact for population and environment.

13 Source: Performance Monitoring of Urban Water Supply and Sanitation Utilities, Summary Report (January – December 2013), GIZ – Water Sector Program

2.4.2 *Support Strategy during Crisis*

Since the outbreak of the conflict in March 2015 all core donors have stopped their direct interventions. The offices were closed and international experts and officers left the country due to security reasons.

The international relief and humanitarian organizations have launched an assistant relief program to mitigate the impact of conflict to the population of Yemen and to provide drinking water and sanitation services to the minimum level of demand. The vital pre-conflict funding organizations, particularly KfW and World Bank resumed their indirect support through contribution in financing these programs to be implemented using the emergency rules and guidance of the international humanitarian agencies.

The main humanitarian organizations which are currently working in the water sector are: UNICEF, International Committee of the Red Cross (ICRC), OCHA, OXFAM, CARE, (United Arabic Emirate) UAE Red Crescent, Mercy Group and other organization in addition to several united nation organizations.

The organizations provide fuel for operation of generators, spare parts to rehabilitate / maintain the water and sanitation facilities, replace pumps, install public water tankers in the poor communities' zones, piping works as extensions and the provision of allowances for LC operators in cities where the army conflict is ongoing.

In general all agencies are coordinating through WASH cluster at the executive level with the LCs management. The figure below shows the overall process and mechanism of implementation.

Each agency has its own specific rules and regulations to proceed with the implementation process as follows:

→ UNICEF: proceeds with study, tender and supervision according to the capacity and ability of the LC. In case of incompetent LC, the UNICEF performs all procedures for procurement and supervises the implementation; the LC is engaged in handing over and commissioning. Otherwise the LC is in charge of all the procedures except payment for contractor. UNICEF verifies if the implementation / procurement has been executed according to the specifications and complies with expected impact.

→ UAE Red Crescent: the LC is in charge for all procedures except the payment.

→ All other agencies: organizations take responsibility for all procedures like procurement / execution and the LCs share the handing over and are then responsible for operation and maintenance.

Consultant investigations

Part of the investigation of the Stage III assessment study was to collect data on the subsidies provided from donor organizations to the LCs during the crisis. The donor organizations are providing subsidies for fuel, for equipment such as spare parts, pumps, generators and for small scale investment´s or rehabilitation measures of the LCs infrastructure. The major needs are fuel, spare parts submersible pumps, laboratory equipment. However, due to budget limitations and security issues, the requested materials, equipment and fuel is not provided to the full extent to the LCs.

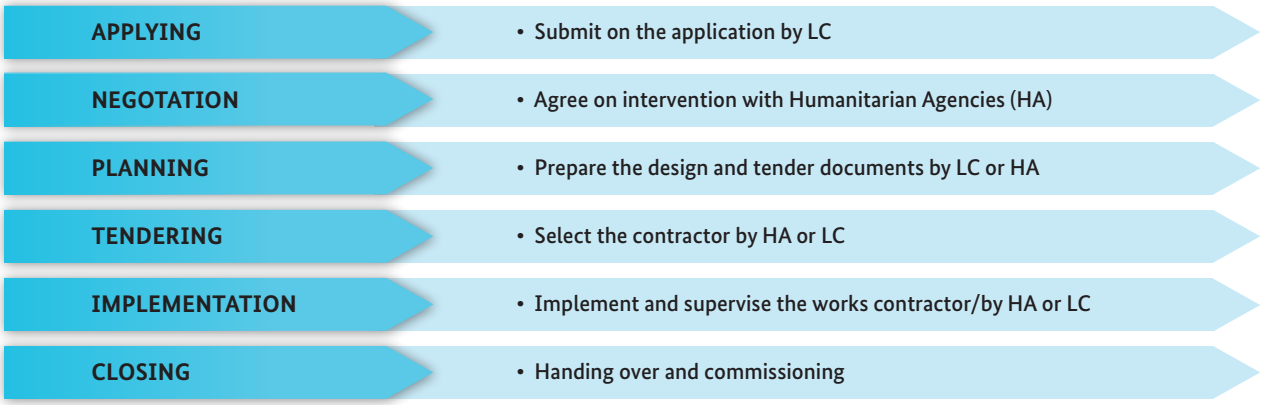

FIGURE 1: IMPLEMENTATION PROCEDURE OF DONOR FUNDED PROJECTS[14]

14 based on LCs managers discussion in 2nd local workshop on 19 July 2017 in Sana'a

The LC management would coordinate directly with the humanitarian organization regarding their urgent requirements. The main partners are UNICEF, ICRC, CRC, UAE Red Crescent and WASH. This procedure is effective; however some of the funding organizations are not linked to the cluster and there is limited data exchange among the organizations.

2.4.3 Support through WASH Cluster

The WASH (Water, Sanitation and Hygiene) cluster in Yemen was activated in 2010. The cluster embraces all partners of rural water sector, the international humanitarian, relief and first aid agencies and the public organizations such as the General Authority of Rural Water Supply Project, social fund for development, public works unit. The cluster meets once per month.

One core objective of the WASH cluster is to ensure sufficient sectoral coordination and capacity at the national and sub-national levels. The national cluster is based in Sana'a and sub-national clusters are present in Sana'a, Sa'ada, Ibb, Hudaydah and Aden.

The WASH Cluster operates according to the following Guiding Principles[15]:

- In case needs are bigger than availability of resources (financial, human), support for water supply in health facilities and safe drinking water is a first priority.
- Support should find the right balance between reaching large numbers (cities) and including the most vulnerable (such as IDPs, rural population and people depending on water trucking).
- Any fuel support should be accompanied by advocacy, demanding fuel to enter into the country and prioritizing fuel for water supply.
- Any fuel support or water trucking activity should have a clear monitoring plan and follow up.
- Exit mechanisms should be in place, such as agreed upon triggers that determine when the support will stop.
- Support should be committed for short periods only. Extension can be done after reviewing the situation, following these guiding principles.

Regarding the support of the urban water supply system WASH approach is:

- Drinking water is a first priority. Support with fuel should not go beyond provision of 15 litres per day and calculations on minimum pumping hours should be obtained from local water corporations.
- A combination of providing fuel to operate the system and setting up water distribution points to reach those without a connection is recommended. In this case, local water corporations are responsible to set up and manage the water points.
- Water should always be chlorinated, both piped water and water distributed through water points. If needed, the local water corporation should be supported with water treatment chemicals.

15 Source: Wash Cluster – Guiding principles to support access to water for conflict affected people in Yemen

3 Yemen Water Sector

3.1 Water Sector Reform

3.1.1 Strategies and Policies

The Government of Yemen (GoY) initiated within the last 20 years vital policies decrees and strategies to introduce sustainable water resource management as well as water and sanitation services management. The government realized end of the 1990s the upcoming problem in securing the water needs for the population. The excessive water extraction (3.4 million m^3/year) is by far exceeding the replenishment of the scarce water resources (2.5 million m^3/year)[16]. The government called for cooperation and coordination with the international donor group leading to the integrated water resources management and water sector reform with the following outputs[17]:

a) In 1996 establishment of a public organization responsible for water resources named the National Water Resources Authority. The organizations function is to ensure effective and efficient integrated water resources management at national and local levels with the principle of local community participation in the management.

b) Issuing cabinet resolution No. 237 for year 1997 for urban water sector reform.

c) Several studies were performed relating to the transfer from centralized management to decentralized management of water resources and water and sanitation services.

d) Proclaim the Water Law in 2002 and its executive By-law in 2009.

e) Establish the Ministry of Water and Environment (MWE) in 2003.

f) Set-out the first National Water Strategy and Investment Program (NWSSIP) in 2004 for the period of 2004 to 2009.

g) Set out the first NWSSIP update in 2008 for the period of 2009 to 2015.

h) Release the partial update of NWSSIP in 2013 for the period of 2013 to 2016.

In spite of the implemented regulations and studies performed, the activities were in fact still inadequate. The reasons for failing to reach the announced goals were due to certain political, social and institutional factors.

16 National Water Resource Authority Report, 2002

17 The National Water Sector Strategy and Investment Programme Update (General Chapter One December 2008)

3.1.2 Urban Water Sector Reform

The Cabinet Resolution No. (237) of 1997 was the strategic baseline for the reform: embracing a policy of decentralization, corporatization, commercialization, separation of service delivery and regulatory functions as well as participation of communities in planning and managing these services and partnership with private sectors.

The main objectives of the sector reform were:[18]

- Increase coverage of urban population by Water Supply and Sanitation (WSS) services;
- Reach financial sustainability of WSS utilities;
- Separate sector regulatory and executive functions;
- Decentralize WSS service provision;
- Enhance capacity building of staff;
- Involvement of local communities' and private sector;
- Keep service affordable to the poor.

The resolution transferred the responsibility of regulatory tasks to the National Water Supply and Sanitation Authority (NWSA) while the decentralized branches / utility had been given the responsibility of the executive tasks management.

The established Local Corporations in the capitals of the governorates, should be able to provide the water and sanitation services through the improvement of their institutional capacity.

Managing the water resources is the sole responsibility of the National Water Resources Authority (NWRA).

3.1.3 Establishment of the Ministry of Water and Environment

The Ministry of Water and Environment (MWE) was established in May 2003 with the objective to reorganize the water sector, establish integrated water resources management and to prepare the necessary institutional and investment conditions to face the exacerbated water problems in Yemen. The MWE was charged with one of the most complex development problems in Yemen and its most challenging tasks, namely: to solve the water scarcity problem, providing drinking water to the treating wastewater, managing water resources efficiently and planning its use in line with the water law.

The MWE initiated a participatory process which involved all stakeholders and which aimed at elaborating a clear and shared vision of its priorities. Through the irrigation, and environment and human), the necessary approaches to address water and environmental issues could be identified. Subsequently the necessary measures regarding institutional, legislative and investment requirements were determined.

The figure below presents an overview of the Local Corporations (LC), Autonomous Utilities (AU) and Branches headed by the ministry. The colour shaded indicates the assessed Local Corporations, Utilities and Branches within this assignment.

18 Cabinet resolution No. 237 for year 1997

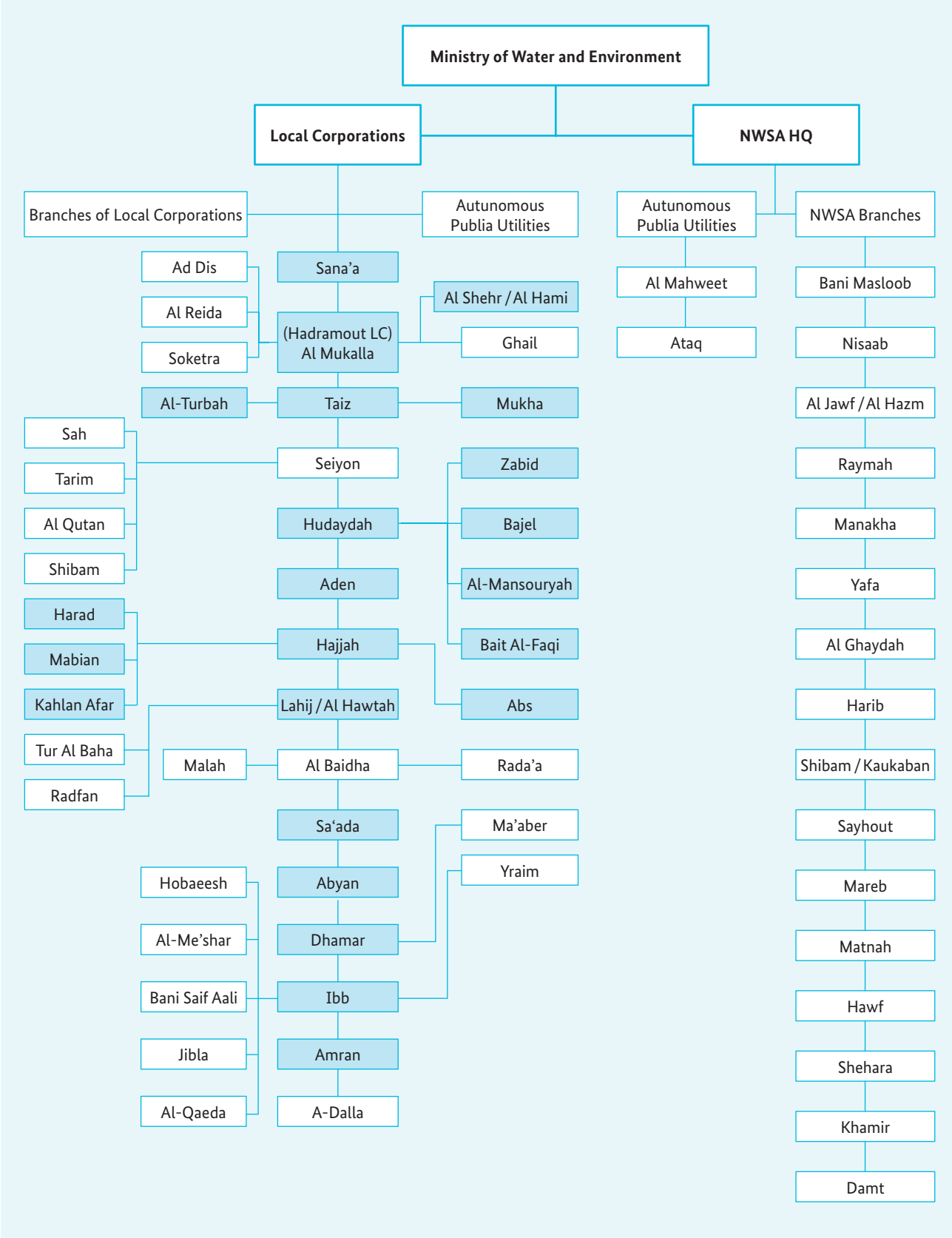

FIGURE 2: OVERVIEW OF YEMEN PUBLIC WATER SUPPLY AND SANITATION ORGANIZATION[19]

19 Original Source: Equity and Efficiency in Yemen's Urban Water Reform (March 2009), GIZ / MWE

3.1.4 National Water Sector Strategy and Investment Program (NWSSIP)

1) NWSSIP I (2004)[20]

Following the reorganization of the water sector in 1997, the MWE initiated a multi-stakeholder process of preparing a consolidated strategy, action plan and a five year investment program for the water sector as a whole – the National Water Sector Strategy and Investment Program (NWSSIP 2005 – 2009).

This strategy proposed a set of institutional, financial and other measures, which aim at addressing discrepancies in the five sub-sectors in order to protect the interests of all stakeholders in the resources. Obviously, if the situation would continue as it was without regulation of groundwater extraction and its use, then this would eventually harm everyone, including farmers, who will be the first victims of water exhaustion.

At the same time, water regulation was needed to safeguard or secure the economic and social growth of the cities. Growth would not happen unless the cities satisfy their water needs. Hence, an equitable mechanism for rural-to-urban transfer of water from the rural peripheral areas surrounding the cities needed to be developed. At the same time strict measures to protect the well-fields against illegal drilling would have to be taken.

The program aimed to address the following main problems in the five sub-sectors, water resources, water and sanitation in urban areas respectively rural areas, irrigation, environment and human:

- The low water resources availability and groundwater overdraft;
- Vulnerability of irrigated agriculture;
- Inefficient service and inadequate coverage;
- High fiscal subsidy of water supply and sanitation in urban areas;
- Poor sustainability of water supply and sanitation in rural areas.

The objectives for the Urban Water Supply and Sanitation (UWSS) sector were adopted from the Water Sector Reform Program which were set out in the Cabinet Resolution 237 of 1997 (as outlined in Chapter 3.1.2 above), followed by the development of an action plan and investment program. With the adoption of the Millennium Development Goals (MDGs) the quantitative targets for 2015 for water and sanitation coverage were set as following:

- Percent of urban population covered with water supply services: 75 %;
- Percent of urban population covered with sanitation services: 63 %;
- Population covered with urban water supply services: 6.7 million;
- Population covered with urban sanitation services: 5.6 million.

The investment program (2005 – 2009) had foreseen a budget of about USD 1.6 billion of which nearly USD 800 million were allocated for the urban water supply and sanitation sector. USD 750 million was for the rehabilitation of water and sanitation infrastructure of 32 towns. USD 48 million was allocated for institutional support needed for the decentralization process and on national level, capacity building measures, development of Public-Private-Partnership (PPP) programmes and studies for innovation and alternative water sources.

The sectoral Joint Annual Review (JAR) was an effective practice that had been adopted and applied during the NWSSIP implementation between 2005 and 2008 as a tool to monitor and evaluate the implementation performance and progress. The JAR was compiled by the MWE for the years 2005 to 2008 for evaluating the performance of the preceding year. It comprised the utilities achieved performance indicators i. e. quality and extent of water and sanitation service, budget performance, operation and financial efficiency, institutional capacity, poverty situation. The JAR practice has stalled since 2008, while a Monitoring and Evaluation (M & E) unit was established in MWE for monitoring of the four sub-sectors.

2) NWSSIP II Update (2008)[21]

The assessment of the implementation level of NWSSIP I was in general satisfactory. Regarding the set objectives for the UWSS the following was achieved by 2007 for total urban population of 6.4 million:

- Increase of coverage for water supply from 47 % in 2002 to 56 % (3.6 million);

20 National Water Sector Strategy and Investment Program (NWSSIP) report (2004)

21 Update of the National Water Sector Strategy and Investment Programme (Dec. 2008)

- Increase of coverage for sanitation service from 25 % to 31 % (2.0 million);
- Create autonomous institutions: 15 LCs and 12 Autonomous Utilities (AU);
- Implementation and service provision efficiency has remarkably improved.

Main constraints for the limited progress were the restricted implementation capacities through the utilities and lack of finance.

During the process of monitoring and evaluation of NWSSIP implementation, it was realized that some performance indicators were unattainable. Therefore, NWSSIP I had been updated for the period (2008 – 2015) to the program NWSSIP II (2008) and was ready for implementation at the end of year 2008. Its revised goal "to improve the Yemeni population's sustainable and economically efficient use of the nation's scare water resources" should be then achieved through the following key objectives:

- Strengthen institutions for sustainable water resources management;
- Improve community-based water resources management;
- Increase access to water supply and sanitation service;
- Increase returns to agricultural water use;
- Recover control over groundwater abstraction in critical water basins;
- Establish the WSS program as wide sector approach mechanism for implementing the investment program of NWSSIP Update;
- Establish a M & E unit at MWE to ensure an effective control of the NWSSIP II implementation. The M & E function has confined to the urban sub-sector scope using the Performance Information and Indicators System (PIIS) which is still successfully in use at some LCs.

The updated program aims to increase the water and sanitation coverage for the growing population (9.76 million) by 2015 as following:

- Urban population covered by water supply: 60 % (6 million);
- Urban population covered by sanitation services: 33 % (3.2 million).

The NWSSIP II investment program was to be financed through the multi sectoral implementation program – former Water Sector Support Program (WSSP) where the core donors and GoY placed their financial support. The former WSSP, launched in 2009, had a total committed budget of USD 340 million for financing various components. The implementation through this program failed mainly because of the large discrepancy in funding and implementation mechanism of the donors and the limited institutional capacity of the executing agencies. Only the International Development Association (IDA) remained as support for the WSSP.

The change in political conditions and hence security instability caused termination or suspension of most of the investment interventions within the past few years.

The following achievements and results on the institutional development were made by 2015:

- Some vital regulatory frameworks were developed and approved;
- Restructuring of the former sector-wide financing approach to the current Water Sector Support Project (WSSP) with total fund of USD 90 million granted by IDA and local contribution;
- Several coordination frameworks have been established on the sector level, i. e. Core Donor Group (CDG) with function as a common platform to discuss, coordinate and harmonize the donors various interventions in the water sector.

3) National Dialogue (ND)[22]

As part of the governance regime transformation a National Dialogue (ND) was kicked off in March 2013 lasting for nearly nine months. Among other topics the water as a development issue of great importance was discussed with participation of water agencies (NWRA, LCs, GARWSP) and the MWE. The focus remained on the water sector key issues to develop an improving vision for the water sector, sub-sector and affiliated agencies frameworks taking into consideration the anticipated Yemen governance regime transformation. The results of the ND sessions were summarized in the ND Outcomes Document of January 2014. The document introduced many fundamental changes, concerning the water sector.

22 Yemen National Dialogue – Outcomes Document of January 2014

These changes will have significant implication on all institutional regulatory, organizational, coordination and implementation frameworks in the water sector and four sub-sectors.

3.1.5 Monitoring and Control

1) Performance Indicator Information System

The software for the Performance Indicator Information System (PIIS) was developed in 2004 by the MWE and the Technical Secretariat (TS / GTZ[23]). The system should monitor and evaluate the performance of the urban water sector at the local and national level. The PIIS was initially installed at the ministry, 17 Local Corporations (LCs) and Autonomous Utilities (AU) as well as at the branches of National Water and Sanitation Authority (NWSA).

Since 2005 till now, the monitoring process performed by MWE with the assistance of GIZ WSP has taken various mechanisms based on the fragile political development in Yemen and its implications for the urban water sector. Since 2005 till 2014 the monitoring process was steered through a systematic mechanism by using the PIIS system. The frequency of reporting took place in quarterly, semi-annual and annual pattern to assist the Ministry of Water & Environment and other water sector stakeholder to address real and potential trends of performance on the level of operational, financial and managerial capacities of LCs / Utilities. The table below provides an overview for the monitoring process of UWSS performance indicators in Yemen since 2005.

2) Management Information System (MIS)

The envisioned MIS was intended as a computerised tool to support the M & E activities of MWE. It would be one part of the overall M & E system.

The objective of the Management Information System (MIS) is to support MWE's policy making and coordinating role. The MWE would primarily monitor impact and outcome performance indicators of the four sub-sectors (urban, rural, integrated water resource management, irrigation) as sated in NWSSIP update, reached through the analyses results. In this context first steps had been taken to establish an M & E system for the water sector. A consultancy by Denkmodell and mbi GmbH in July 2010 prepared the ground for such an M & E System on organizational and technical level. The outcome was a Combined Mission Report, a System Concept and the Terms of Reference for the Development of a MIS[24]. The assignments had been commissioned by the former GIZ in the context of the GIZ Programme Institutional Development of the Yemeni Water Sector. Though, the political development of the country prevented the continuation and implementation of the MIS.

Basic task of the MIS would be to monitor implementation (outputs) and resulting outcomes and impacts against the set targets of NWSSIP Update. In addition it should also allow tracking the financial allocations against the actual expenditures. The system shall be established as a central data bank at the MWE and would be accessible via internet to the MWE and the sub-sector offices.

Duration	Targeted LCs / Utilities	Monitoring Tool	Frequency of Reporting	No. of Indicators
2005 – 2008	24 (LC, Utility & Branch)	PIIS	Annually	17 of 72 evaluated
2011 – June 2014	19 (12 LCs & 7 Utilities)	PIIS	Quarterly, Semi-Annual & Annually	6
May 2015 – December 2016	5 LCs	Manual (Excel sheet)	Quarterly & Annually	11
Since 2017	5 LCs	Manual (Excel sheet)	Quarterly & Annually	23

TABLE 4: MONITORING PROCESS OF UWSS PERFORMANCE INDICATORS

23 Now: GIZ – Water Sector Programme (WSP)

24 Monitoring and Evaluation of the NWSSIP Update – Organisational Setup & Management Information System (2010) by denkmodell

3.2 Laws and Regulations

The following sub-chapters describe in brief the important laws and regulations relevant for the water sector in Yemen and applicable for the Local Corporations and Autonomous Utilities.

3.2.1 Law of Public Institutions and Companies

The Law of Public Institution and Companies No. (35) was issued in April 1991. The law governs all duties, responsibilities and rights of public institutions and companies including instructions for the key bodies of these entities, the Board of Directors, control and audit functions and the executive management. The few relevant articles are described in brief:

- Article (3) and (4) of the law define the applicable rules and the obligations of the concerned institutions towards the citizens.
- The units which are covered by the provision of this law are allowed to establish branches inside or outside the country (Article 5) and enjoy legal autonomy and financial independency (Article 6).
- Article (52) and (53) regulates how decisions are taken by the Board of Directors or the Ministry and about the formation and membership of the BoD.

3.2.2 LCs Establishment Decree

The water sector reform facilitated the establishment of the Local Corporations (LC) for water and sanitation in the governorates according to the provisions of Cabinet Resolution (237) of 1997. The LCs are responsible to manage the urban water sector at the governorate level. The Yemen government established the first and second local corporation in the Sana'a capital and in Aden governorate in 2000. Until now 15 LCs had been established in 14 governorates, with 2 in Hadramout Governorate as special case due to huge size of the governorate.

According to the Law of the Yemeni Public Institution and Companies establishing new public organization should be through a presidential decree. Therefore for each LC a decree has been issued at the date of establishment. This stipulates provisions and rules to govern and manage the LC as well as the functions, tasks and responsibilities of interrelated public bodies, MWE, BoD and the LC management. The following articles of the decree describe the key responsibilities and financial regulation of the corporation:

→ The Local Corporations are entrusted for the service provision in specified areas (Article 2).

→ Corporations act financially autonomously, supervised by the Minister (Article 3).

→ Corporations shall aim to secure water supply and sanitation service to all customer groups (Article 4).

1) Mandate of the Local Corporation

The Corporation shall, in the fulfilment of its objectives, exercise the following functions and tasks:

- Carry out studies, research and statistics on water consumption rates in the Capital Trust for various uses, estimate immediate and future needs of such supplies and search for sufficient water resources for securing such needs in coordination with the National Water Resources Authority (NWRA).
- Establish investment plans and programs and make use of external grants and loans in the framework of the general strategy of the state and subject to the Water Supply and Sanitation Sector Reform Program.
- Implement water extraction, storage, purification and distribution as well as wastewater treatment and disposal projects.
- Select suitable sites for establishing necessary installations for water extraction, storage and distribution as well as sewage treatment plants.
- Prepare plans, studies, research and technical designs for the implementation and development of water supply and sanitation services.
- Manage, operate and maintain all water supply and sanitation plant under its control.
- Make maximum use of treated wastewater for suitable purposes.
- Carry out studies and designs for water supply and sanitation network extensions in coordination with concerned bodies and implement and maintain its projects.

- Take all necessary actions and measures to ensure protection of environment and public health from water misuse and sanitation risks.
- Train and educate its technical staff and upgrade their professional skills and capabilities.
- Conclude contracts and agreements concerning implementation of its functions and tasks.
- Provide information and data requested by concerned government agencies and investors concerning the activities of the Corporation and provide technical advice in the field of its activity.

2) Mandate of the Board of Directors

The Board is the supreme administrative authority of the Corporation and shall have full powers to supervise, guide, formulate policies and approve plans and programs aiming at fulfilling the obligations of the Corporation and shall exercise the following tasks and functions subject to the applicable laws and regulations:

- Study and approve draft policies and plans concerning management and administration of the activity of the Corporation and follow up their implementation.
- Study and approve administrative, financial and technical by-laws of the Corporation and submit them to the Minister for approval.
- Approve performance criteria and evaluate and check reports submitted on progress of Corporation's activities.
- Propose entry of the Corporation in joint ventures with others or assignment of part of its activities or operations to other partners and study rules regulating such assignments in preparation for their submission to concerned bodies for approval subject to applicable rules and regulations.
- Revise and approve annual balance sheets, profit and loss statements and inventories of the Corporation's stock and assets and submit those to the Minister for approval.
- Approve draft annual financial plans and acts to achieve revenue and expenditure, forecasted in the budget, to ensure maximizing revenue and minimizing expenditure.
- Propose water tariffs and sanitation services fees and submit those to the Minister for approval.
- Propose modifications to the equity of the Corporation.
- Approve incentives and financial reward schemes.
- Study and approve draft organizational by-laws and structures of the Corporation.
- Review matters and subjects presented by the Minister or Chairman from time to time concerning the operations of the Corporation.

3) Autonomous Utilities

The Autonomous Utilities (AU) are managed independently from the Local Corporations. They are controlled and regulated through the Local Advisory Committee (LAC). The LAC is composed of a head member, the General Manager of the district and at most 3 members of either local council, the private, education, beneficiaries and LC representatives as well as the gender representative. Only the utility manager is member of LAC as secretary. The Minutes of Meetings of the LAC are circulated to the LC. Upon request from the LAC the key staff of the AU is asked to participate in their meetings for clarification and discussion of the reports provided by utility to the LAC.

4) Mandate of the Local Advisory Committee

- Review the annual budget for the work and make observations and provide the statements for inclusion in these plans;
- Monitoring the implementation of the annual budget;
- Provide advice on tariff and other fees (delivery fees, fines, and all other related to water and sanitation);
- Approve / disapprove the proposals made by the AU regarding the withdrawal from the connection or depreciation accounts for the purposes for which the accounts were opened;
- Assisting the branch in solving problems and collecting debts;
- Review and comment on the recruitment plan;

- Review the incentive system for the staff according to the local conditions of each utility;
- Provide advice on technical, financial and administrative activities, including periodic monitoring and monitoring of accounts;
- Supporting the branch in protecting the water basins from pollution and depletion in the well fields of the branch.

3.2.3 Civil and Service Law

The Civil Service Law number (19) of 1991 sets rules for public employees covering: recruitment, career, salary (including incentive scheme), working time, capacity building, employees' rights and their displacement.

Article (21) of the law, the "Development of the General Function", may help institutions to solve the critical problem related to structures, regulations and job descriptions. The article proposes that an administrative unit for cooperation and working methods that is technically linked to the cooperation or management sector in the ministry shall:

- Assess existing regulations and organizational structure and propose developments according to management requirements;
- Prepare general functional structure of the administrative unit and the functional structure of its subordinate units;
- Apply the rules and regulations of the job description and classification system and contribute in the achievement of its objectives within the scope of the administrative unit and its subsidiary units;
- Identify the shortcomings and weaknesses affecting the adequacy of work functioning properly. Propose appropriate solutions to improve methods and means of work and develop its means and simplify its procedures;
- Prepare organizational charts according to the regulations and organizational structures approved for the administrative unit and complete the certifying procedures on them by the concerned authority.

3.2.4 Law of the Local Authority

The Law of the Local Authority No. (4) established in 2000 is the ordinary legislation of the former governance rules responsibilities for local councils and its relations and supervising roles of the administrative public units in the governorate and the district levels. Article (3) and (4) of the law are of particular concern for the Local Corporations and Utilities.

Article (3) describes the composition of the local authority that expresses the authority of the administrative units and the laws.

Article (4) defines the basis for the rules of the local authority: the principle of administrative and financial decentralization, expanding public participation in decision-making and managing local affairs in the fields of economic, social and cultural development through elected local councils. The article further explains the local authorities' role in the process of implementation of development plans and programs.

With regards to Article (3) sub-article (D), it seems that the relation among the local corporation and the local council is not in place. Only Article (123) Clause (19) Sub-clause (A) creates a link through the introduction of a fee on the water bill for the local council. However, the Establishment Decree of the LCs enhances the relation among LC and local council where the BoD is headed by the Governor of the local council. In case of absence of the Governor, the General Secretary of the local council directs the meeting of the BoD. In the districts level the local advisory committee (LAC) is headed by the General Manager of district accompanied by maximum 2 or 3 local council members.

It should be mentioned that the implemented decentralization of the water sector contributed to enhancing the LCs resilience during the crisis. In case of the absence of the central governmental and BoD supervision, control and support, the LCs is dealing directly with the local council. The local council provided financial support for salaries, fuel for operating the generators and for other urgent needed equipment.

3.2.5 Water Law and its By-law

The Water Law No. (33) was established in 2002 as orderly legislation to prevent water resources depletion and organizing the various water uses. Unfortunately implementing this law and by-law has been interrupted due to

the long period between issuing the law in 2002 and the by-law in 2009, besides other political and social aspects which needed to be considered.

The Yemen amended Water Law No. (41) of December 2006 provides regulations and guidelines for the efficient economic water use and its protection. It further determines the rights for use of water resources.

The use of public water sources by private bodies is restricted for individuals and families which inherited the right for use of water considering the purpose of use associated easement and limits (Part 5, Article 29).

Other persons or groups may only use wells or other forms of collected water from springs or water basins if they have been authorized and obtained a license. (Part 5, Article 33 and 35). They further have to adhere to the allowed take-off quantities and provided technical specifications (Article 37).

Part 4, Article (26) describes the responsibilities of the Ministry regarding organization and management of the water uses.

3.2.6 Finance and Accounting

The provisions of the Financial Law No. (8) of 1990 apply to all ministries, government authorities and bodies and different organs and branches embraced by the public budget of the state.

Article (21) regulates the dealing with national budgets: the new public budgets needs to be issued and approved prior to the start of the new financial year. In case of pending approvals and upon a respective resolution of the Ministry of Finance, the previous year's budgets remains applicable until new budgets are approved, provided that revenues are collected and expenditures are spent in accordance to the applicable laws effective of the previous year.

The Article (26) defines the handling of revenues: All revenues are paid to the Central Bank and its branches. It is prohibited to use other banks except if no local branch for the Central Bank exists. Only in this case revenues may be transferred to a bank authorized by the Central Bank.

Article (73) regulates the treatment of uncollectable debts. If collection is not possible because of insolvency of the debtor, approved by a final judicial decision, the debt is removed by the Ministry of Finance.

Article (66) determines the financial monitoring of the public sector: Without prejudice to the competencies of the Central Organization for Control and Auditing (COCA) this organization undertakes the monitoring of all public sector units, audit of their final accounts and balance sheets and approves them.

The Ministry of Water and Environment and the Ministry of Finance are monitoring and controlling the implementation of the annual budget while COCA is authorized to audit the financial accounts of the utilities.

3.2.7 Procurement Law and its Executive By-law

The Procurement Law No. (23) of 2007 and its by-law No. (53) of 2009 formulates the regulations, rules and procedures for public tendering process. The law has to be followed by all public organizations, including the urban water and sanitation local corporations

The High Authority for Tender Control (HATC) was established in 2009. It is acting as a procurement policy and monitoring board in charge for the supreme procurement oversight and acts as the review authority for complaints by bidders. It reports directly to the President.

The High Tendering Board (HTB), established in 2007 is a key public procurement monitoring body against corruption. The board includes the Technical Committee and Financial and Administrative Management and operates the Procurement Management Information System (PMIS). HTB needs to approve all tender with values above YER 250 million. Results of tenders are published on the HTB website, which in addition provides service information, such as standard tender documents and procurement procedures.

The Government or public institutions do not publish official notices in either a gazette or public procurement bulletins to provide information on advertisement and tender notices. Interested contractors must obtain the required information from local newspapers or through direct contacts with the entities that published the tender.

The Procurement Management Information System (PMIS) has been created to replace existing manual and electronic systems. This should guarantee better transparency and processing of tenders. It reinforces the Procurement Law and became operational in 2010.

4 Strengthening the Resilience of the Water and Sanitation LCs

Building up the resilience of the LCs should contribute to an enhanced and increased access of water supply and sanitation service for the urban population. The primary goal shall be to support the utilities during the crisis to enable the continuation of services, respectively to resume services after conflict in certain heavily affected towns. To foster such activities it is required to analyse the institutions with regards to current practices or situation split into beneficial conditions and shortcomings.

4.1 Beneficial and Restricting Factors

Although the work environment for the LCs staff in Yemen was and still is harsh during the ongoing conflict and the LC faces numerous challenges due to the crisis, the following beneficial conditions prevail:

- → Decentralized utilities: most of the corporations and utilities are financial, technically and administratively independent, therefore the impact of the on-going crisis is different from one LC to another;
- → All LCs continue to provide service (drinking water and sanitation);
- → The LCs are still committed to the laws and regulations;
- → The complete Board of Directors is still available to govern the LCs;
- → All LCs maintain their institutional structures with its departments and staff who are conducting their usual activities;
- → Tariffs can be adjusted and applied after approval through the BoD;
- → All LCs operate according to the principle of cost recovery, i. e. to cover the operation and maintenance costs;
- → Most of the infrastructure of the LCs are save and in function;
- → Most office facilities like IT equipment, systems, networks, databases is save and in function;
- → Low water tariff application;
- → Continuing support from humanitarian organizations;
- → Favourable climate condition for renewable energy system application;
- → Available solar systems and companies on the Yemen market;
- → Presence of appropriate IT systems and applications.

These favourable conditions would enhance and foster the implementation of recommended measures in order to strengthen the utilities.

Nevertheless the LCs have to cope with significant problem which aggravated through the crisis. These shortcomings are often interlinked with each other and hinder the LCs to provide sufficient water and sanitation services:

- Failure or frequent interruption of public power supply;
- Inability of LC to replace the deteriorate public energy supply with reliable alternative energy systems;
- Lack of generators and especially fuel to produce energy needed for the operation of water and wastewater pumps as well as for wastewater treatment plants;
- High and fluctuating prices on fuel or non-availability of fuel on the market;
- Financial shortage preventing LCs to purchase fuel, spare parts or alternative energy sources, like solar systems;

- Financial shortage preventing LCs to procure operation and maintenance materials for rehabilitation and restoring water and sanitation services;
- Suspended or terminated investment programs preventing urgent required rehabilitation and extension projects to be implemented;
- Insufficient skilled staff and lack of materials to restore water and sanitation services through installation of required materials and equipment;
- Low morale of LC staff due to outstanding salary payments;
- Damage and vandalism of water and sanitation facilities due to the conflict;
- Looting of LC equipment like vehicles, machines, materials from stores and laboratories;
- Financial shortage due to lack of funding and low revenues;
- Low revenues due to inability or low paying moral of customers to pay their fees and debts;
- Lack of governance and management leading to insufficient guidance regarding (emergency) planning for rehabilitation or network extension measures;
- Lack of IT equipment and office equipment causing inefficient work processes and delays;
- Absence of customer water meters resulting in none or estimated, mostly too low water billing;
- Depleted water resourced, e. g. wells;
- Unstable economic and political situation.

As mentioned before the LCs operate independently, thus the described shortcomings are more or less profound for each LC. The specific problems have to be identified for each LC individually to be able to pinpoint the exact required support.

4.2 Resilience Factors

Currently different donor organizations are supporting the utilities to maintain the water and sanitation services. The support is usually in form of fuel, generators and selective O & M equipment. However such assistance is tackling only the emergency needs and would not strengthen the utilities in the long term. To make the LCs perform sustainably and efficiently, comprehensive technical assistance and investments are needed. Therefore the resilience of the LCs can be increased through institutional support combined with investment measures and have subsequently been grouped into these two main categories: Technical Assistance and Investment. The table below presents the identified resilience factors with its expected respective output after implementation of related activities. More details on the institutional condition followed by respective proposed measures are presented in the referenced following chapters.

The sequence of activities does not present the priority; it is proposed to implement most of the measures in parallel and during the conflict. Thus the overall objective could be reached within the shortest possible time: to strengthen the resilience of the utilities and improve the water and sanitation service for the population.

Reference	Main Activity	Resilience Factor	Impact
Chapter 5.1	Technical Assistance – Capacity building	Improve governance and management skills on top level.	• Support and guide the LC management during the crisis in the decision making of required actions and measures. • Enable managers and key staff to prepare and introduce customized policies and procedures to increase the performance of the utility. • Enhance the coordination and cooperation among the different stakeholders (donors). • Enhance monitoring, evaluation and accountability of the LC to increase the performance.
Chapter 5.2	Technical Assistance – Capacity building, Financial support, Consultancy support, equipment support	Enhance the work capacity and skills of the employees. Human resource development	• Operate the utility more efficient and organized. • Improve coordination and cooperation among different departments. • Improve and increase the service for customers. • Manage professionally the exceptional work. Environment and the new technologies. • Reduce administrative water losses and increase revenue collection.
Chapter 5.3	Technical Assistance – Financial support, Awareness building; Coaching, Investments	Strengthen the financial capacity of the utility.	• Ensure financial means at least to cover the minimum needs for operation of the utility. • Enable urgently needed repair and maintenance of the infrastructure. • Initiate pro-poor projects. • Keep motivated staff. • Enhance financial sustainability.
Chapter 5.4	Technical Assistance – Awareness building, Operation Management Support	Improve customer management and customer relation.	• Increase service coverage and numbers of customers. • Enhance billing and collection procedures. • Increase collection efficiency and revenues. • Establish good customer relation to improve payment moral.
Chapter 6.4.1	Investment – Rehabilitation, Maintenance, Extension	Increase water service coverage and supplied quantities.	• Increase water availability for urban residents. • Improve water supply condition. • Reduce physical water losses. • Increase number of customers. • Improve water quality.
Chapter 6.4.2	Investment – Rehabilitation, Maintenance, Extension	Improve and extend sewer system.	• Improve hygiene and health situation for urban residents. • Protect environment and water sources. • Increase number of customers.
Chapter 6.4.3	Investment	Provide renewable energy system (Photovoltaic).	• Operate water and sanitation facilities sufficiently. • Operate LC offices during working hours. • Reduce operation and maintenance costs.

→

Reference	Main Activity	Resilience Factor	Impact
Chapter 6.4.1 to 6.4.3	Technical Assistance	Investigation on: • Optional water resources[25] • Optional sanitation systems[26] • Optional energy sources • Energy savings	Assessment results on: • alternative water sources, e. g. reclaimed wastewater, rainwater; • alternative sanitation systems; • renewable energy options; • energy saving potentials.
Investment Plans	Investment	Resumption of terminated or suspended projects.	• Increase populations' access to public water and sanitation service, particular for the poor. • Establish functional wastewater treatment systems. • Improve water and wastewater infrastructure. • Reduce physical water losses.

TABLE 5: RESILIENCE MEASURES AND IMPACT

In the long term and considering the post-crisis scenario, the utilities have to get prepared for the future challenges to convert to sustainable self-financing institutions within the new political regime and governance change in Yemen. The previous NWSSIP activities, as briefly described in Chapter 3.1.4 above showed the first fruitful results until the crisis started. The process of decentralization and transformation of the utilities with all the envisaged objectives should be resumed and continued. This is to maintain the progress which they had achieved and to improve the current situation caused by the crisis as well as attain the sustainable development goals.

25 According to NWSSIP II Update (2008) the following seven water supply systems are acceptable: household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection, tanker supply.

26 According to NWSSIP II Update (2008) the following six sanitation systems are acceptable: connection to a public sewer, connection to a septic system, pour-flush latrine, simple pit latrines, ventilated improved pit latrines, semi-decentralized options.

5 Institutional Assessment

5.1 Governance and Management

5.1.1 Appraisal of the Governance and Management Situation

Each Local Corporation and Utility is controlled by its individual Board of Directors (BoD) respectively the Local Advisory Committee and managed by the LC / Utilities management. Details on the tasks and responsibilities are outlined in Chapter 3.2.2 above. The performance of the LC depends strongly on the management skills and the sense of accountability of the leadership.

1) Governance

The members of the BoD / LAC are directors and engineers from different institutions. The BoD is composed of stakeholders in the central government, the local authority, the private sector and the beneficiaries. The board usually consists of 8 members. The members are not particularly prepared or trained for the position. They should meet once a month to discuss the urgent issues of the utility. Before the crisis they met 6 to 12 times a year. The crisis aggravated the situation and meetings took only place up to three times within the last 3 years for most of the utilities. No meetings were held in Sana'a, Hadramout, Al Shehr, Abyan, Lahij and Taiz. Therefore the guidance and control of the utility through the Boards or Advisory Committee had been considerably neglected during the last years.

2) LC / Utility Management

The management of the utility consist of the General Director respectively Utility Director heading the institution and managers for the different departments. The number of managers varies depending on the size of utility respectively service area. Some utilities employ far too high a number of managers. For example LC Dhamar with 25 managers, respectively 10 % of the total staff. The General Director is appointed by cabinet resolution with prior minister nomination. Exceptions are Sana'a and Aden LC where the General Director is appointed by presidential resolution. The department managers are appointed by the minister after the BoD nomination.

Procedures and processes effectively applied before the crisis in different departments were adjusted or cancelled during the conflict by the management. The LC management does not utilize the BoD regarding formulating policies and approving programmes and procedures in the crisis to mitigate the crisis impact on the LCs performance. Many utilities have not established a business plan, essential to identify the requirements on administrative, technically and financially level for the coming years. Only Ibb, Mukalla, Hudaydah, Amran, Hajjah, have annual business plans while Abyan, Lahij, Sana'a Aden, Amran and Sa'ada have neglected the business plan preparation during the crisis.

Furthermore the management does not have the capacity to prepare a contingency plans for emergency situations, which leaves the utility hamstrung and methodless in case of emergency.

The subsequent result is that the utilities are not managed and operated properly. Regulations given through the government and local authority are partly ignored or cannot be followed due to internal or external constraints. Required adjustments of processes are not recognized and are put off. Due to the crisis business plans were not discussed, established or approved, which impairs the performance and the financial capacity of the utility to a great extent.

5.1.2 Measures to Strengthen Governance and Management

The governance and management practices have to be enhanced through different set of measures: capacity building, meetings and workshops, revised and adjusted management procedures, monitoring of the utilities performance.

1) Capacity Building

Capacity building incorporates: training courses, coaching of managers and knowledge exchange platforms.

→ Training courses on the governance level are particular specialized courses of high profile. The Yemen Institute of Directors (YIOD) is offering such specialized training programs on the management and governance level. The participants learn about responsibilities, roles, governance principles, corporate governance procedures and methodology. Other options are training courses in specialized training centres in Amman or Cairo. The courses should cover the relevant topics of the G20 / OECD27 Principles of Corporate Governance, published by the Organisation for Economic Co-operation and Development (OECD) in 1999 (update 2004). The principles are supposed to support the policy makers to evaluate and improve the legal, regulatory, and institutional framework for corporate governance.

  An example for the benefits of such training courses is the Yemen mobile Public Shareholding Company controlled by the 11 BoD members. The BoD is very active and holds 20 meetings per year which is above the required. This commitment is developed and enhanced through the regular annual training courses in the governance principles, tasks and responsibility.

→ On the management level of the utilities, training courses on leadership skills, strategic planning, crisis management and emergency planning are the most important. Further specialized courses should be offered on the department management level to support the utility to establish customized processes and procedures. Training courses on different subjects of Management are provided for example by The Human Resources Development Unit (HRDU) affiliated to the MWE. Further details are listed in Chapter 5.2.2 (2) below.

→ Coaching of managers involves the guidance and support through experts over a certain period of time. Such an activity would help the manager and utility in the preparation of customized procedures and processes and in decision making processes. The experts are from different backgrounds, depending on the kind of support needed in the utility. The professionals could be identified and appointed through a Consultant and then financed through a Technical Assistance program. The positive side effect for coaching of managers is the knowledge transfer on the long term.

→ Exchange platform / information centre: this tool can be established in form of a database, accessible to all managers of the utilities and the BoD members, like the Management Information System (see Chapter 3.1.5). The database would contain all relevant documents, reports, guidelines, laws issued within the last years and supporting the institutions in their management practices and decisions. Such a database could be established and integrated into the former envisaged Management Information System with the central database at the MWE. In addition to the database a discussion forum may be incorporated where managers can raise specific questions or describe problems to which other members could give advices.

2) Meetings and Workshops

The resumption of the monthly meeting of the BoD respectively by-monthly meeting of LAC is of utmost importance. The meetings serve to exchange knowledge and proposals and update the members on the latest problems the utility is confronted. Necessary changes and adjustment of procedures and processes to improve the utilities performance have to be discussed and agreed on. Particularly during the crisis the utility has to deal with challenging situations where cooperation and support from the BoD / LAC is needed. Reporting procedures like Minutes of Meetings, must be implemented and followed to verify the impact on the decisions and take eventually rectifying actions.

Each LC and Utility must establish a management board

27 Forum for international co-operation that brings together leaders, finance ministers and central bank governors of 20 economies.

and conduct regular monthly meetings among all managers. Each department manager would prepare brief regular status / progressive report with respective results to be presented in the group. The exchange of information and discussion would enhance the cooperation among the departments and increase the knowledge.

In addition the cooperation among the different LCs should be improved through regular meetings and workshops of the top management. These meetings should take place every 6 months in different LC locations and once the security situation allows for safe travelling. External participants, i. e. specialized experts, from donor organizations or BoD members should be invited, depending on the agenda of the meeting. The purpose is to transfer knowledge and exchange experience to become acquainted with problems in other LCs and learn how their management is dealing with such problems. Furthermore, participants would learn about possible technical or institutional support that the different LCs could provide and explore the possibilities of exchanging key experts.

3) Revision of Processes and Procedures

Certain procedures and processes must be adhered to so as to enable efficient operation of the utility. Each department would need to maintain their individual activities customized according to their requirements. In-depth investigation of the institution and its departments is needed to identify the detailed required amendments to improve the work efficiency and therefore their performance. These concern mainly the following activities:

- → Billing and collection
- → Customer management
- → Operation and maintenance
- → HR development
- → Financial planning

Training courses with respective topics will support the managers to prepare and implement the utility-tailored procedures. Besides, certain software programmes need to be installed prior to introducing new processes. For the Billing and Collection the Yemeni Customer Information System based on Oracle software has proved to be a good tool. For successful implementation and application of the adapted procedures coaching through specialized experts is needed.

The previous Operation Management Support (OMS), provided though GIZ from 2003 to 2014, has been implemented in the LCs of Hudaydah, Taiz, Ibb, Sana'a and Aden. The objective was to introduce computerized, integrated information management tools on the basis of Geographic Information Systems (GIS) to enhance the business procedures and increase the human and financial capacity on long term. The system was successfully installed and is still operational in Hudaydah, Sana'a and Ibb. The implementation or continuation and extension of this program would be beneficial for the utilities where it is installed and applied.

4) Monitoring and Evaluation (M & E) / Reporting

The effect of investment programmes and other support can be only measured through the M & E activities. The implementation of activities has to be closely controlled and monitored and its impact evaluated and reported by the Management, the BoD and Ministry. Therefore the monitoring and evaluation of the performance of the utilities is an important and responsible task and has to be followed at first by the utility managers. The installed Performance Indicator Information System (PIIS) has to be re-activated for each LC. Each department manager should determine and record the required parameters on a monthly basis and enter it into the PIIS. To resume this activity and ensure correct execution the managers should participate in respective training. The support for each utility could be a constraint to achieving certain milestones, visible through the PIIS results.

The continuation of the Water Sector Support Program (WSSP) in establishing M & E function including data and information systems within the project management unit should be considered. Such an activity would improve the monitoring, follow up and evaluation task of project interventions. In parallel, the preparation of the Joint Annual Reviews (JAR), which had been suspended in 2009, should be re-activated.

The establishment of a central data bank, the Management Information System (MIS) within the MWE, as proposed in the NWSSIP II Update 2014 – 2015 should be followed up. The MIS will ensure the continuous control of water indicators and performance indicators needed as baseline for monitoring and comparing the performance of the utilities over the long term.

5) Emergency Plan

Most of the LCs did not prepare an emergency plan which would help them to follow structured and organized procedures.

The procedures have to be established individually for each LC, considering the existing supply and sanitation system and kind of power supply. Thus the process should describe:

a) How the population is provided with water during prolonged power cuts.
b) How the wastewater is disposed appropriately to avoid health risks and environmental pollution.
c) How the power supply can be maintained.

The LC has to nominate responsible key staff and empower them to act and delegate tasks according to the respective operation procedure in case of emergency. The key staff and active staff have to be trained for their particular tasks and get familiar with the procedures.

Some LCs, e.g. Dhamar, Sana'a, Hudaydah have already prepared an emergency plan which could be adapted to other LCs.

The LC should inform the public about the emergency services through awareness programme in coordination with relevant government offices, local authority, awareness committee and NGOs.

5.2 Organizational Structure and Human Resources

5.2.1 Appraisal of Organization and Staffing

1) Organizational Structure

The Local Corporation usually maintains six main departments with different number of sub-sections:

→ Administration department (includes human resources, legal department, secretaries);
→ Financial affairs (includes procurement, collection);
→ Water supply department (includes water production, O & M);
→ Sanitation department (includes wastewater treatment, O & M);
→ Customer department (includes billing, water meter reading & customer service centres);
→ Project department (includes planning, design, statistics, supervision).

The Autonomous Utilities and Branches maintain three main departments with different numbers of subsections:

→ Administrative department;
→ Financial and customer department;
→ Technical department.

Due to the political crisis of 2011 some utilities adjusted the departments and restructured the organization according to the intention / personal opinion of the General Director and utility managers. The new structure was neither discussed nor communicated with the BoD, MWE and Ministry of Civil Service (MoCS) and has not been approved in many cases. The effect is that the administrative department with management are overstaffed, reaching in some cases nearly 30 % of the total staff number. In some utilities, the three main departments, water supply, sanitation and customer dispose of fewer employees compared to the administration section. The staff number for auxiliary staff, that is guards and drivers are considered too high reaching for example 20 % in Abyan and Sana'a, although many of these employees perform double functions, i.e. guard work also as operator of wells or drivers are also operator of machines, vehicles.

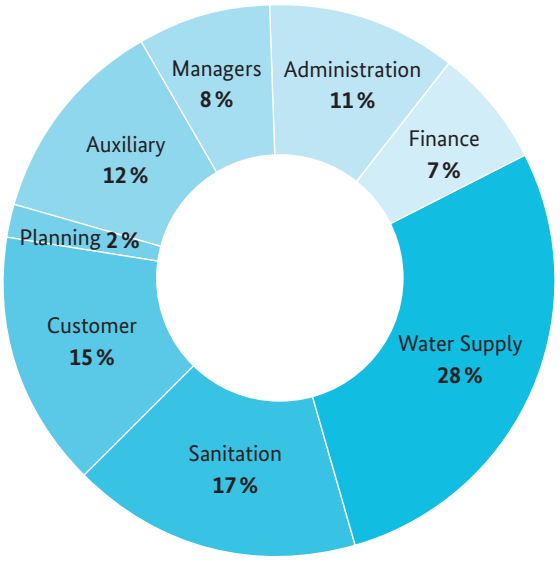

FIGURE 3: STAFF DISTRIBUTION AMONG UTILITIES DEPARTMENTS[28]

28 Average value of 12 assessed Local Corporations and 5 Utilities in 2017

2) Human Resource Management

Human Resource Policies and Procedures: The utilities follow the Civil Service Law which provides regulations about job description, labour force planning, selection and appointment, performance evaluation, motivation and encouragement, training and development, promotions, upgrading, deputation, transferring, awarding vacations, discipline and accountability, discharge, deciding on grievances and termination of employee service.

In general these procedures and policies are poorly applied by most LCs with exception in Ibb and Aden LCs. There, job descriptions are available and staff attendance is controlled.

Staff situation: The PIIS indicator, number of staff per 1000 customers, provides a first impression about the staffing situation within the utilities. According to this indicator most of the utilities would be overstaffed. However the human resource situation of each institution has to be individually investigated considering the current circumstances. It can be expected that the employees are less efficient during the crisis; power cuts prevent them from working a full day and without interruption and some employees may not be able to attend to work at critical times. In Dhamar, Ibb, Amran, Hajjah, Sa'ada and Taiz there is no public electricity supply at all. Besides, all utilities are lacking in IT equipment resulting in increased inefficiency of the staff.

The number of qualified employees is an important indicator for the performance of the utility. In all LCs the number of staff with a university degree is below 20 % and considered inadequate. About 80 % of the employees dispose of a secondary degree or lower qualification and did not receive any particular training to be prepared for their tasks, with few exceptions like in Ibb and Mukalla LCs. The rate of female employees is very low with usually less than 10 % of total staff number. Women are in general more dedicated to their work and their employment and training should be fostered for committed females.

The high number of non-working staff in some LCs leads to additional financial burden on the LC. The reasons for staff absence are that employees are retired, sick, or assigned to other governmental departments. Some are not able to attend to work due to security reasons. It must be noted, that the utilities have to cover for the salaries of released / retired employees, although they do not contribute to the performance of the LC anymore. The worst case is in Abyan LC where 85 % of the employees do not attend to work due to outstanding salary payments and lack of office facilities.

Salary payments: Because of the crisis and subsequent lack of budget, most of the employees did not receive their salary for a different period; most of them from September 2016 until now. There are several million Euros of outstanding payments for the staff almost for each LC. Although Amran achieved high collection efficiencies, they have to utilize the cash for the increased cost for operation and maintenance of the water supply system, Al-Shehr and Ibb are exceptions which are able to pay the salaries from their revenue, while in Aden Lahij, Abyan and Mukalla the utilities are able to pay the salaries from the received support by the government and local council.

Disregarding these adverse conditions, the majority of employees attend to work, because they expect the payment once the utility is capable to finance the salaries. Certainly the poor financial situation contributes to lack of engagement of staff and therefore overall insufficient performance of the utility.

Work environment: During the crisis, the work environment deteriorated considerably. Due to security reasons the cost of transportation increased and people are restricted in entering to some facilities. Offices in Lahij, Abyan, Abs, and Harad had been totally destroyed and with it most of the equipment and furniture.

Lately, the situation has improved in most of the LCs: the office in Abyan and Lahij is being rebuilt and should be operational soon.

All of the utilities are suffering from deficient IT hardware and software. Computers, servers and printers are old 0,7 or out of service. The operating system is out of date and software is outdated. Some of the utilities have even not sufficient furniture. During the crisis and due to power cuts, the utilities have been functional only few hours during the normal working hours. Often the LCs have no power saving devices such as UPS or voltage regulators to maintain electricity supply.

5.2.2 Measures to Enhance the Organizational Structure and Human Resources

To enhance the performance of the utilities following measures on the organizational structure and human resource level are proposed.

1) Re-structuring of the Organization

A balanced organizational structure with appropriate staff number per department is the pre-condition for proper human resource planning and therefore an efficiently operating utility.

As a first step, the main departments, water supply, sanitation, customer, need to be strengthened and the administration and management section thinned out. Subsequent training is required for relocation of employees from the overstaffed departments to the main department to prepare them for the new tasks. This is in practice a very challenging measure, which requires besides managerial commitment and leadership also significant training to enable the employees to work at the new positions. In parallel, the utility has to stop employing new staff in order to reduce the number of employees and therefore the high cost on human resources over the long term.

The applied organizational structure has to be compared with the approved version and discrepancies identified and the reasons for the change explained. The number and size of the departments and sub-units must be harmonized with the dimension of the utility, i.e. extent of service area and number of customers. The appropriate re-structuring of the organization would be a post-crisis activity where institutional experts have to be involved and the strategy of the NWSSIP considered.

2) Human Resource Development

The Human Resource Development (HRD) centre under the umbrella of MWE developed strategies for the Urban Water and Sanitation Sector in Yemen. The strategy considers the entire system of developing the Human Resource. For the future adjustment of the organization and capacity building measures the following principles of the strategy should be considered.

Training of employees: The skills and capability of the key staff has to be enhanced through training measures. The training courses should enable the managers and key staff to initiate, phrase and implement or adjust the necessary processes and procedures to enhance the performance and make the institution financial viable. The courses should help them to be prepared during emergency situations. Specialized technical training to enhance the operation and maintenance of the water and sanitation system has to be provided.

Through the assessment of the staffing situation of each utility the training needs can be identified and can be grouped according to themes with participants from the individual utilities. The positive side effect is the joint learning and exchange of knowledge and enhancing discussions on individual topics.

There are several options for available training centres in Yemen and outside.

- The Human Resources Development Unit (HRDU) in Sana'a Capital has been established by a Ministerial Decree and is supported by GIZ. The centre has vast experience in organizing and offering training courses in the water sector. The HRDU offers training courses for technical matters, on administrative, and finance subjects and also for management.

- Water and Environment Centre (WEC), an academic and research institute in Sana'a, offers short-term courses in the water sector in the various fields of water supply and wastewater.

- Dhaban Institute in Sana'a has high school program for water sector and is funded by GIZ.

- There are several institutes for management training (e.g. National Institute of Administrative Sciences in Sana'a Yemen) and for accounting and computer program application.

- The Arab Countries Water Utilities Association (ACWUA) in Amman offers courses in water and sanitation service operation and in utility management.

All of the local training centres can provide the training also in Mukalla, Aden or Hudaydah. Above mentioned centres offer traditional training courses in form of classroom sessions.

As an option for the classroom training, specially customized E-Training courses could be provided. The participants would not have to travel, which is in particular for employees from crisis areas an advantage.

Delegation and coordination of works: The employees have to receive clear instructions from their superiors. Documented workflows with assigned persons / positions should be introduced to avoid overlapping of tasks. Detailed job descriptions shall be prepared to support the work process. The job descriptions are available and in use by some of the LCs, like in Aden. In Ibb, Hajjah and Dhamar the instructions are old, established in 2000 or before and

need to be updated. The utilities should obtain or prepare detailed job descriptions according to their needs and provide them to their employees in addition to explanation of their responsibilities and tasks. Support through external institutional expert may have to be provided.

Regular meetings should be held for each individual section to discuss work schedules, responsibilities and problems, in particular for the O & M unit. The key staff has to be instructed about their responsibilities during emergencies in accordance with the established emergency plan.

Salary payment and incentives: The regular payment of the staff should be implemented to keep the performance at least at a moderate level. The financial requirements should be carefully scrutinized for each utility in relation to financial constraints caused by the crisis which are beyond the control of the utility. The following criteria should be considered when calculating the salary requirements:

- The utilities' financial situation;
- The current subsidies from MoF for the recurrent budget;
- The collection efficiency;
- The period of suspended salary payments;
- The amount of fuel support through funding organizations.

Financial support could be given through the Ministry of Finance (MoF) for a limited period. This would reduce the financial burden on the LCs and enhance the motivation of the employees. The support should be linked to realisable targets, e.g. increase of collection efficiency or limited to a (individually) agreed number of employees per 1000 Customers or fulfilment of the agreed and approved organisational structure. (→ monitoring & evaluation).

The LC should also consider introducing incentives for excellent work performance or commitment. In some LCs incentive schemes are already applied, e.g. Ibb, and Mukalla for monthly performance.

Office Equipment: Appropriate work environment is a prerequisite to enhance the work performance of the employees. This includes not only sufficiently furnished office rooms, but availability of urgently needed IT equipment, printers and software updates.

The respective IT requirements have been assessed for each LC and are included in the investment package for the Technical Assistance measures. Some of the procurement has to be accompanied by training measures and technical support for the hardware and software installation and application.

A long term investment is the installation of an integrated GIS system which incorporates the water network, facilities and with link to the customer database including address. GIS enhances the assessment on customer location, density, consumption data, leak locations and provides therefore an excellent tool for needed rehabilitation measures or for extension planning of water systems. The investments are major, since it requires not only the software but extended and repetitive training to maintain a sustainable GIS unit.

5.3 Financial Capacity

5.3.1 Appraisal of Financial Condition

1) Financial Procedures and Processes

The utilities are in general following the policies and procedures of the Financial Law and according to the consolidated accounting principles as briefly described in Chapter 3.2.6. The below outlined procedures reflects the practice of the LCs during the crisis.

Financial Planning (annual budget): The annual recurrent budget and the investment program represent the financial plan as the annual budgeting for the next year which includes the employment plan, financial plan (revenue, total expenses) and investment plan (comprising the financing resource by government and international donors) for all public bodies, the ministries and affiliated public and mixed (public and private shareholders) organizations. The procedures and process of preparing and approving the budget are:

a) Each public utility / body prepares an individual budget and obtains the approval of the BoD and the related minister followed by the submission to the MoF for discussion and obtaining its approval.
b) The MoF, after approval of the individual budget of all public organs, prepares an overall national budget and reports it to the cabinet for approval.
c) The cabinet reports the budget to parliament for approval.
d) The parliament reports the budget to the republic president who issues a republic resolution in approving this national budget.

The national budget planning is considering the objectives of the Millennium Development Goals.

The utilities annual total recurrent budget is used as monitoring tool to identify the LC's performance in utilizing the allocated and received budget. The deviations of the expenses to the approved or received budget from the funding sources – recurrent or investment budget – are identified. The updated national budget had not been prepared and approved since 2014 by the MoF. Due to the price escalation within the last two years it is not possible to monitor the budget performance against the last approved budget.

In addition some LCs received support from MoF before crisis which stopped during the crisis like in Amran, Hajjah, Sa'ada however this support still continue in Abyan, Lahij.

The previous legal practice (before crisis) of financial transfers among LCs and Central Bank managed by the Ministry of Finance, is not performed for some LCs, like in Sana'a Hudaydah, Mukalla, and Dhamar. Therefore, these LCs disburse directly from their revenues through cash funds for the urgent expenses like salary and purchasing fuel.

Assets Management: All utilities are using an asset and inventory (stock) system software linked to the accounting software. Mukalla LC and its branches and Aden LC are using the cost centre system software in addition. Such software supports the identification of direct and indirect cost of production facilities (water and wastewater systems) and calculates the depreciation expenses monthly instead of yearly. For example the production cost for each well with all direct and indirect costs can be calculated to determine the cost per m^3 water produced. Most of LCs have completed the annual inventory of assets of 2016. They proceeded with the annual updating of the data asset register to add any new assets and to calculate the depreciation cost of old assets in term of the historical value of purchase and the depreciation fixed rate of each asset. However, the damages during the crisis will anyway require a revaluation of the assets.

Due to the financial constraints, most LCs did not deposit any amount of depreciation expenses into the depreciation account in the bank but only record this amount in their accounting cash book and the balance sheet. Other utilities, like Zabid, Bait Al Faqi and Hajjah, deposited some amount in the past years to the depreciation account but withdrew it later to cover part of the salaries and fuel expenses.

Accounting System: All Yemen utilities apply a unified accounting system to classify and record the accounting data. It is a compulsory system for the economic units sector. To overcome the limitations and to meet the requirements of international accounting standards, a classification for accounting, the accompanying system has been added to the unified system. This system is more detailed and it helps to calculate the cost of activities. The produced reports meet government and donor requirements.

All utilities are using accounting software for the automatic recording of the monthly revenues and expenses. Respective monthly balance sheets are produced. The software is linked to all other installed programmes: payroll, assets, stock accountant, billing and PIIS.

Finance auditing: The LCs are subject to the auditing and inspection of the Central Organization for Control and Auditing (COCA) or external auditors authorised by COCA. The latest financial statements of most utilities were audited by COCA in 2013 or 2014. Hajjah LC made its financial statement for 2015 while Amran, Abyan has it only for 2010 and Sa'ada for 2008. The last interim financial reports and balance sheets for all LCs were issued between December 2016 and March 2017.

2) Recurrent expenses

The actual recurrent expenses of the utilities comprises cost for monthly accruing expenses like salaries, fuel, electricity, spare parts for O & M and some minor other cost. The salary is the highest cost factor in the range of 40 to 70 % of the total recurrent expenses, followed by the fuel / electricity cost between 20 to 50 %. Compared to previous years, the share or amount on salary cost has remained nearly constant, since the number of employees did not change significantly. The expenses on energy increased significantly resulting in less available budget for necessary O & M activities. Expenses which are not actually paid are recorded as accounts payable in accordance with accounting standards. For example most of the LCs could not pay the salaries for more than 6 months or cover even the cost for electricity, taxes and insurance.

Financing is needed for the replacement of outdated or worn out equipment and for the maintenance and extension of the water and sanitation infrastructure. During the last few years the utilities were financially not able to reinvest the depreciation in the existing assets, as a result of the absence of a national budget and investment program. They were forced to rely on the support from donor organizations in this respect.

The financial situation was aggravated because of decreased collection efficiency and revenues with increasing cost for energy and materials at the same time. Before the crisis, electricity was provided by the power grid at low cost. The liable amount of payments for electricity consumption was settled at the governmental level through MoF. The accounting transaction was made between the LC, the Electricity authority and the budgeted centralized governmental consumers. Due to the frequent or permanent power cuts, nearly all of the LCs have to operate the water supply system and sanitation system with costly diesel generators. The expenses for electricity increased by 3 to 4 times in some LCs compared to before the crisis. The utilities are not able to keep the water production at the required level, because they are not able to finance the fuel. Particularly the LCs Sana'a, Amran, Dhamar, Ibb and Hudaydah are affected by the increased electricity costs.

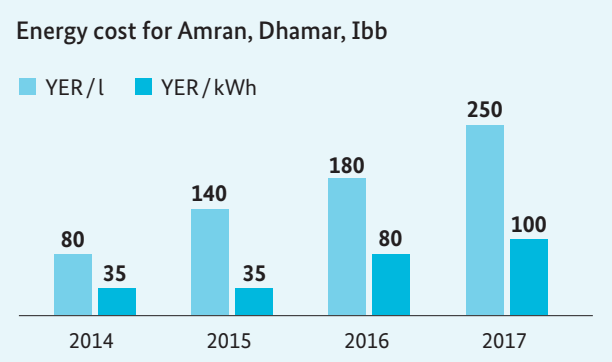

FIGURE 4: PRICE DEVELOPMENT FOR FUEL AND PUBLIC POWER SUPPLY

3) Income

The income of the utilities is rarely enough to cover the expenses for salaries and fuel. The available budget is not sufficient to carry out any maintenance of the networks and infrastructure facilities, leading subsequently to interruption and failure of the water supply and sanitation service. The utilities main income is from the revenues from water sales and support from donor organizations and the government.

Revenues: Depending on the tariff structure and the customer structure the revenues vary considerably among the utilities. Revenues from water sales, sanitation services and new connections is under normal circumstances the main source of income for a utility and would be sufficient to cover all O & M costs. However, during the ongoing conflict, the decrease of revenue collection was reflected in the inability to cover the O & M cost in nearly all Yemen water utilities. A positive exception is Ibb LC were the collected revenues are covering the running / recurrent cost. The comparison of billed, collected and the recurrent expenses (O & M cost) are reflected in the figure below.

The effect of the low collection efficiency is raising indebtedness from unpaid bills amounting to several hundred millions of Rials. The lowest intenseness is in Ibb with 7 months debts age (= total accumulated debts divided by the monthly average billing amount) while the highest was identified in Lahij with 183 months debts age as of March 2017. Reasons for the low revenue collection are outlined in Chapter 5.4.1 below.

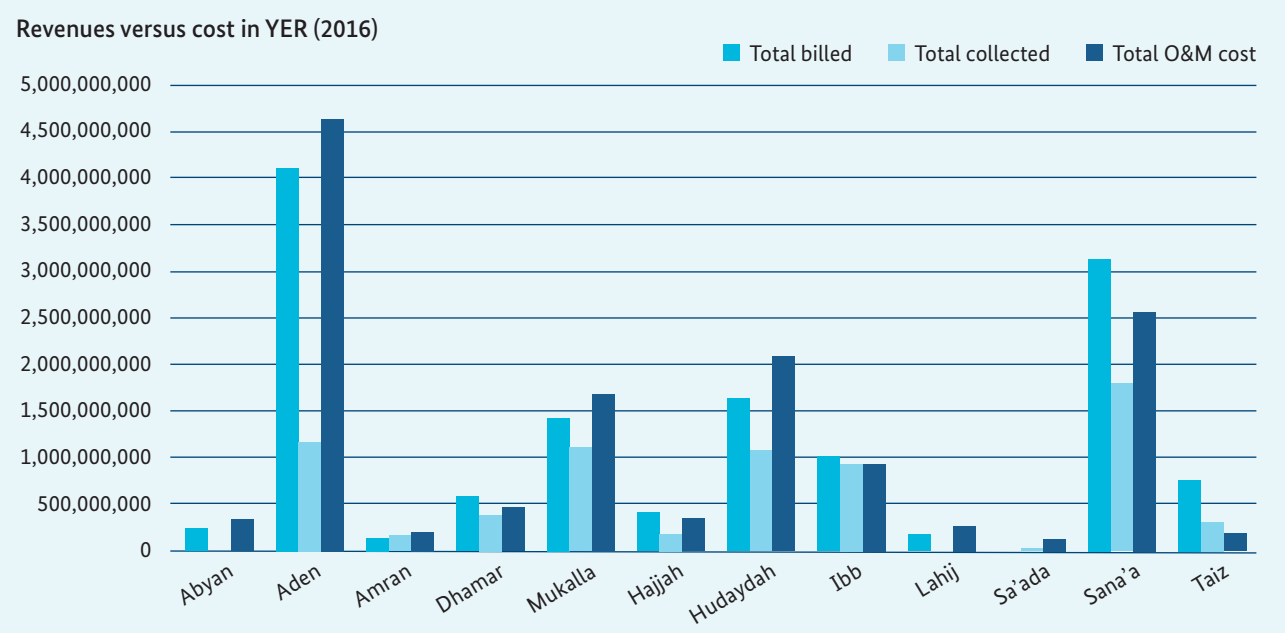

FIGURE 5: FINANCIAL EFFICIENCY OF THE LCS

Government support: Other source of income is the recurrent budget from the Ministry of Finance (MoF) provided to some LCs to cover the chronic gap of operation and maintenance costs.

- In Amran, Sa'ada and Hajjah branches the support provided from MoF was cancelled in 2016;
- Abyan, Lahij LCs received continuing support until now;
- Aden has received support during crisis from the Ministry of Finance (MoF);
- Hadramout and Sana'a and Hodeida has received support during crisis from the Local Council;
- Taiz does not receive any governmental support and has also no revenues from water sales;
- Ibb relies on its revenues before and during crisis in addition to the support received from donor organizations in form of materials and equipment.

Grants, donations and aid: Most of the international funding organizations suspended the implementation of development projects in 2014. The current support relates only to emergency relief and humanitarian activities. The utilities received support in form of fuel, spares and some equipment from UNICEF, WHO, Development Aid Foundation, Red Cross. Details regarding the current humanitarian support procedures of the donor organizations are outlined in Chapter 2.4.2. The figure below presents an overview of the support through donor organizations and government per capita compared to the amount of supplied water. There is no obvious relation to between funding and amount of water production.

5.3.2 Measures to Improve the Financial Capacity

1) Reduction on energy expenses

The utilities have to be released from their staggeringly huge power costs. Options to resume public power supply have to be investigated provided that suitable prices per kWh are applied. If political or other constraints do not allow for public electricity supply, alternatives should be found. Some of the utilities, like Dhamar, Hudaydah, and Sa'ada introduced pilot projects for the use of solar power for operating wells. The necessary investments for solar power measures have been estimated and incorporated in the investment plan for those utilities where it is applicable. In Dhamar, Hudaydah including the affiliated utilities, Abyan, Lahij, Aden and Sa'ada solar power would be a suitable alternative to the generators. For Ibb LC solar power can be used only partly, due to the cloudy weather conditions. First estimations indicate that the use of solar systems would reduce the operational cost by about 30 % of current electricity cost. Other options for other alternative energy sources as wind energy, geothermal energy, and biogas have to be investigated through Feasibility Studies individually for the LCs as outlined in more details in Chapter 6.4.3.

Energy savings can be achieved by replacing the existing electricity current system of well pumps and pumping stations from start-delta / direct online take-off to soft starter take-off. This will reduce current take-off from 2.5 times to 1.4 times. Additional energy saving potentials on the water supply and the sanitation system should be identified through energy experts.

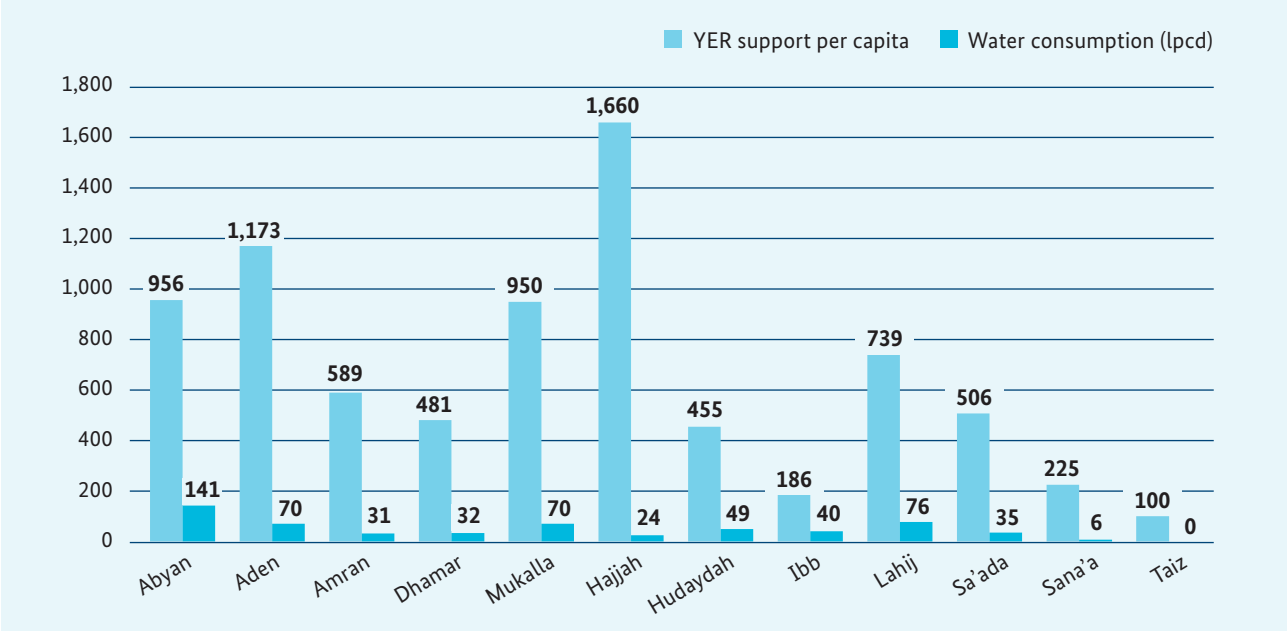

FIGURE 6: SUPPORT VERSUS WATER SUPPLY PER CAPITA IN 2016

The support on power supply and establishing alternative energy sources would enable the utilities to spend more time and money on the maintenance of their water and sanitation systems.

2) Increase of revenues

Utilities have to increase their revenues through several measures. Proper billing and collection procedures have to be resumed and enhanced. This comprises both, institutional and technical measures: introducing / updating of Oracle software, establishing and updating of customer database, introducing organized efficient reading cycles, training of staff, issuance of bills, introducing public awareness campaigns and following up on payments. Regarding the technical activities, new water meters have to be installed, where they are broken, looted or where not installed in the first place as well as connecting new customers to the supply system and increasing of the service coverage.

Subscribers have to be billed according to the actual consumption. The tariff structures have to be revised and appropriately adjusted for each utility individually, considering the current conditions and predicted further inflation in the future. Tariffs need to ensure that water service bills for average consumption must not exceed 5 % of the household income, to consider the poor. The splitting of the sewerage service fees from the water consumption is very important to tackle customers not connected to the water supply system. These concerns customers supplied from private tankers, commercial and governmental subscribers which have their own wells but with connection to the public sanitation system. For those customers, a reasonable flat rate to determine the disposed wastewater volumes needs to be established.

In parallel to above measures the utility should decrease the unaccounted for water (particularly apparent losses) to increase revenues.

The LC should try to collect parts of the significant outstanding payments of the customers including the governmental customers by applying different methods:

- → Encourage the customers to pay (through awareness campaigns);
- → Follow up on old outstanding payments;
- → Discounts on timely payment;
- → Offering instalment agreements;
- → Entail fines and / or disconnecting default customers;
- → Agree with the MoF and MWE to utilize governmental debts against the liabilities of LCs towards the government.

3) Application of improved financial and accounting procedures

The LCs have to redesign the charts of accounts, introduce cost centres and profit centres and separate direct and indirect cost. Such would enable the LC to recognize and allocate expenses and revenues accurately and enhance future financial planning directing towards preparation of annual business plans to control and monitor annual planned versus actual expenses.

The installation / upgrade / re-customization of accounting software and subsequent training of the users would enhance the control of finances, overview of fixed assets, inventory control besides the accounting itself and reduce errors.

Standardized forms for financial statements and templates for consolidated financial reports should be prepared and introduced.

For efficient and accurate billing and collection procedures the customer database / billing system has to be linked to the financial software. In the long term the GIS system, as used already in several LCs shall be linked to the customer database.

5.4 Improve Customer Management

5.4.1 Appraisal of Customer Management Situation

1) Service coverage

The public water supply system cover between 38 % (LC Taiz) and 99 % (LC Hajjah) of the urban population, in average 59 % of all assessed utilities in 2017. The number of new house water connections increased by 3 to 8 % in some LCs within the last 2 years. The number of residents, connected to the sewer system is much lower, reaching between 38 % (LC Taiz) to 69 % (Aden) and average 44 % for all assessed utilities with a sewer system. Most of the utilities face difficulties in ensuring sufficient water supply due to the increased number of IDPs moving to the towns and requiring public services.

The utilities are not able to maintain, rehabilitate and operate their system without external support. The damage of infrastructure and deficient water production leaves customers with no or inadequate water supply. The suspended investment programs that had previously been granted from the national budget by MoF prevent the utilities to extend their network, add new customers and satisfy the population growth.

Another restriction to the increase in service coverage is that some utilities, like Taiz, Sana'a, Amran, and Hajjah face water scarcity in their governorates. Technical solutions have to be found with respective projects implementation to increase the water production.

2) Customer types and consumption pattern

The majority of customers are domestic households representing over 90 %, followed by commercial and governmental connections. The connections from industry, schools and mosques are negligible or incorporated in the other connection category. The number of residents served by one house connection varies from LC to LC and is between 6 to 12 persons per connection. The consumption amount depends on the availability of water, and the ability of the LC to produce and distribute sufficient water respectively. The supplied or consumed amount per customer varies among the utilities and is in average 46 lpcd. Between 50 % to 80 % of the domestic customers are in the lowest consumption tariff of 0 to 10 m³ per month. An exception of high concern is Sana'a LC; due to the low water production and the increasing number of residents, the average supply dropped to just 6 lpcd.

3) Billing and Collection procedure

Different methods are used for the billing and collection procedures depending on the available equipment like software, availability of functional water meters and the capacity of the utility. Typically, the meter readings are taken monthly according to a customer list and provided by the customer department to the IT department. The IT enters the associated readings into the billing software and then issues the bills as packages for each district. The bills are distributed manually to the subscribers. Fee collection takes place through the collection centre with the collected revenues reflected in the collection customer list. The customers pay either directly at the LC customer office, at the post office, by SMS mobile at certain banks, at certain private exchange companies or to the LC reading / collection / disconnection campaign staff. Where GIS

Nos. of water connections in March 2017 (Ibb)

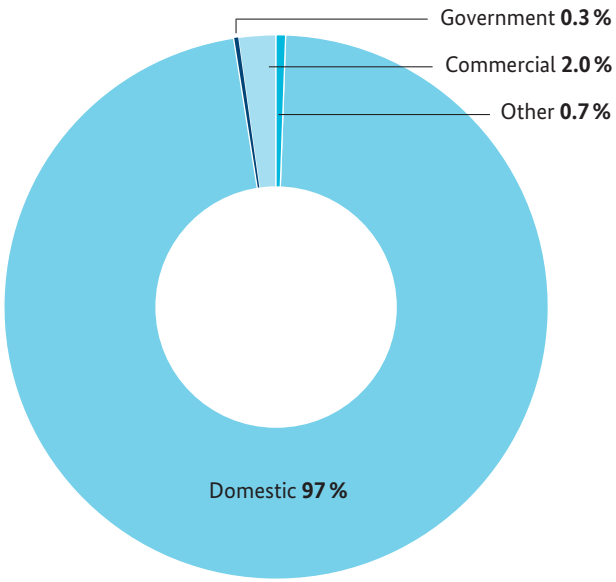

FIGURE 7: SHARE OF WATER CONNECTIONS PER CUSTOMER CATEGORY

system is installed the utilities may utilize GIS supporting tools, e. g GIS based reading routes. All collected amounts should be deposited into the LC revenue account at the Central Bank. However, due to the financial constraints, currently most of the LCs disburse directly for salary payment and fuel purchase.

The majority of connected customers have water meters installed. However in most of the LCs half of the meters are either not functioning, have been destroyed by war or were looted, e. g. in Abyan, Lahij, Hudaydah and its utilities. In case of non-functional water meters, the LCs apply either fixed rates of water consumption per month, like in Dhamar LC or monthly estimated consumption based on historical data of water meter reading as in Hudaydah, Sana'a, Aden and Mukalla LCs. In addition there are huge numbers of zero readings, which might have different reasons, e. g. water meters are out of order, accommodations are not occupied, the subscribers are connected but do not receive water or are illegally connected by bypassing the water meter. Due to decreased water production and supplied amount in Sana'a LC, 72 % of the total customers have zero readings but have to pay for 10 m³ as minimum fixed consumption. As most of these bills are not paid, customer's debts increase and there are doubts that these receivables will be ever collectable in the future.

A special case is the Taiz LC: since there is no access to the LC office downtown, the LC enters a flat rate consumption for all customers into the billing system. The interruption of the monthly readings and recording into billing system

would lead to difficulties in resuming the billing again in the future.

The utilities use different software systems for billing and collection. While Amran, Sa'ada, Hajjah branches, Hudaydah branches and Al Mukkha are using the old system "Yemen Soft" all other utilities are using the "Yemeni Water Customer Information System". Yemen Soft is based on Access database and is showing several deficiencies regarding inability to store customer information, non-support of meter management, it is not possible to modify the system, new reports cannot be prepared, cost for installation and maintenance are high and it cannot be linked to other applications used in the water sector.

4) Collection efficiency

The collection efficiency is usually higher than the percentage of paying customers. This indicates that the utilities collect the fees from subscribers with higher consumption and higher bills. The cash collection efficiency is usually in the range between 60 % and 90 % (except Abyan: 4 % and Lahij: 0.7 % in 2016), while the percentage of paid bills is even lower (see also Figure 5) The low collection rate is basically caused by (i) subscribers not able or willing to pay their bills, (ii) Tariff structure / fee calculation which is not appropriate, (iii) Billing & Collection procedure not realized.

- Due to the crisis, the willingness and ability of the customers for payment decreased considerably. This has basically three main reasons: the supply service deteriorated during the crisis in terms of supply duration, quantity and quality resulting in dissatisfied customers. Second, the population is financially not able to pay the bills, since the prices for commodities increased considerably while at the same time their income has decreased. And third the weak performance of governmental bodies in the local and central level in pursuing and applying fines to the non-paying customers.

- Tariff structure: The tariff structure is proposed by the LC management and needs to be approved by the BoD and MWE before the LC management enforces new prices. Some LCs / utilities have adjusted and applied a new tariff structure during crisis while in other LCs the applied tariff structure is outdated and does not properly balance the increased cost situation. The tariff is in some LCs too low with just 50 YER / m^3 for the first 5 or 10 m^3 and including the sewer fee as percent of the water fee. Al Shehr, Mukalla and Aden apply such a low fee system but introduced in parallel rental fee of 300 YER / month for the water meters. Dhamar on the other hand is using an unfair tariff structure with the highest rate for the lowest consumption category charging 300 YER / m^3.

  The tariff would in most cases be above the production cost excluding depreciation cost. However if collection efficiencies are in average 60 % and the average unaccounted for water 37 %, the tariff cannot cover even the recurrent cost.

5) Customer services centre

Most of the utilities have no customer complaints unit installed. The complaints are taken by the customer department but without procedures in place how the complaints are dealt with or if they get solved. Hudaydah, Ibb and Sana'a use a Maintenance Management System linked to the GIS; where customer complaints can be traced and incorporated in the database. The complaints are entered, O & M section informed and feedback given back to the customer unit when the problem is solved.

Utilities have neither the budget available for customer awareness campaigns nor did they receive support from organizations within the last few years. Customers may not realize about problems which the utilities are facing during the crisis and feel disadvantaged and this will be reflected in the willingness in paying the bills.

5.4.2 Measures to Enhance the Customer Management

The customers are providing the financial basis for the LC's operation in terms of the recurrent payments. Therefore, effective operation of the customer department is of utmost importance.

Good customer management comprises:

- The establishment and maintenance of customer database;
- Availability of functional customer water meters;
- Re-studying the tariff structure and adjustment to establish fair fee system;
- Efficient procedures for meter reading, billing and collection;
- Procedure for new connections, disconnections, replacement of meters;
- Following up on outstanding payments;
- Establish customer complaints unit;
- Awareness campaigns.

Customer database: The LCs / utility using the Access database (Yemen Soft) should be changed to the Yemeni water customer information system, based on Oracle software. The software is designed on a single database that also contains general accounting data, inventory, fixed assets, payroll and HR data. It is supported and maintained in Yemen. The software should be updated to Oracle 11G for all LCs. Additional new software applications should be installed to support automated collection, register connected customers and to identify customers for disconnection.

Field surveys are required to update the customer database by collecting subscriber information, water meter data, not recorded customers, disconnected customers, etc.

Water meters: Old and damaged water meters have to be replaced. Functional meters have to be installed for all customers. At least the meter's serial number and date of installation has to be entered into the customer database. Most LCs need support in procuring new water meters to replace the non-functional water meters and install new meters for those customer without water meters. The big LCs require benches for calibration of water meters, spare parts and tools for the repair and maintenance of faulty meters.

Tariff Structure: The tariff structure should be re-studied for each individual utility. In particular those utilities which did not adjust their tariff during crisis. The amendment shall consider on one hand the increasing O & M cost but on the other hand that the poor should be able to afford the public water (not exceeding 5 % of the household income). Ideally the tariff covers the water production, distribution and maintenance including depreciation cost. The currently established tariffs vary from LC to LC and the cost coverage depends often on the differently high pumping cost and water treatment cost. The tariff structure should be revised and adjusted gradually to avoid customer rejection and according to the increase of O & M costs.

Billing & Collection: Utilities have to continue and resume the appropriate monthly billing and collection procedures, particularly in Abyan and Lahij. The processes should be automated and enhanced through updated and new tools, e. g. billing software, handheld units for meter reading, establishing a link between billing system / customer database and accounting system. Most utilities would need to be furnished with new servers, computers, billing printers, billing papers to be able to execute the tasks efficiently.

Collection centres should be established at several locations in the city depending on the size of the supplied area: The centres should be equipped with proper IT facilities and linked to the main server in the head office using wireless connection.

Connection / disconnection: procedures for new connections, replacement of old or damaged meters as well as for disconnection have to be resumed or established where not in place. The information has to be entered into the customer database. Customer department and O & M unit have to coordinate the activities.

Outstanding payments: the utility should introduce procedures to collect outstanding payments. Particular the old debts from those customers which are able to pay, should be followed up. To enhance the process, incentives in the form of discounts, or fines and disconnections of meters should be introduced and applied.

Customer complaints: The customer satisfaction must be taken into consideration as it contributes considerably to the payment morale of the subscribers. Particularly during the crisis the water service has deteriorated due to manifold reasons. The LCs should establish customer complaints units, where incoming complaints are registered and followed up. Awareness campaigns, as described below, will sensitize customers on the importance of the LCs water supply and sanitation service performance.

Awareness campaigns: The LCs should enhance its relation with the local communities and customers in order to:

- → Enhance the LC ownership by local communities and customers to keep the LCs infrastructures and equipment safe from vandalism, looting or destruction during the conflict.

- → Sensitize customers about importance of regularly paying service bills to maintain continuation of operation, water supply and sanitation services.

In addition, provision of information regarding water conservation, hygiene issues, safe wastewater disposal, environmental protection shall be given to the customers.

These objectives could be met through implementation of public awareness campaigns through established Awareness Committees. Since each LC has its special requirements due to the prevailing local conditions, the preparation of LC tailored individual two years awareness programs is recommended. For the initiation of this pro-

cess and to support the campaigns a specialized consultant shall be engaged who is experienced in the preparation and implementation of campaigns and respective materials. The program should include the content for each campaign, the addressed audience, duration, location, required input and other important requirements. The program shall be coordinated closely with the LC, local council, women department of the LC and possibly donor organizations involved in such activities.

The performance of the committee shall be observed and evaluated by the Consultant according to recognized international standards. The impact of the awareness campaigns has to be assessed according to the goals set to enable the identification of further additional or amended awareness measures.

6 Infrastructure Assessment

6.1 Water Service Situation

6.1.1 Water Resources and Production

Yemen has one of the lowest water availability per capita in the world, according to the outcomes of the National Water Conference hold in Sana'a in January 2010 it was 132 m^3 per year which is far below the international water poverty line of 500 m^3 per year. The situation is further aggravating due to population growth of 3 – 5 % per year.

The main source of water is the groundwater, only 0.3 % of the water source comes from desalination plants in Aden. Since the groundwater is heavily exploited the depletion rate is higher than the replenishment rate, by about 0.9 million m^3 per year[29].

Less than 15 % of the produced water is used as potable water for domestic purposes, the major consumer is the agriculture using the water for irrigation, representing about 84 % while the remaining is used for Industrial and Mining.[30]

In urban areas the water production varies considerably from area to area depending on the water availability and production cost. In Taiz the water basin is heavily depleted; the preferable water resource would be from a new desalination plant at Mukha and conveying the water to Taiz by pumping. However, the long distance and high elevation (1,400 masl) may result in very high construction and operation costs. In Sana'a and Amran the water is extracted from deep wells, with subsequent high water production costs. Hajjah extracts water from shallow wells but the water has to be pumped via three pumping stations from 920 to 1,875 m above sea level which increases also the water production cost. In Abyan, Aden, Hadramout and Hudaydah the well depths is low resulting in moderate water production cost.

The water production within the last few years fluctuated considerably from utility to utility. Beside the failure of submersible pumps and the lack of spare parts, the inability to purchase sufficient fuel for pump operation is the main reasons for the low production. The utilities have tried to maintain the produced amount to sufficient level to supply the minimum amount. The worst situation is in Sana'a, where the production reduced by 72 % in 2016 compared to 2014. The average consumption of the urban customers was 62 lpcd in 2009 according to the MWE. The recent assessment indicate a drop of the average consumption to 46 lpcd in 2016 of the assessed utilities. Exceptions are Abyan (141 lpcd) and Sana'a (6 lpcd). Another important factor is the high physical and administrative water loss, in average 37 % in 2016 of assessed utilities and causing respective financial loss.

6.1.2 Water Service Coverage

The Yemeni UWSS sub-sector considers urban population to be covered with water supply if the service meets all of the four criteria:

→ Safe according to WHO guidelines.

29 National Water Resource Authority (2002)

30 The Potential of Strategic Environmental Assessment for Integrated and Sustainable Water Resource Management in the Republic of Yemen (2013) by Amer Al-Ghorbany

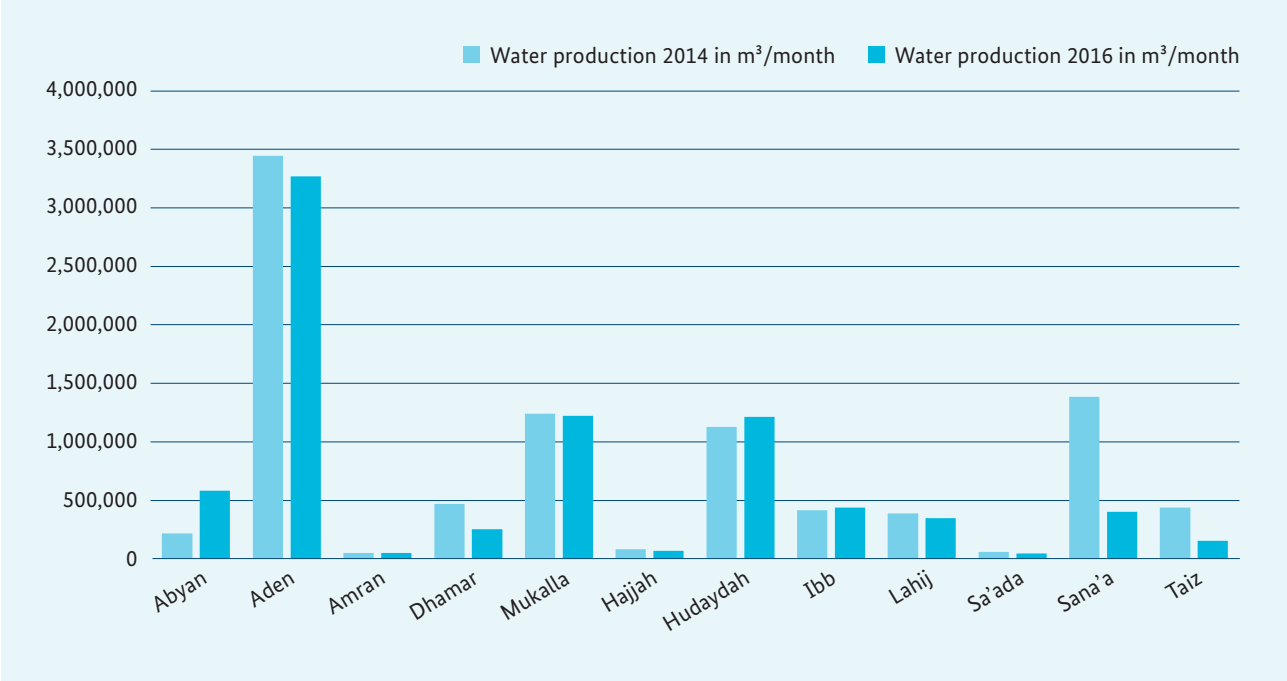

FIGURE 8: WATER PRODUCTION IN 2016 COMPARED TO 2014

→ Affordable according to WHO guidelines the expenditure on water and sanitation should not exceed 5 % of monthly household income.

→ Available every day for at least six hours and in water scarce areas at least once a week for six hours per day.

→ Regulated by the independent regulator for the sector (or MWE until the regulator is operational).

The NWSSIP[31], has identified seven accepted water supply systems such as:

1) Household connection
2) Public standpipe
3) Borehole
4) Protected dug well
5) Protected spring
6) Rainwater collection
7) Tanker supply

The household connection and public standpipe are to be established through the LC (public sector). The most common public supply system is the traditional water supply system, where the water is lifted from boreholes and then distributed, either directly or via reservoirs and pumping stations, through the network and house connections to the customers. The public standpipe exists only in Labo'as –Yafa'a. Protected dug wells and springs are only in use in Hajjah LC. The supply of customers through rainwater collection and tanker supply is not under the responsibility of the LCs and not practiced yet.

1) Public water supply

In average about 59 % of the urban population within the service area of the LCs, are connected to the public water supply system in 2017. The coverage decreased by 9 % compared to 2014 (68 % average for all assessed LCs). However, the water coverage varies from LC to LC: while the lowest coverages are in Sa'ada (36 %) and Taiz (38 %) highest coverage was assessed in Hajjah (99 %) and Mukalla (91 %). The water coverage is no indicator of the sufficiency of water for the customer. Due to the shortage in water production the customers receive in many LCs less then 40 lpcd. Particularly Sana'a and Taiz are affected from the very low water availability.

Although the water coverage is considerably high in some LCs, most of the LCs are not able to provide sufficient water to the connected population due to power supply interruptions, operational failures and deteriorated or damaged networks. The LCs tried to overcome the

31 Update of The National Water Sector Strategy and Investment Programme (Dec. 2008)

problem of the regular or even permanent power failure by installation of an increased number of power generators to be able to operate the wells and pumping stations. Nevertheless, the severe fuel shortage (combined with lack of finance) has caused huge deficiencies in the water production quantity. In some areas the low water tables, e.g. in Sana'a, Amran, Taiz aggravates the situation further. In addition, due to the increased population through the IDP's the water supply situation worsened. At the same time, facilities and networks are not maintained which exacerbates the supply situation further.

Thus, the regular water supply by public network is not guaranteed anymore in most places. Areas which were supplied 18 hours per day / week are now supplied only 3 hours per day / week such as in, Sana'a Dhamar, Amran and Hajjah. However in Hudaydah, Mukalla, Al Shehr, Abyan and Aden they supply water already for 12 hours / day. The LCs are trying to provide the minimum amount of 40 lpcd on average.

2) Private Water Supply

The private sector covers about 40 % of the urban population which is not connected to the public water supply system. In addition the customers with insufficient public water supply would have to buy water from the private supplier. While the average tariff of water from the LC is 210 YER / m^3 the water from private supplier would cost 4 to 5 times more, about 1000 YER / m^3.

The private supplier withdraw the water usually from private boreholes, springs or dug wells. However there is no data on the production capacity, number of production facilities or any other details.

In order to ease the supply condition and enable the minimum amount of water to be provided, the NGOs increased the number of water distribution points considerably in some towns.

3) Water Quality

The water quality is becoming a major issue, considering the recent increase in suspected cholera cases just within the last few months. Between 27 April and 3 August 2018 WHO reported 315,000 suspected cholera cases[32] in the 12 governorates where the assessed LCs are located. The disease is caused due to the bad potable water quality and consumption of vegetables irrigated with untreated wastewater.

The utilities are lacking in laboratory equipment, chemicals and materials to carry out water tests. Some LCs do not have laboratories at all, e.g. in Amran, Abyan and Lahij. In all assessed utilities and branches the chlorination facilities are either damaged, not available or there is a lack of chemicals / chlorine. The result is insufficient treated water which is unsuitable for direct drinking purpose.

The water quality of private suppliers is not controlled by the authority which is causing a potential risk to the consumers.

6.2 Sanitation Service Situation

6.2.1 Recognized Sanitation Systems in Yemen

Sanitation systems in Yemen were documented in the past as traditional dry toilets with urine separation that were installed in multi-storey houses in Yemeni towns. Until recently this system as well as composting toilets were used continuously for hundreds of years. The Yemeni residents used to collect faeces, which were dried and burned as fuel or used as fertilizer.

Most of the Yemeni cities experienced in the sixties and seventies of the last century a change in urban activity, which led to change in method and type of wastewater disposal systems concerning the collection and treatment. The urban areas switched from the traditional sanitation system to centralized and decentralized collection system through sewer network with subsequent treatment and / or collective disposal to wadis or sea.

Approved current wastewater disposal systems

The NWSSIP[33] took as its criterion for improved sanitation coverage that in addition to the five acceptable sanitation systems included in the Millennium Development Goal (MDG), decentralized sanitation systems should also be considered, provided that they are regulated and monitored. This enlarged definition considers the fact

32 Cholera outbreak – Daily epidemiology update, 3 August 2017 by WHO

33 Update of The National Water Sector Strategy and Investment Programme (December 2008)

that Yemeni topography and the low quantity of wastewater can make centralized sewage treatment systems uneconomic. The six sanitation systems accepted for the NWSSIP Update are:

- → Connection to a public sewer
- → Connection to a septic system
- → Pour-flush latrine
- → Simple pit latrine
- → Ventilated improved pit latrines
- → Semi-decentralized options

The applied sanitation systems in the assessed cities can be grouped in the two main categories:

- → Public sewer collection network with subsequent treatment or untreated to the sea / wadi;
- → Private cesspits (pit latrines) used in the areas which is not covered by public sewer network.

6.2.2 Public Sanitation System

The public sanitation system in Yemen is in general poorly developed; the extension of sewer systems has been neglected in the past due to various reasons. Out of 23 investigated utilities only 12 operate a public sewer collection system. Sa'ada, Mansouria, the affiliated branches of Hajja have no sewerage system and Abyan, Lahij sanitation system consists only of few sewer lines under responsibility of the local council. On the other hand, most of those LCs which have sanitation systems have not even connected 50 % of the urban population to the network. The percentage of urban population connected to the public sewer system varies significantly among the utilities. The lowest coverage is in Amran, Taiz and Al Shehr with about 36 to 40 %. The highest coverage is reached in Zabid followed by Aden with 74 % respectively 69 %. The residents not connected to the public sewer system have to discard their wastewater to private cesspits or other means.

For households and other customers connected to the sewer system, their wastewater is collected and transported by gravity or pumping via lifting stations to the WWTP or directly to the wadi or sea. Some utilities, like Aden, Hudaydah and Mukalla require several sewer pump stations which increases not only the maintenance works but also the operational cost. Besides, the pump station operation depend on the availability of electricity. At times of power cuts some areas are likely to get flooded with wastewater.

Wastewater characteristic

The low water availability and consumption affects the characteristics of the wastewater. The current BOD_5 of wastewater influent to the WWTP in the mountains reaches 1000 – 1200 mg / l while in coastal areas it reaches between 500 – 700 mg / l which is classified to be double to triple of the recommended concentration by Mecalf and Eddy[34].

Existing treatment systems

There are seventeen wastewater treatment plants in the assessed utilities operating with one of the four following treatment systems:

1) Stabilization pond as in Dhamar, Taiz, Aden, Bajil, Bait Al-Faqi, Amran, Mukalla and Al-Hudaydah;
2) Imhoff tanks followed by trickling filters as in Hajjah;
3) Activated sludge – Extended aeration as in Sana'a and Ibb;
4) Imhoff tanks followed by Stabilization ponds as in Zabid.

The operators of the wastewater treatment systems face several challenges and problems. The frequent power cuts, unexpected nature of wastewater (high BOD5) and sludge causing poor treatment efficiencies. The treatment systems employing Activated Sludge Extended Aeration process consume high energy. On the other hand, the so called low cost treatment systems, which comprises the stabilization ponds and Imhoff tanks followed by trickling filters as applied in most LCs have proved to operate satisfactory due to the simplicity and flexibility of the processes.

Some of the WWTP have exceeded the nominal flow capacity limit. The inflow amount exceeds by far the acceptable amount, e. g. in Sana'a, Ibb and Hajjah (secondary treatment method). The result is that the WWTP is not able to treat the sewerage effectively causing beside environmental problems bad odour which is affecting the population in the surrounding.

34 Wastewater Engineering: Treatment and Reuse, by Metcalf & Eddy

Wastewater reuse

The possibility of using low-cost reclaimed wastewater for irrigation depends on the topography of the served cities: while the LCs located at coastal areas discharge the treated wastewater directly into the sea, those cities placed in the mountain area could probably use the treated wastewater without high pumping cost.

6.2.3 Private Sanitation Systems

The cesspit or pit latrines have been used and still being used by the households which are not connected to the sewer network. The latrines were built without specifications and / or sanitation educational background so their faulty design causes the following problems:

- → Groundwater pollution;
- → Soil clogging, which causes overflow of wastewater to the streets.

There are no dry toilets or compost toilets in use in the investigated area but unified septic tanks in Al-Shehr.

6.3 Damage on Water and Sanitation Infrastructure

6.3.1 Direct Damage

The damage to the water and sanitation infrastructure is of a different magnitude in the individual governorates and utilities. While the LCs of Ibb, Dhamar, Amran were not directly affected by the crisis, the LCs in Aden, Abyan Lahij, Sa'ada and Sana'a suffered from crisis. The destructions stretches from damaged offices, stores, reservoirs, wells, WWTPs to destroyed valve chambers and networks. In addition some areas were hit by natural disasters. Al Shehr and Mukalla were affected by the Chabala Hurricane in November 2015. Parts of the network, the WWTP and pumping station and the reservoir got damaged. Hajjah city was subjected to flooding in April 2016, which caused LC material losses and infrastructure damages. The destroyed facilities are causing interruption of the water supply and dysfunctional collection and treatment systems.

Taiz, Haradh, are in critical situation for three years now and Mukha since beginning of 2017. The damage on the infrastructure has to be revalidated once the crisis is over.

Some LCs have already started with the rehabilitation works, like in Aden, Lahij, Abyan, Sana'a, Sa'ada and Hudaydah, with the support of funding agencies. Additional temporary solutions have been provided by the humanitarian agencies to re-establish the water supply service.

6.3.2 Indirect Damage

Insufficient O & M: Due to financial constraints and the absence of an investment program since 2015 the utilities have not been able to maintain and rehabilitate their infrastructure adequately. In particular borehole pumps, booster pumps, chlorination and purification water facilities are affected. The result is operational failure and shortening of the lifetime of this electro-mechanical equipment. Other problems are network leakage, where pipes cannot be repaired due to the lack of materials or unavailable equipment and tools. Subsequently the utility is not in the position to operate the water supply system and sanitation system efficiently and to its full extent.

Power outage: The power supply from the public electricity grid is interrupted or completely cut in many areas. The LCs tried to overcome this problem by procurement of generators and support through donor organizations and recently in some cases through installation of solar panels. UNICEF has stopped the support in providing diesel to the LCs in the 4th quarter of 2016. However, during the outbreak of Cholera in May 2017 they resumed the fuel supply support for some LCs. Because of the frequent power cuts, the demand for diesel increased considerably. The price of diesel increased from 60 YER (before) to about 240 YER (during) the crisis in some areas. Therefore, the LCs spends more than 4 times the financial amount on fuel compared to before the crisis. The most affected LCs suffering from the high energy costs are Dhamar, Sana'a and Hajjah. Their low collection fees prevents them from purchasing fuel resulting in decreased water production and supply. Hudaydah LC is unable to keep up the power supply after power interruption from hotline of R'ass Kateb power station. Because of the low revenues the LC is unable to purchase fuel for generators.

Aden, Lahij and Abyan were suffering from the power shortage in 2015, but recently the power has been re-established from the public grid and the fuel prices are stable at a moderate level.

Regarding renewable energy – as explained in Chapter 2.2.2 such optional energy sources did not play a significant role in electricity generation of the LCs, due to the

missing institutional arrangements but also lack of capacities and finance.

6.4 Re-establishing and Maintaining Water Supply and Sanitation Service

6.4.1 Water Supply Services

The water supply has to be re-established, maintained and improved through different set of measures. The main objective should be first to enable the LCs to operate the fully available and necessary water resources and supply system efficiently and second to increase their service coverage area through new connections and network extension. The following measures should be implemented in dependence of the actual situation, urgency and feasibility of each utility:

- Increase the water production through:
  - Improving the power supply continuity;
  - Rehabilitation and maintenance of pumps and networks;
  - Rehabilitation of existing and construction of new wells.
- Establishing organized operation schedule;
- Connecting new and in particular poor households to existing water networks;
- Mount public water tanks / small reservoirs in scarcely supplied areas;
- Re-establish and furnish water and sanitation laboratories to carry out water quality tests;
- Install chlorination units to disinfect water;
- Rehabilitation and extension of water supply network;
- Connection of additional customers to extended network;
- Rehabilitation or new construction of reservoirs and pumping stations.

The detailed investment needs have been identified for each utility and are described in the assessment report and listed in the Investment Plan of Part 2 report.

Suspended or terminated rehabilitation and network extension projects shall be resumed for areas in post-crisis condition.

The water supply through the private sector should be more in the focus of the LCs' water supply strategy. The private water suppliers, i.e. well owners, are supplying up to 40 %[35] of the urban population. Therefore, this group contributes considerably to meeting the water needs of the residents. The NWSSIP Update 2008 programme recognized the private water sector as an important water provider and planned to integrate their capacity into the overall water strategy plan. Such plans should be resumed once post crisis situation applies.

Optional Services

The alternatives to the public water system are limited and have to be evaluated individually. The installation of a parallel water supply system as installation of water tankers has to be carefully scrutinized and decided case by case. Negative side effects, e.g. supply of free water to a great extent has to be avoided in order not to interfere in the utilities business. Some of the required measures are to be executed in cooperation with the donor organizations or the private sector, since they are active in optional water supply. The following activities should be considered in the improvement of the water supply situation and needs to be further investigated for the individual LCs and in cooperation with the concerned stakeholders.

- Installation of water tanks at public places and institutions: water tanks should be installed where no public network is available or according to the emergency plan;
- Provide the LCs with water tankers to establish competition market to the private sector;
- Private sector partnership with potential water providers: active and new potential private water suppliers should be integrated in the overall water supply scheme of the city. The utility should opt for agreements regarding supplied area, quantity and quality to guarantee the coverage of water supply to all the population;
- Water harvesting methods: identify areas where water harvesting of unpolluted water is possible, e.g. public roofs, sloped rocky areas, depressed areas. In the long term the implementation of a separate rain water and collection system should be considered for reuse;

35 Update of The National Water Sector Strategy and Investment Programme (December 2008)

- Standpipe at wells / transmission lines: suitable locations for installation of hydrants at well locations or along the transmission line could be identified. Naturally these locations would be close to residential areas, not connected to the public network. Prior hydraulic calculations are required to identify the pressure on critical points further up the line;

- Self-help groups: residents should be sensitized and trained to support them in establishing alternative water provision methods, e.g. water harvesting (cistern construction), reuse of wastewater;

- Installation of desalination facility: the implementation of desalination facilities close to coastal towns will be inevitable on the long term looking at the scare water availability and rapid depletion of the scare water resources.

6.4.2 Sanitation Service

The wastewater systems of the utilities should be improved and extended to enhance the service for the customers and increase the number of sewer connections. This may be achieved by applying measures that include the following:

- Rehabilitation of sewer systems: old and damaged sewer pipes have to be replaced. Sewer pumps not functioning properly need to be maintained or replaced with new ones;

- Increase the number of household connections: the utilities should opt for connection of all households within the existing collection system;

- Extension of sewerage system: areas without access to a sewerage system should be connected through extension of the existing system, considering hydraulics, the WWTP capacity and implementation cost;

- Emptying of cess pits: utilities have to be equipped with sufficient suction tankers to enable them to regularly empty the cess pits of households and transport of collected wastewater to the WWTPs for treatment.

Optional and additional services

Coverage of the urban population often does not reach even 50 %. The wastewater is collected in basic cess pits, where the sewerage leaks to the surrounding and below grounds. This causes soil and groundwater pollution, which may lead to health problems among the residents. The following activities should be considered in the improvement of the sanitation situation and needs to be further investigated for the individual LCs and in cooperation with concerned stakeholders.

- Installation of septic tanks / Anaerobic Baffled Reactor (ABR): connection of households to collective ABR or individually installed dry toilets. The implementation could be through financially supported and trained local self-help groups or the local council;

- Decentralized low cost treatment systems: investigate for suitable locations where wetlands can be constructed;

- Reuse of reclaimed water: The options for reuse of treated wastewater should be closer investigated including the requirements at the WWTPs. Recognized methods for the treatment have to be applied to avoid health risks.

- Pre-treatment facilities for heavily polluted wastewater from hospitals, butchers, dairies, restaurants have to be designed and implemented to avoid blockage of the sewerage system and overload of the WWTP.

6.4.3 Provision of Power Supply

1) Conservative and Immediate Energy Supply

For immediate support the LCs have to be provided with sufficient fuel, generators and spare parts to enable them to operate their water supply and sanitation systems sufficiently. The demand has to be calculated individually based on the pre-crisis situation and the prevailing public power supply condition. It is expected that the support is needed for at least one year, until first alternative electricity systems are installed and in operation and / or the public power supply is restored. The support in energy supply have to be re-assessed after one year to verify

→ the situation of the public power supply system;
→ the financial capacity of the LC;
→ the change in water needs due to increasing / decreasing population (IDPs);

→ the change in energy requirements due to new equipment, new or maintained wells;
→ the fluctuation of fuel price.

In parallel, alternative options have to be further investigated. The possibility to restore the public electricity supply and respective requirements has to be studied as a first step. The needed institutional support for the Public Electricity Corporation has to be assessed to assist them efficiently in maintaining and improving their services.

2) Renewable Energy Supply

a) Solar energy
The most feasible optional energy source to be implemented within short time is the solar energy. The average solar radiation in Yemen ranges between 5.2 – 6.8 kW / m² per day. The annual average daily sunshine is between 7.3 and 9.1 hours per day. Even in winter the daily average sunshine duration is more than 8 hours per day. The feasible application is either centralized (on-grid) which can be used in larger farms or decentralized (off-grid) which can be used for small scale power generation. Off-grid system are appropriate for rural and remote areas, where no public power grid is available.

The Yemen water sector has already gained some experience with the system and the Photovoltaic systems are available on the local market. Besides, the system appear to be the most economic with the least operation and maintenance effort and cost in the long run. Solar energy is sustainable, its technology entirely relies on renewable sun's light. The major constraint is the space requirement: per kW about 7 m² is required and the high initial investment cost.

b) Biogas
Yemen is an agricultural country which produces huge amounts of bio waste. The biomass can be used for electricity generation. For example Sana'a city produces about 1,000 tons of waste. In specialized digesters biogas with content of methane and carbon dioxide can be produced. For every ton of waste an estimated amount of 50 m³ biogas production is expected. Therefore the potential for Sana'a would be 5,000 m³ equivalent to 50 MWh electricity which could power 5,000 houses.[36]

For the Sana'a wastewater treatment plan the LC planned to reduce the operating expenses through anaerobic digesters implementation by German consultant and contractor. The produced electricity should cover 35 % of the total energy consumption after the upgrading of the WWTP. The project was financed by Arab Social Fund for Development. Unfortunately the project was suspended in 2015 and could not be completed because of the crisis.

A project on biogas use was established in Al-Habeel, Lahji governorate in 1990's by the Ministry of Electricity and the assistance of United Nations Economic and Social Commission for Western Asia (ESCWA) organization, financed by UNIFEN and the government of Holland[37]. The project could provide the village with low cost energy.

c) Wind energy
In Yemen the wind is available almost throughout the year which allows to use wind turbines in many areas. Particular the coastal areas where high and constant wind speed of 8 m / s occurs for more than six month between September to March, the conditions are favourable for wind farms along the coast. There is good potential for implementation of wind farms on the coastal strip as well as on offshore areas. One of the most suitable coastal areas is Al-Mukha in Taiz governorate.

The Government of Yemen decided to build a wind farm at Al-Mukha in 2016. The wind turbine was rated to produce 2 MW of power. With 1500 turbines an energy production of 240 MW is expected.[38]

d) Geothermal power plants
The volcanic activity is very high in Yemen producing high heat flow which can be utilized to produce electricity. Many geothermal fields in Yemen are readily available for geothermal energy application, as in Dhamar, Ibb and other coastal areas.[37]

There are more than seven areas with natural hot springs. In 1984 a study financed by World Bank was performed through Geothermex Inc. investigating on the possibility of geothermal energy in Dhamar area. The study concluded that it is possible to build a geothermal power station with capacity of 125 – 250 MW.

36 Journal of Fundamentals of Renewable Energy and Application, A. Qasem, Sana'a University

37 ISESCO Science and Technology Vision – All Renewable Energy Applications in Yemen are Best Practice (May 2005) by Al-Ashwal

38 Journal of Fundamentals of Renewable Energy and Application, A. Qasem, Sana'a University

Considerations and Conclusion

Under the current condition only the immediate implementation of solar power systems is feasible. The other alternative options need to be assessed in terms of technical feasibility, investment cost, on grid or off-grid options and suitable locations.

For the development of renewable energy on big scale the cooperation between the local government, the Ministry of Electricity and Energy and relevant international and regional agencies is required. The previously initiated cooperation projects should be resumed and further potential and possibilities on renewable energy pilot projects investigated. The National Strategy for Renewable Energy and Energy Efficiency, outlined by the MEE has to be considered for the assessment.

Barriers as high investment cost, institutional barriers (lack of regulatory and legal framework, lack of coordination, professional dedicated institutions) technical barriers (lack of standards, technology, qualified expertise, skilled personnel for operation), social barriers (public awareness), and subsidized diesel have to be scrutinized and solutions found.

3) Energy Saving

Through the installation of new and proper designed equipment, fit for the purpose and the installation of solar systems the energy consumption should be considerably reduced. Further assessment on the complete water supply systems and sanitation systems are required to identify the energy saving potentials and respective needed measures.

6.5 Gender Supporting WASH Projects

6.5.1 Assessment of the Service Situation

The WASH Cluster coordinate the Humanitarian relief organizations activity to cover and take care of emergency measures to enable the minimum water supply and provide other urgent needed materials to the population and particularly the poor, women and children. In this regard they are providing fuel for pump operation and set up water distribution points. The current crisis however, caused the support to fade and the organizations are not able to supply all people in need or those living in critical areas. It should be noted that in some cities, like Amran, traders and business people facilitate water distribution points.

For the households, not connected to the water supply network, usually women and children collect the water from the public water distribution points with distances varying from 10 to 30 minutes walk. In carrying out these chores women and girls are sometimes harassed. A similar situation prevails in both, poor household areas and camps without sanitation facilities; when females have to release their needs in the nature, they may be victims of harassment.

In general there are huge shortcomings in the provision of sanitation facilities in public institutions, schools and especially camps. Most of them are lacking on water tanks, clean sanitation facilities and also electricity.

Schools: The water and sanitation service is overstrained in some schools due to the increased number of IDP students, like in Ibb city.

Most of the schools have not enough water storage capacity to cover the needs during non-supply time. The power cuts prevent the school to pump the water to the roof tanks. Therefore the school is forced to buy costly water from private tankers or get along with the available water. Some schools use solar energy to pump the water to the roof tanks. Several schools were provided with tanks from funding organizations.

The bathrooms in some of the schools are in a bad condition, e. g. blockage in the toilets causes overflow and unhygienic conditions. The schools have no budget to employ cleaners and buy detergents. Most schools suffer from a lack of functional bathrooms in general and in particular in separate bathrooms for females. Often the bathrooms are not usable due to a failure of the toilet flushing / lack of water and broken armatures. Schools would be either connected to the public sewerage system or dispose the wastewater to cess pits.

The situation at private schools is significantly better, since they have the budget to purchase the lacking amount of water and for maintaining clean sanitation facilities.

Hospitals: The situation in hospitals is similar to the public schools with regards to water supply and maintenance of bathrooms. Due to the scarce water supply in some governorates and the shortage in water tanks the available water is not enough. The hospitals are forced to buy the water from outside.

There is also a lack of sufficient and functioning bathrooms, especially at older hospitals. For example in Hudaydah hospital the bathrooms are frequently flooded

and the suction tanker is called to empty the tanks. The hospitals do not have separate treatment tanks prior to discarding the sometimes heavily polluted wastewater to the public sewerage system or cesspit. This practice is causing a heavy load on the WWTP and may lead to insufficient treatment and environmental pollution.

IDPs / Marginalized: The majority of IDPs are staying with host families (62 %), with another 19 % renting accommodation. WASH reports[39] that 82 % of all IDPs have been displaced from their homes for over a year. The remaining 19 % of IDPs have no other option than to reside in collective centres or spontaneous settlements. Often there are no bathrooms in the camps, no toilets and even cess pits. The residents have to go to the surrounding natural places. This is putting especially women and children at some risk when going out at night. For those living in camps or houses with insufficient or no water supply, they have to collect the water from the public water distribution points or obtain water from private suppliers at high cost.

6.5.2 Improving the Water and Sanitation Service

The procurement and installation of equipment for schools, camps and public places are urgently needed for the improvement of the water and sanitation service of children, women and marginalized people. Respective implementation enhances the hygienic condition and help to prevent the outbreak of diseases, like Cholera.

Particularly WASH Cluster is providing considerable support to the poor and marginalized people. Any support from international funding organizations will have to be coordinated closely with Humanitarian relief organizations.

The assessment of the current situation at schools, hospitals and of displaced and marginalized people revealed the following urgent needed equipment:

- Water tanks for schools, hospitals, camps;
- Septic tanks for schools, camps;
- Solar system and pumps for schools and hospitals;
- Pre-treatment tanks for hospitals;
- Sufficient and separate (males / females) functional bathrooms in schools, hospitals and camps;
- Maintenance of bathrooms in schools;
- Refrigerators for water-cooling for schools.

The detailed requirements have been outlined in each technical assessment report for the individual utility and the respective town in Part 2 report.

39 WASH Cluster Strategy Note – September 2016

7 Monitoring and Evaluation

1) Performance Indicators

The impact of the implementation measures should be monitored on a quarterly basis with reporting of the LC director to the ministry. The Performance Indicator System (PIIS) could be utilized and amended to suit the new requirements under the current situation.

The 10 Emergency Performance Indicators which are used already in 5 LCs as described could be adopted, adjusted and extended to the following PIs:

1) Percentage of Water & Sewerage service coverage versus total population within service area;
2) Number of water supplied days per month;
3) Quantity of water pumped (m^3) per month;
4) Cost of kilowatt hour per m^3 of water produced;
5) Number of main pumps for the water supply system;
6) Number of functional pumps in service;
7) Number of working generators in the operation of pumps;
8) Percentage of collected revenues;
9) Actual operational cost coverage;
10) Non-revenue water;
11) Total staff per 1000 house connection.

2) Reporting

Each LC should nominate a focal person responsible for the monitoring of the agreed indicators. Therefore the collection of respective data from the different departments is required. The focal person should verify the data for plausibility before entering them in the monitoring system / database and prepare a valid monthly Performance Indicator & Progress Report. The report should be shared with the Ministry of Water & Environment and other water sector stakeholder to address real and potential trends of performance on the level of operational, financial and managerial capacities of the LCs / Utilities during and after the crisis.

3) Post-crisis Monitoring

For monitoring of the LC performance in post-crisis, the Joint Annual Review report should be resumed. This review report was an effective tool to monitor the performance of the utilities. The annual reports should be prepared by the ministry with the support of a Consultant comprising and summarizing the evaluated results of the provided Indicator Reports.

Once the Management Information System (MIS), as mentioned in Chapter 3.3 is established at the ministry, the LCs should be linked to the system. The Performance Indicators data entered from each LC will be transferred to the system. The ministry would be in the position to enhance the control on the performance of the utilities and could react faster if deviations to the achievable goals are detected.

8 Conclusion

The Damage Assessment Study, Stage III reveals the strangling problems and shortcomings the LCs are confronted with since the beginning of the crisis. The impact of the conflict in Yemen is affecting the water sector significantly. The LCs need urgent financial support and technical assistance to be able to continue and maintain their services. The identified measures are required for the resumption and / or continuation of activities and for the introduction and application of efficient procedures. The LCs have to get prepared for the new challenges which the conflict imposes on them. This can be achieved through the proposed two-track approach:

1) Providing technical assistance to enhance the staff capacity, improve the performance and financial capacity;
2) Providing investments to restore, rehabilitate and extend the water and sanitation system.

The recommended measures must include the installation of alternative regenerative power systems to foster the independency of the LCs on costly generators and fuel.

Following urgent activities should be initiated within the next months for the assessed LCs:

In order to coordinate the emergency response measures, it is proposed to hold a conference with the participation of GIZ WSP and active donor organizations to discuss the results of DAS III and identify the intervention of each organization, agree on the implementation time frame and on proper implementation method and monitoring processes.

Further, suspended and new investment projects aiming at network rehabilitation, extension and construction of new water resources should be initiated and implemented to provide sufficient and continuous water supply to the urban population. The sewerage system should be extended comprising also the rehabilitation, extension and new construction of wastewater treatment plants. These measures would increase the number of connected households, which is beneficial for both: the customers having access to affordable and reliable water supply and safe hygienic sanitation system; and for the LC getting new paying customers.

Technical Assistance	Investment Measures
→ Financial support for salary and fuel. → Training courses for management and key staff. → Procurement and installation of office equipment including IT hardware, software and solar systems for offices. → Specific coaching and consultancy support. → Procurement and installation of material and equipment for public institutions and places (through WASH). → Awareness campaigns	→ Restoration of damaged water and sanitation infrastructure. → Installation of solar systems to provide alternative energy. → Restoration and maintenance of wells. → Provision of materials, tools, vehicles for the maintenance and operation of the water and sanitation system. → Laboratory and disinfection equipment and materials. → Resumption of suspended or terminated water and sanitation projects.

TABLE 6: OVERVIEW OF IMMEDIATE MEASURES (CONFLICT)

Alternative options on water resources and water supply, sanitation systems and power supply have to be further investigated in the context of the UWSS. This incorporates feasibility studies and pilot projects on:

- → Rainwater harvesting, desalination plants, reuse of reclaimed water;
- → Decentralized, low-cost and sustainable sanitation systems;
- → Regenerative energy systems;
- → Energy saving potentials in the water and sanitation systems.

Such studies have to be proposed and coordinated with the responsible ministries and institutions: National Water Resource Authority, Ministry of Agriculture and Irrigation, Ministry of Water and Environment, Ministry of Electricity and Energy as well as the Public Electricity Corporation.

Once the conflict ceases, the LCs should aim for establishing sustainable, financial viable institutions. Extensive coaching and consultancy support will be needed to prepare and implement effective procedures within all departments. The organizational structure shall be scrutinized and adjusted to the size and requirements of the LC. At the same time regular human resource development programs have to be initiated and organized to establish an efficient, skilled, accountable and motivated work force in the long run. The previous NWSSIP activities (see Chapter 3.1.4) should be resumed and its objectives of a long term strategy for the Yemen water sector pursued.

List of References

Al Barashi, I., & El-Zahab, A. [n.d.]. Evaluating the Energy System in Yemen.

Al-Ashwal [May 2005]. ISESCO Science and Technology Vision – All Renewable Energy Applications in Yemen are Best Practice.

Al-Barashi, I., & El-Zahab, A. [2016]. Evaluating the Energy System in Yemen. Journal of Electric Engineering, JEE, vol. 16, issue 1, pp. 338 – 342 (Article 16.1.41).

Al-Ghorbany, A. [2013]. The Potential of Strategic Environmental Assessment for Integrated and Sustainable Water Resource Management in the Republic of Yemen.

Cabinet resolution No. 237 [1997].

Central Statistical Organization – Population Projection in Districts.

Equity and Efficiency in Yemen's Urban Water Reform, GIZ / MWE, March 2009.

GIZ [2013]. Performance Monitoring of UWSS Utilities – Semi Annual Report (January – June 2013).

GIZ [2013]. Performance Monitoring of UWSS Utilities – Summary Report (January – December 2013). Water Sector Program Area 1 Policies, Strategies & Coordination.

GIZ [2016]. Yemen Water Sector – A Managerial, Financial, Human Resource, Operational Structures.
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Government of Yemen [1991]. Civil Service Law No. 19.

International Organization for Migration (IOM); The UN Refugee Agency (UNHCR) [February 2017]. Multi-Cluster Needs Assessment of IDPs, Returnees and Host Communities in Yemen (TFPM).

International Organization for Migration (IOM); The UN Refugee Agency (UNHCR) [March 2017]. Task Force on Population Movement.

Knoema [n.d.]. Accessed 19 March 2018.
https://knoema.com/atlas/Yemen/GDP-per-capita.

Kreditanstalt für Wiederaufbau (KfW) [2015]. Water Crisis Program Yemen (WCPY) – Technical Needs Assessment Report.

Monitoring and Evaluation of the NWSSIP Update – Organisational Setup & Management Information System, by denkmodell [2010].

MWE, GTZ, World Bank [March 2009]. Equity and Efficiency in Yemen's Urban Water Reform.

National Water Resource Authority Report 2002.

NWSSIP [2004]. National Water Sector Strategy and Investment Program (NWSSIP) report.

NWSSIP [December 2008]. Update of the National Water Sector Strategy and Investment Programme.

OECD MENA Initiative [n.d.]. Enhancing Integrity in Public Procurement in Yemen.

Qasem, A. [n.d.]. Journal of Fundamentals of Renewable Energy and Application.

Regional Center for Renewable Energy and Energy Efficiency [2012].

The national benchmark workshop [September 2007].

UNICEF [June 2017]. WASH Cholera response matrix.

UNOCHA [2017]. Humanitarian Dashboard (January – June 2017).

UNOCHA [2017]. Humanitarian Response Plan – January to December 2017.

WASH [September 2016]. Cluster Strategy Note.

Wash Cluster – Guiding principles to support access to water for conflict affected people in Yemen.

Wastewater Engineering: Treatment and Reuse by Metcalf & Eddy.

WHO [3 August 2017]. Cholera Outbreak – Daily epidemiology update.

World Bank [June 2017]. Restoring and Expanding Energy Access.

World Food Programme (WFP) [December 2017]. Yemen Market Watch Report.

World Food Programme (WFP) [January 2018]. Yemen Market Watch Report.

Yemen National Dialogue [January 2014]. Outcomes Document.

Yemen Civil Service Law number (19) of 1991.

Yemen Financial Law No. (8) of 1990.

Yemen Law of Public Institution and Companies No. (35).

Yemen Law of the Local Authority No. (4) established in 2000.

Yemen Water Law No. (33) was established in 2002.

Yemen Procurement Law No. (23) of 2007 and its by-law No. (53) of 2009.

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