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SYRIAN ENGINEERS FOR CONSTRUCTION AND DEVELOPMENT

منظمة المهندسين السوريين للإعمار والتنمية

How Syria Crisis Affects the Potable Water System Efficiency in Non-State Armed Group Controlled Areas

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Introduction

In recent years, water resources are under an increasing stress due to impacts of climate change, population increase and economic development (Selek et al.,2018).

Before the conflict of Syria at 2011, nearly 85% of the population in Syria accessed well-developed, state-owned, and centrally-managed water systems. Most of the water systems in rural Syria is defined as intermittent water supply on the contrary millions of people throughout worldwide have access to water consistently (Van den Berg et al, 2011). In the rural areas of Syria, piped water supply services are considered as intermittent water supply (IWS), that means the water is available only limited hours per a day (Ilaya-Ayza et al., 2017).

On the other hand, Syrian major cities only have sewage systems including treatment plants while other parts of the country relied on simpler technologies. The public institutions manage water systems in towns, cities and villages. About 85% of the population of towns and cities in Syria

obtained their water needs form public water systems, on the other hand the others (about 20%) obtained potable water from other water resources such as private water well, water tracking etc. An average Syrian consumes drinking water about 100-200 liter/a day. The population in Daret Azza subdistrict obtains water from deep water wells which supply with Syrian standard on drinking water (SAOSM, 2007).

The Syrian conflict has enveloped the entire country and has led to socially, economically and civilly mass-scale destruction at all levels of society. The conflict has led to one of the worst humanitarian crises of modern history, leaving a particular impact on the most vulnerable populations of women and children. The water systems and wells have deteriorated drastically due to the conflict. Materials such as diesel for generators, chlorine etc. for operating water systems healthy and efficiently are extremely limited due to high prices and non-availability. Furthermore, during the 2014 and 2015 season, Syria has experienced one of the worst droughts affecting negatively all kinds of water systems of the last several years. Humanitarian intervention has thus far largely focused on emergency response including water trucking and the provision of bottled water.

It is estimated that 80% of water infrastructure in Syria is in need of rehabilitation and maintenance (UN-OCHA, 2018; HNO, 2017). As a consequence of the combined effect of infrastructure breakdown and scarce of water, an increasing proportion of the population nowadays depends on trucked water, provided by both the public and private sectors, which are not regulated or resorting to unprotected water sources, and have witnessed increases in prices.

Additionally, as a result of the lack of electricity in these cities, water stations do not work, it is need to have diesel/fuel oil to operate them. The number of displaced persons and communities in these cities and towns has increased day after day as a result of the lack of potable water.

On the other hand, the poverty level is also rising and every family needs to have about ١٠-٢٠$ monthly for purchasing unsafe water. This amount in general is not available to Syrian poor people, as 80 percent of its population live at or below the national poverty line in Syria.

Moreover, the lack of electricity has had negative impacts across sectors, including health, and water, sanitation and hygiene (WASH). Indeed, 13 million of Syrian people have not chance to access permanently healthy water. The population, live in areas that are out of control of the regime, often depends on water tanks and other sources, supplied by private companies. This situation poses enormous financial burden on Syrian households (UN-OCHA, 2018; HNO, 2017).

Similar to several other systems in MENA (Middle East and North Africa) region, the water systems in Syria are characterized as being urban; modern and extensive. Water and sewage networks require increased support to continue providing a minimum level of services (UN-OCHA, 2017, HNO, 2016). The assessment objectives may be summarized as given below.

- Define the worst communities in water and sewage sector which need urgent technical and financial assistance.
- Drawing true picture about water infrastructure in the areas, out of the Syrian regime control.
- Understanding the negative effects of the war on the water sector in the areas out of Syrian regime control (UNICEF, 2017).

Methods

This research focused on Daret Azza subdistrict, located on Jebel Saman district in Syria, and managed by Aleppo governorate, Non-State Armed Group NSAG-controlled areas since the end of 2012 (Figure 1-2). Its population is about 109.612 people (47.637 internally displaced persons (IDPs), 61.975 local people) as showed in the table 1 (IOM, NPM, 2017).

Table (1): The Total Number of Population of Daret Azza Subdistrict Communities

Country	Governorate	District	Sub-district	Community	Number of populations
Syria	Aleppo	Jebel Saman	Daret Azza	Hur	3474
Syria	Aleppo	Jebel Saman	Daret Azza	Tqad	8067
Syria	Aleppo	Jebel Saman	Daret Azza	Arhab	3359
Syria	Aleppo	Jebel Saman	Daret Azza	Majbineh	2674
Syria	Aleppo	Jebel Saman	Daret Azza	Bsartun	5500
Syria	Aleppo	Jebel Saman	Daret Azza	Anjara	12.754
Syria	Aleppo	Jebel Saman	Daret Azza	Zarzita	4030
Syria	Aleppo	Jebel Saman	Daret Azza	Hoteh	8384
Syria	Aleppo	Jebel Saman	Daret Azza	Bshantara	1265
Syria	Aleppo	Jebel Saman	Daret Azza	Bishqatine	1174
Syria	Aleppo	Jebel Saman	Daret Azza	Kafrantin	225
Syria	Aleppo	Jebel Saman	Daret Azza	Qabtan Eljabal	4811
Syria	Aleppo	Jebel Saman	Daret Azza	Daret Azza	43.320
Syria	Aleppo	Jebel Saman	Daret Azza	Deir Saman	7000

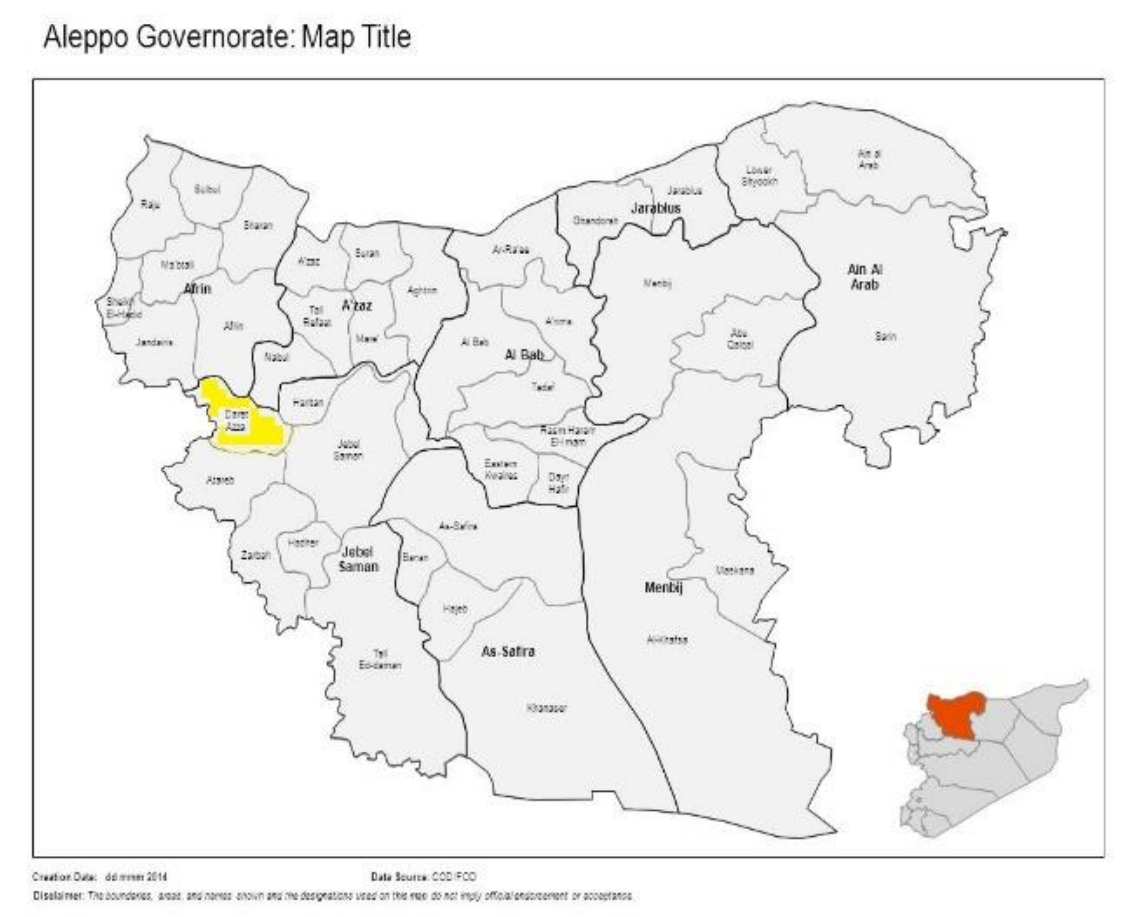

Figure 1-2. Syria map, Aleppo governorate and Daret Azza subdistrict location.

The water system in Daret Azza subdistrict consists of the following parts:

Mechanical devices: Horizontal and vertical pumps, generators, pips, valves, chlorine dosing pumps.

Civil infrastructure: ground water tank, high water tank, distribution rooms, control rooms.

Electrical infrastructure: Cables, transformer and control panels.

SECD (Syrian Engineers for Construction and Development) organization team collaboration with United Nations Children's Emergency Fund (UNICEF) and Water, Sanitation and Hygiene (WASH) cluster/Turkey hub conducted a project for technical assessment of water stations in Daret Azza subdistrict, and also SECD team made a needs assessment for rehabilitation of its sewer system. The assessment of water stations at Daret Azza subdistrict was conducted by five technical engineers of SECD in the field.

SECD used the following simple equation which usually used by UNICEF (UNICIEF, 2017) for assessment of water stations. This method is familiar in Syria and most of water engineers use this equations for calculate the composite indicator.

$$I_C = W_1 \times I_1 + W_2 \times 1_2 + W_3 \times I_3 + \ldots + W_N \times I_N$$

Where W_N is a weight for the N^{th} component indicator (I_N), I_C is the composite indicator and $W_1 + W_2 + W_3 + \ldots + W_N = 100\%$ (UNICIEF, 2017).

For Daret Azza subdistrict, the water-supply infrastructure efficiency (WSIE) can be calculated by the equation given below.

WSIE = (55%) mechanical devices efficiency+ (30%) civil infrastructure +(15%) electrical infrastructure.

The value of weight was calculated according to the cost and the importance of the indicator. In general, for water station of Daret Azza the average cost of rehabilitation of mechanical devices was about 55%, and the cost of rehabilitation civil infrastructure was about 30%, and the cost of electrical infrastructure related to water stations was about 15%. Each indicator consists of many sub indictors:

- Mechanical devices consist of many sub indictors: Is there a stand-by submersible pump(s) ready to use? The answer should be: yes or no.
    - Is there a stand-by horizontal pump(s) ready to use? The answer should be yes or no.
    - Is there a stand-by chlorine pump(s) ready to use? The answer should be yes or no.
    - Does the submersible pump(s) functions? The answer should be yes or no.
    - Does the Horizontal/vertical pump(s) functions? The answer should be yes or no.
    - Does the generators functions? The answer should be yes or no.
    - Do the pipes and valve(s) functions? The answer should be yes or no.
    - Does the Horizontal/vertical pump(s) functions? The answer should be yes or no.
    - Is there a submersible pump(s) ready to use? The answer should be yes or no.
    - Is there a horizontal pump(s) ready to use? The answer should be yes or no.
    - Is there a chlorine pump(s) ready to use? The answer should be yes or no.
    - Is there a generator pump(s) ready to use? The answer should be yes or no.

- Civil infrastructure consists of many sub indictors:
  - Does the ground water tank (s) functions? The answer should be yes or no.
  - Does the high-water tank functions? The answer should be yes or no.
  - Does the distribution room(s) functions? The answer should be yes or no.
  - Does the control room(s) functions? The answer should be yes or no.
- Electrical infrastructure consists of many sub indictors:
  - Is there a stand-by cables (s) ready to use? The answer should be yes or no.
  - Is there a stand-by transformer (s) ready to use? The answer should be yes or no.
  - Is there a stand-by control panels to use? The answer should be yes or no.
  - Does the cables (s) functions? The answer should be yes or no.
  - Does the transformer (s) functions? The answer should be yes or no.
  - Does the control panels s function? The answer should be yes or no.
  - Is there a sufficient cables (s) ready to use? The answer should be yes or no.
  - Is there a sufficient transformer (s) ready to use? The answer should be yes or no.
  - Is there a sufficient control panel? The answer should be yes or no.
- Maximum Production Capacity of Water Stations (MPCoWS) (m^3/day): The amount of water produced by all water wells if the water pump work about 16 hours per a day (it is assumed that all water stations are function).

- Maximum Amount of Water for Per Person (MAoWP) (l/person, day) =Maximum production capacity ×1000× 0.8/number of populations.
- The Actual Average Water Consumption for Per Person (AAWCP) (l/person, day) = the amount of water consumption per person per day. SECD team consulted the families, selected randomly lived in the target location and reported the values about water uses. Before the crisis in Syria, each people consumed about 80-150 liter /day of drinkable water. However, after the Syrian crisis, the water consumption has been getting lower and lower because of the scarcity of water and the extreme high-water prices.
- Actual Production Capacity of Water Station (APCoWS) (m^3/ day): According to the lack of public electricity and diesel for the generator in water station. In the water stations, water does not produced stably so the value of APCoWS is equal to 0 when there is not public electricity and diesel for the generator in water station, and sometime its value equal to MPCoWS.

Results

SECD team during October and November of 2017 conducted the work for the understanding of sewerage and water system infrastructures that were located in Daret Azza district. The results of the assessment are shown in the tables 2, 3 and 4.

Table (2): The Technical Assessment Results for Sewer Network of Daret Azza Subdistrict Communities

Community	% of people served by public Sewer network	Amount of Wastewater (m^3/day)	Percent amount of treated wastewater (%)	Existence of WWTP (Yes/No)	Registered cutaneous leishmaniasis Cases during 2017 (ACU, EWARN 2017)
Hur	77%	133.4	0	NO	89
Tqad	82	374.3	0	NO	117
Arhab	72%	137.0	0	NO	
Majbineh	65%	109.1	0	NO	
Bsartun	82%	193.6	0	NO	
Anjara	83%	581.6	0	NO	183
Zarzita	0%	154.8	0	NO	
Hoteh	68%	288.4	0	NO	6 0
Bshantara	69%	52.6	0	NO	
Bishqatine	72%	49.8	0	NO	
Kafrantin	0%	8.8	0	NO	
Qabtan Eljabal	83%	234.8	0	NO	205
Daret Azza	89%	2218.0	0	NO	371
Deir Seman	72%	374.4	0	NO	

Table (3): The Technical Assessment Results of WSIE Of Daret Azza Subdistrict Communities.

Community	The water network coverage WNC (%)	Number of Water Stations	WSIE (%)	MPCoWS (m^3/day)	MAoWP (l/person. day)	Availability of public electricity (h/day)	AAWCP (l/person. day)	APCoWS (m^3/day)	Total WDB during 2017 (Assistance coordination unit (ACU), EWARN 2017)
Hur	71%	2	48	1060	244.1	0	48	718	2401
Tqad	82	1	49	594	58.9	0	58	396	
Arhab	72%	1	64	360	85.7	0	51	0	
Majbineh	65%	1	63	450	134.6	0	51	0	
Bsartun	82%	3	57	792	115.2	0	44	429	
Anjara	%٨٧	6	72	2484	155.8	0	57	0	121
Zarzita	0%	1	61	630	125	0	48	0	
Hoteh	68%	9	42	3996	381.3	0	49	0	1081 ()
Bshantara	71%	1	62	540	341.5	0	52	361	
Bishqatine	72%	1	66	396	269.8	0	53	0	
Kafrantin	0%	0	0	0	0.0	0	49	0	
Qabtan Eljabal	81%	4	60	1638	272.4	0	61	0	247
Daret Azza	91%	4	77	8370	154.6	0	64	270	10234
Deir Saman	0%	1	59	360	61	0	49	215	

- The water-supply infrastructure efficiency (WSIE)

-Maximum Amount of Water for Per Person (MAoWP) (l/person, day) =Maximum production capacity ×1000× 0.8/number of populations.

-Actual Average Water Consumption for Per Person (AAWCP)

Actual Production Capacity of Water Station (APCoWS) (m^3/ day).

Table (4): The Availability of Fuel and Chlorine of Daret Azza Subdistrict Communities Market and the Various Cost of 1 m3 of Drinkable Water

Community	Availability of fuel at water Station	Availability of fuel at the market	Availability of chlorine at water station	Availability of spare parts at water s tation (%)	Availability of technical people at water station (%)	Cost of buying 1 m^3 by water tracking	Cost of supplying (COS) 1m^3 by public water network	What percentage of income is used to buy water
Hur	75%	100%	0	27%	51%	1.19	٠,٨٥	10 %
Tqad	67%	100%	0	17%	52%	1.25	1.08	12%
Arhab	0	100%	0	29%	59%	1.17	0.82	8%
Majbineh	0	100%	0	17%	62%	1.16	0.81	12%
Bsartun	0	100%	0	12%	52%	1.1	0.67	9%
Anjara	0	100%	70%	72%	79%	1.05	0.89	12%
Zarzita	37%	100%	0	0	0	0.92	0.48	11%
Hoteh	0	100%	40%	19%	52%	1.2	0.91	9%
Bshantara	68%	100%	0	31%	41%	1.13	٠,٧٥	9%
Bishqatine	0	100%	0	28%	43%	1.11	0.89	7%
Kafrantin	0	100%	0	0	0	1.2	N/A	13%
Qabtan Eljabal	0	100%	0	23%	73%	1.1	٠,٧٥	12%
Daret Azza	12%	100%	70%	63%	85%	1.4	.09 ١	8%
Deir Saman	71%	100%	100%	10%	62%	1	0.249	13%

1. 100% of wastewater do not be treated because there is not a wastewater plant. Therefore, the cutaneous leishmaniasis is disseminated through country. Ground water are also polluted. According to ACU Reports, there were totally 14.536 patients with waterborne diseases and 971 patients with cutaneous leishmaniasis in Daret Azza subdistrict during 2017 . Local council and any nongovernmental organizations of NSAG-controlled areas do not have enough financial and technical resources for constructing wastewater treatment plant (ACU, EWARN 2017).
2. All sewer network is functioning, but there is a need to rehabilitate most of them. Additionally, Kafrantin and Zarzita communities do not have sewer network, so day by day, the water resources are getting polluted more and more.
3. The WNC values are about 0% (which mean there is not water network) and 91% of the houses of the communities have not access to the public water network. Zarzita, Deir Saman and Kafrantin communities till now (30.12.2017) did not have water supply network. Therefore, it is so important to construct new water systems in the locations which did not have any water supply networks or had dysfunctional networks, and also to extend to the areas that did not have this system.

4. WSIE is about 0% (which mean there is not water station because some communities in Syria do not have water station till now, and the people get obtain water from other communities) to 71%. Water-supply infrastructure in Daret Azza subdistrict should be rehabilitated and maintained, but the local authorities of Daret Azza do not have enough financial resources for making necessary rehabilitation. SECD, World Vision International (WVI), and other non- government organizations (NGOs) worked in Daret Azza for solution of water issues. Similarly, they also do not have enough financial resources to fix all the problems related to water system.

5. AAWCP (l/person.day) is about 44-64 liter/day. It is similar to the value in the export of WoS-WASH Clusters which the average number of water consumption of each person in Daret Azza subdistrict is explained as 61.73 liter /day.

6. MAoWP (l/person.day) values for Daret Azza communities are various among 0 (for the communities no having water stations) and the maximum value with 381.3 liter (l/person.day). This indicator is very important to determine their needs to establish new water stations. If MAoW value should be less than 50 liter/person, there will be a need to construct a new water station. Therefore, Deir Saman village urgently needs a new drinkable water resource. Most of water stations has not produced water because of lack of electricity and diesel for the generators replaced in water stations. In addition to, local councils and water units do not have enough financial resources for covering the operating costs of supplying water. On the other hand, a number of NGOs have supported certain local councils and water units such as Bsartun and Hur etc. By this way, they may provide potable water for their people, and the others such as Deir Saman, Daret Azza may conduct recovery costs, even if just drop. After all, water units and local councils in Daret Azza have needed uninterrupted support, as 85% of Syrian people has lived under the poverty line according to OCHA reports.

7. The cost of 1 m3 by water trucking in Daret Azza communities is between 0.249-1 $ while in the regime-controlled areas, it is about 0-0.13 $/m3 (MoWR, Order 894, 2014). Because the fee for water supplying service is determined by government. On the other hand, this water is not healthy, as it has not be disinfected. In parallel with this, the indicator of water disease born of Daret Azza is getting higher and higher according to reports of the Early Warning Alert and Response Network Program (ACU, EWARN 2017).

8. COS of 1 m3 of drinking water by public water network in Daret Azza communities is between 0.92-1.4 $. (Figure 5). Contrarily, this water is healthy depending on many factors: the depth of ground water table, the length of water networks etc. The maximum value of COS in Daret Azza and Tqad is shown as Figure 6. Because the ground water table level is too high, and the dynamic level in these communities is about -450 m.

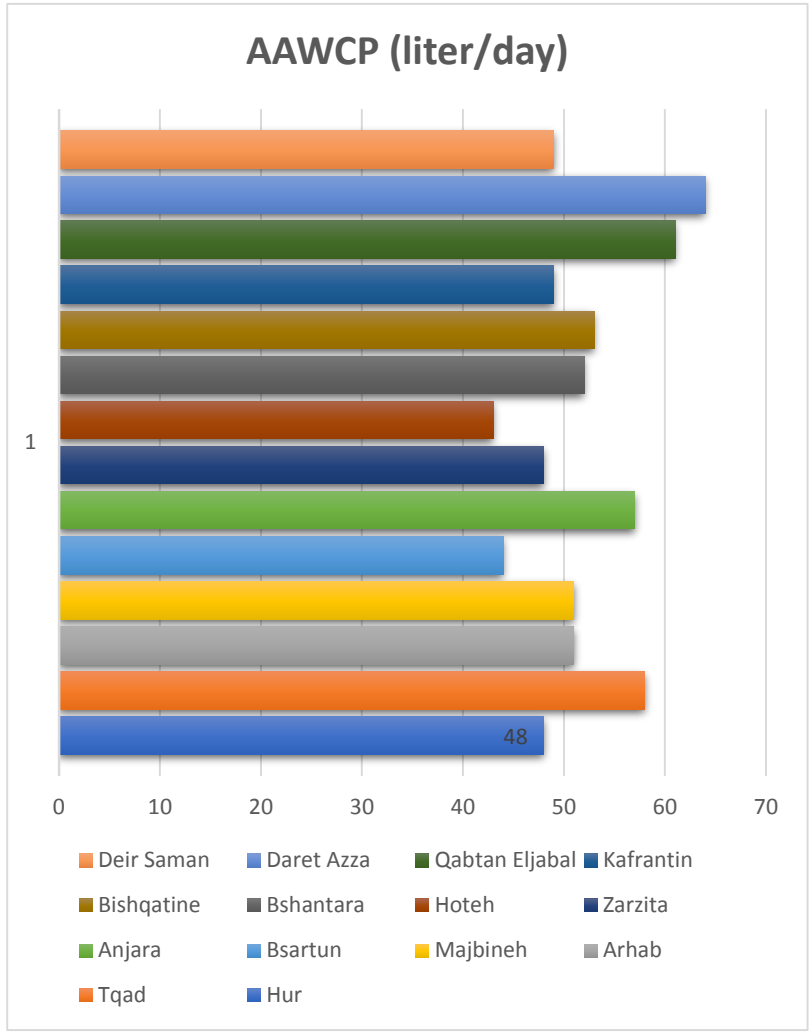

Figure 3. AAWCP (l/person.day) of Daret Azza subdistrict communities.

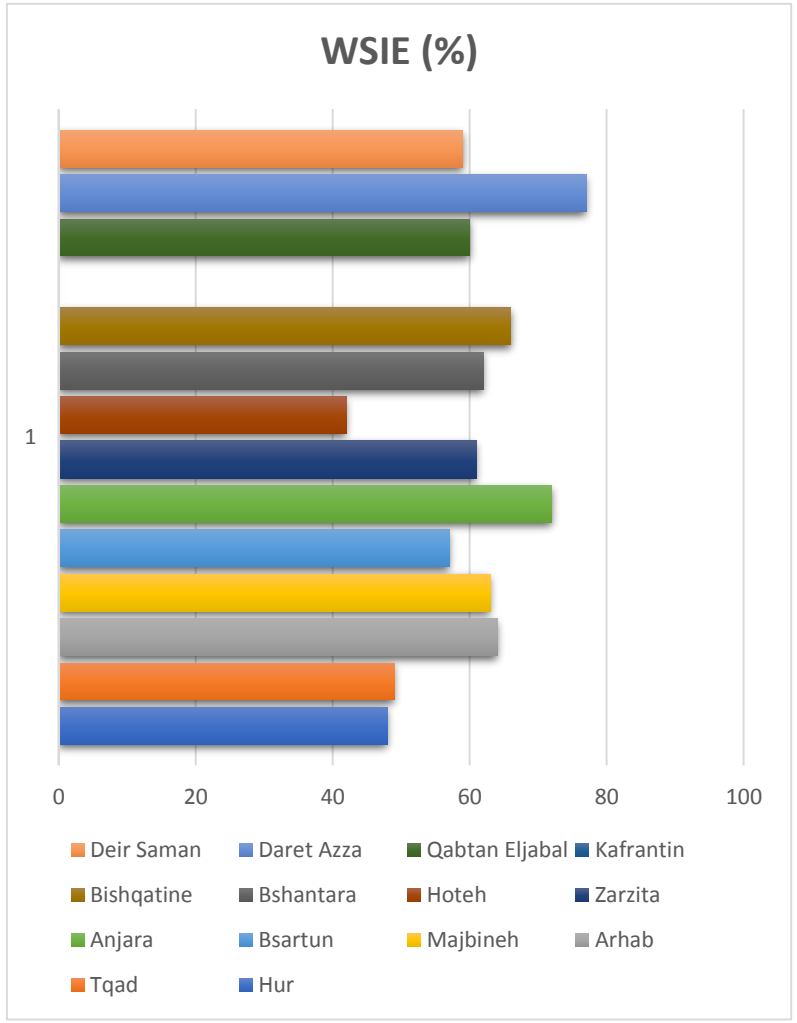

Figure 4. WSIE (%) of Daret Azza subdistrict communities.

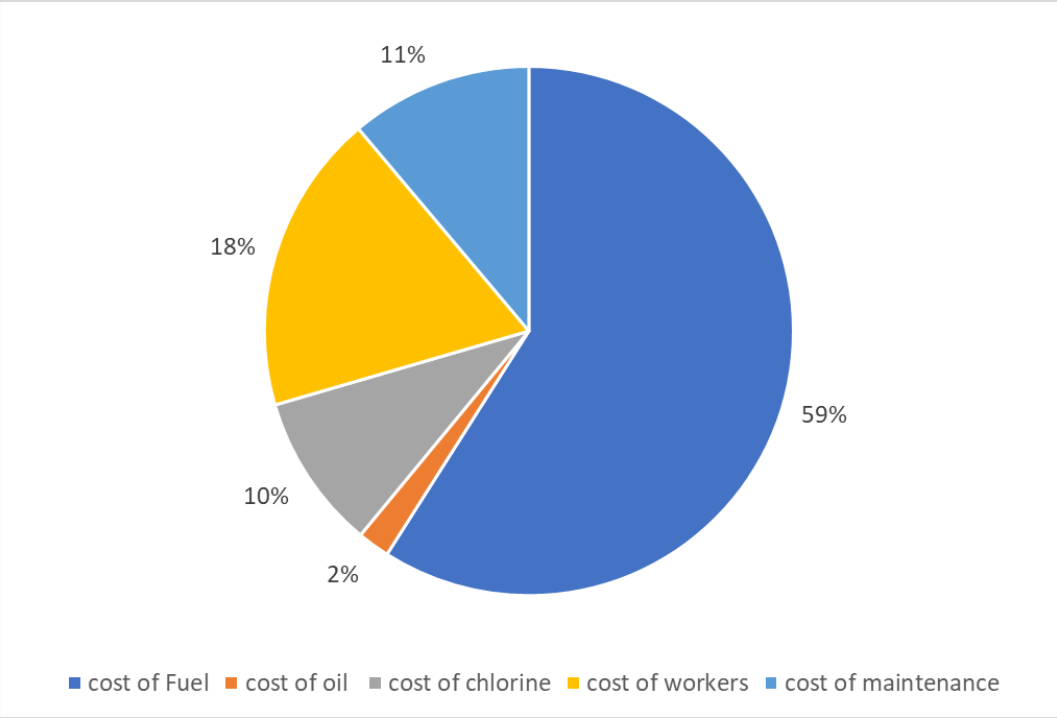

Figure 5. The cost segregation of supplying 1 m3 of drinking water by public water network of Daret Azza communities.

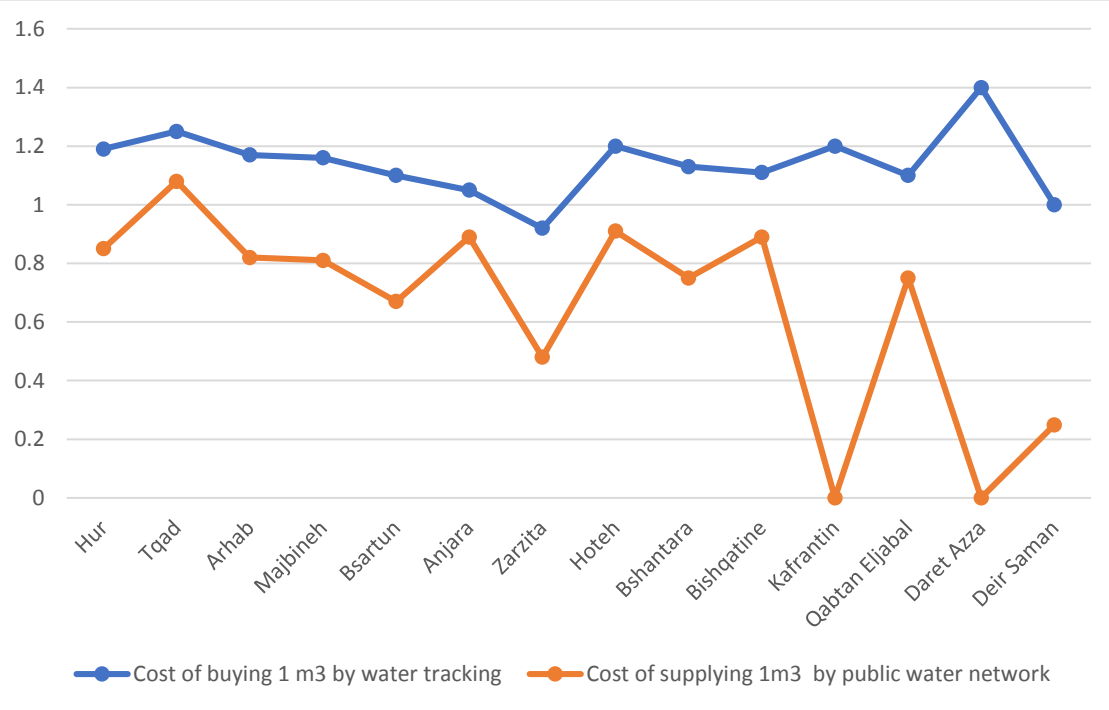

Figure 6. The cost of supplying 1 m3 of drinking water by public water network and the cost of buying 1m3 by water tracking.

9. The people of Daret Azza communities spends about 8-13% of their income for buying unsafe water. The amount is so high for them as shown in Figure 7. The people living in the regime controlled areas spends about 0.5-1% of their income, as fee for water supplying services is determined as 0-0.13 $/m3 by the government. Before 2011, most of Syrian people spends about 0.3-1% $/m3, so the people in NSAG and potable water sectors need uninterrupted financial and technical supports

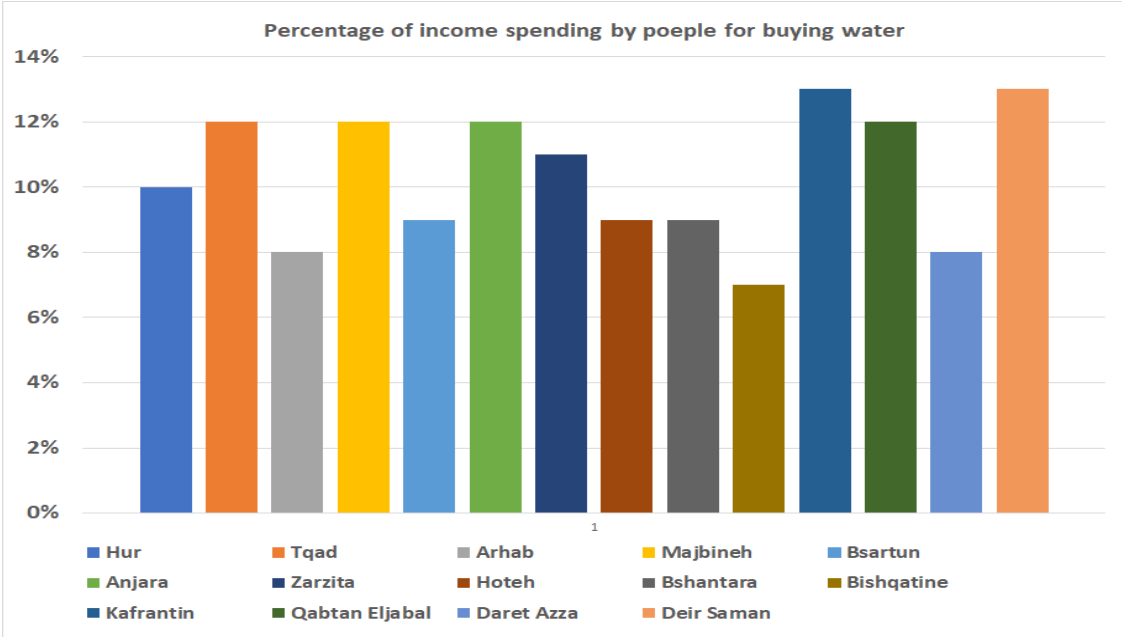

Figure 7. The percentage of income spending by people for buying water by track in Daret Azza subdistrict communities.

Conclusion

The assessment showed that the people in NSAG-controlled areas needs urgent and sustainable technical and financial supports, especially for obtaining drinking water. The unhealthy water which is supplied by water tracking is the root cause of high WDB during 2017. 14.536 patients with WDB was registered in 2017. Additionally the untreated wastewater of Daret Azza subdistrict is one of the cause of cutaneous leishmaniasis during 2017.

Acknowledgement

The assessment showed that the people in NSAG-controlled areas needs urgent and sustainable technical and financial supports, especially for obtaining drinking water. The unhealthy water which is supplied by water tracking is the root cause of high WDB during 2017. 14.536 patients with WDB was registered in 2017. Additionally the untreated wastewater of Daret Azza subdistrict is one of the cause of cutaneous leishmaniasis during 2017.


Thanks
For Listening
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