جهاز التخطيط والإحصاء

Planning and Statistics Authority

Water Statistics

In the state of Qatar 2019

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WATER STATISTICS

In the State of Qatar, 2019

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His Highness Sheikh Tamim Bin Hamad Al-Thani
Emir of the State of Qatar

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Preface

Allah the Exalted said in Holy Quran: "We made from water every living thing"*. Hence, water is life!

The protection of our national natural freshwater resources is part of our National Development Strategy.

Qatar relies on seawater desalination as the main source for drinking water and on groundwater abstraction for agricultural purposes. The re-use of treated wastewater has become an important alternative source of water for agricultural and green spaces irrigation.

Water policies of Qatar have achieved several successes, including safe drinking water for all population, minimum water loss, high-level treatment of urban wastewater and re-use of large proportions of treated wastewater. Statistics show that water use efficiency has increased in most economic sectors.

However, our fresh groundwater reserves are still being overexploited, which leads to lower groundwater levels and increased salinity. This in turn makes it difficult to use the groundwater for irrigation and drinking water purposes in the future.

According to available statistics, there is still the potential to increase the re-use of treated wastewater, so that household and economic activities will become more efficient in water consumption and reduction of water loss.

All these measures will contribute to water and food security and to sustainable development according to Qatar National Vision 2030.

This 4th Water Statistics Report gives a comprehensive overview on water sources and uses. Publishing these statistics is an important step to support knowledge-based decision-making in the water sector.

Dr. Saleh M. Al-Nabit

President of the Planning and Statistics Authority

(*) Sura Al-Anbiyaa (The Prophets), Verse 30

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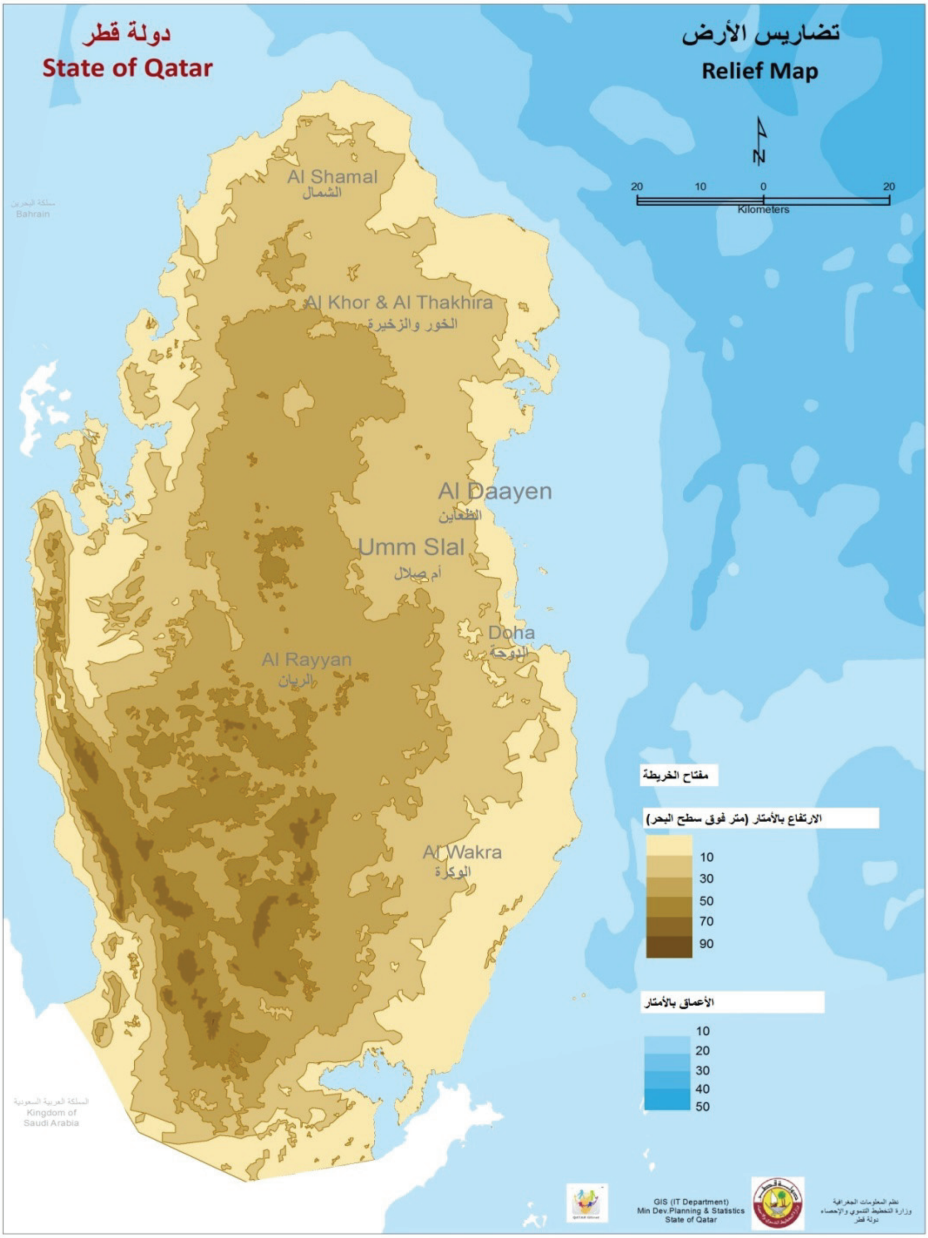
1. General Information

Qatar is situated midway along the western coast of the Arabian Gulf between latitudes 24.27˚-26.10˚ North and longitudes 50.45˚ – 51.40˚ East. Its surface area is 11,521 km2, which includes several small islands in the Arabian Gulf such as Halul, Shira'who, Ashat and Al-Bishiria.

The peninsula is approximately 185 km in length and 85 km in width. The waters of the Arabian Gulf surround the majority of the country, while the only land border of about 60 km separates the country from the Kingdom of Saudi Arabia. The United Arab Emirates lie to the east and Bahrain to the northwest of the country.

Qatar generally consists of flat rocky surfaces. It does, however, include some hills which reach an altitude of 100 m above sea level. Most of the country's land is sandy desert covered with scrub plants and loose gravel. Moving sand dunes, with an average height of about 40 meters, are found in the southern part of the country and in the northeastern coast near Ras Laffan. The northern part of Qatar is relatively low and rises gradually to the west and southwest. (See Map1-1).

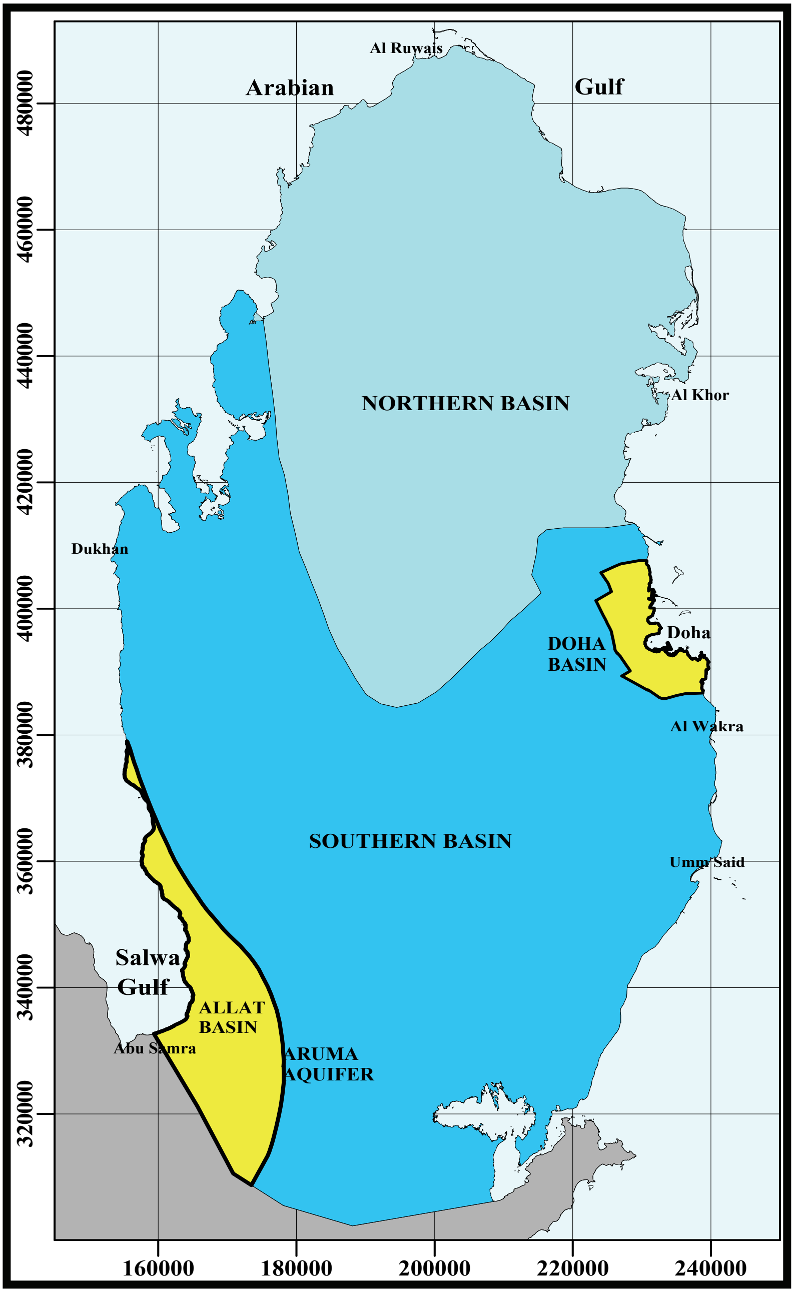
Map 1-1: Relief Map of Qatar



Source: Planning and Statistics Authority

Qatar's main groundwater basins include the Northern Basin, Southern Basin, Doha basin and the Allat Basin. (See Map 1-2).

Map 1-2: Groundwater Basins in the State of Qatar



Source: Ministry of Municipality and Environment

2. Water Indicators in the 2030 SDGs

Table 2-1: Water indicators in sustainable developments (2014-2019)

Goal	Target	Indicator	Indicator Name	2014	2015	2016	2017	2018	2019
3	3.9	3.9.2	Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)	0	0	0	0	0	0
Mortality rate per 100,000 population by environmental risk									
3	3.9 3.9.2		Unsafe water	0	0	0	0	0	0
			Unsafe sanitation	0	0	0	0	0	0
			Lack of hygiene materials	0	0	0	0	0	0
6	6.1	6.1.1	Proportion of population using safely managed drinking water services	100%	100%	100%	100%	100%	100%
6	6.2	6.2.1	Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water	100%	100%	100%	100%	100%	100%
6	6.3	6.3.1	Proportion of wastewater safely treated	93.90%	99.10%	99.10%	98.90%	99.40%	99.60%
6	6.3	6.3.2	Proportion of bodies of water with good ambient water quality	...	...	...	...	...	...
6	6.4	6.4.1	Change in water-use efficiency over time	Water Efficiency in the Agricultural, Industrial and Commercial Sector (QR/L)					
			Value added of agricultural activities (at constant prices 2018) (QR)/ amount of water used in the agricultural sector (liters)	0.003	0.003	0.004	0.004	0.005	0.005
			Value added of industrial activities (at constant prices 2018) (QR)/ amount of water used in the industrial sector (liters)	36.6	36.8	16.8	33.9	15.6	11.6
			Value added of commercial activities (at constant prices 2018) (QR)/ amount of water used in the commercial sector (liters)	2.2	2.7	0.9	3.2	7.2	2.3

Goal	Target	Indicator	Indicator Name	2014	2015	2016	2017	2018	2019
6	6.4	6.4.2	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	…	230%	229%	247%	247%	280%
6	6.5	6.5.1	Degree of integrated water resources management implementation (0-100%)	…	…	80%	82%	82%	81%
6	6.b	6.b.1	Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	100%	100%	100%	100%	100%	100%

...: Unavailable from the source

Source: Qatar Sustainable Development Goals Report 2016-2020

3. Water Resources

3.1 Rationale

Qatar's only natural freshwater resources are rainfall and groundwater. The conservation of the quality and quantity of the country's groundwater resources is one of the targets of Qatar's NDS 2011-2016 and NDS 2018-2022.

Table 3-1 shows the natural long-term water balance (1998–2019) of Qatar's groundwater basins. The groundwater safe yield amounted to 57.2 million m^3 per year. However, the current groundwater abstraction reached 250 million m^3 per year, leading to depletion of aquifers, low groundwater levels and increased salinity.

Table 3-1: Natural water balance of Qatar's aquifers
(Annual average 1998-2019)

No.	Water Balance	Million M^3/Year	Data Source
1	Recharge of aquifers from rainfall	75.2	Kahramaa and Ministry of Municipality and Environment (Long-term annual average 1998-2019)
2	Total renewable water resources*	75.2	
3	Groundwater outflow into sea and deep saline aquifers	18.0	Kahramaa and Ministry of Municipality and Environment (Long-term annual average 1998-2019)
4	Average annual water balance (groundwater safe yield) **	57.2	Subtraction result (2-3)

* FAO Aquastat, OECD, UNSD and Eurostat

** Without the returns from irrigation

Source: Ministry of Municipality and Environment and Kahramaa

There are also several ongoing projects to artificially increase the water recharge into aquifers (e.g. via recharge wells) and the artificial injection of TSE and distilled water. The irrigation return flow plays a significant role the overall water balance.

3.2 Key Messages

a) During the period 2008–2019, the total rainfall (monitored at Doha International Airport) was lower than the long-term average rainfall (1962-2019), except for 2015, 2016 and 2018. The average rainfall in 2019 in Doha International Airport formed 90% of the long-term average.

b) Water abstraction from fresh groundwater is mainly for agricultural purposes (about 230 million m^3 per year in recent years; i.e. 92% of total abstracted groundwater).

c) The annual water deficit (mainly caused by groundwater abstraction) varied between 166 million m^3/year and 11 million m^3/year during the period 2008–2019.

d) Artificial recharge of groundwater aquifers by TSE injection, recharge wells and recharge from irrigation are the main source for the national groundwater reserve (44% of the annual additions to groundwater reserves from irrigation water, 31% from artificial recharge and 25.1% from rainfall).

3.3 Statistics and Indicators

3.3.1 Rainfall

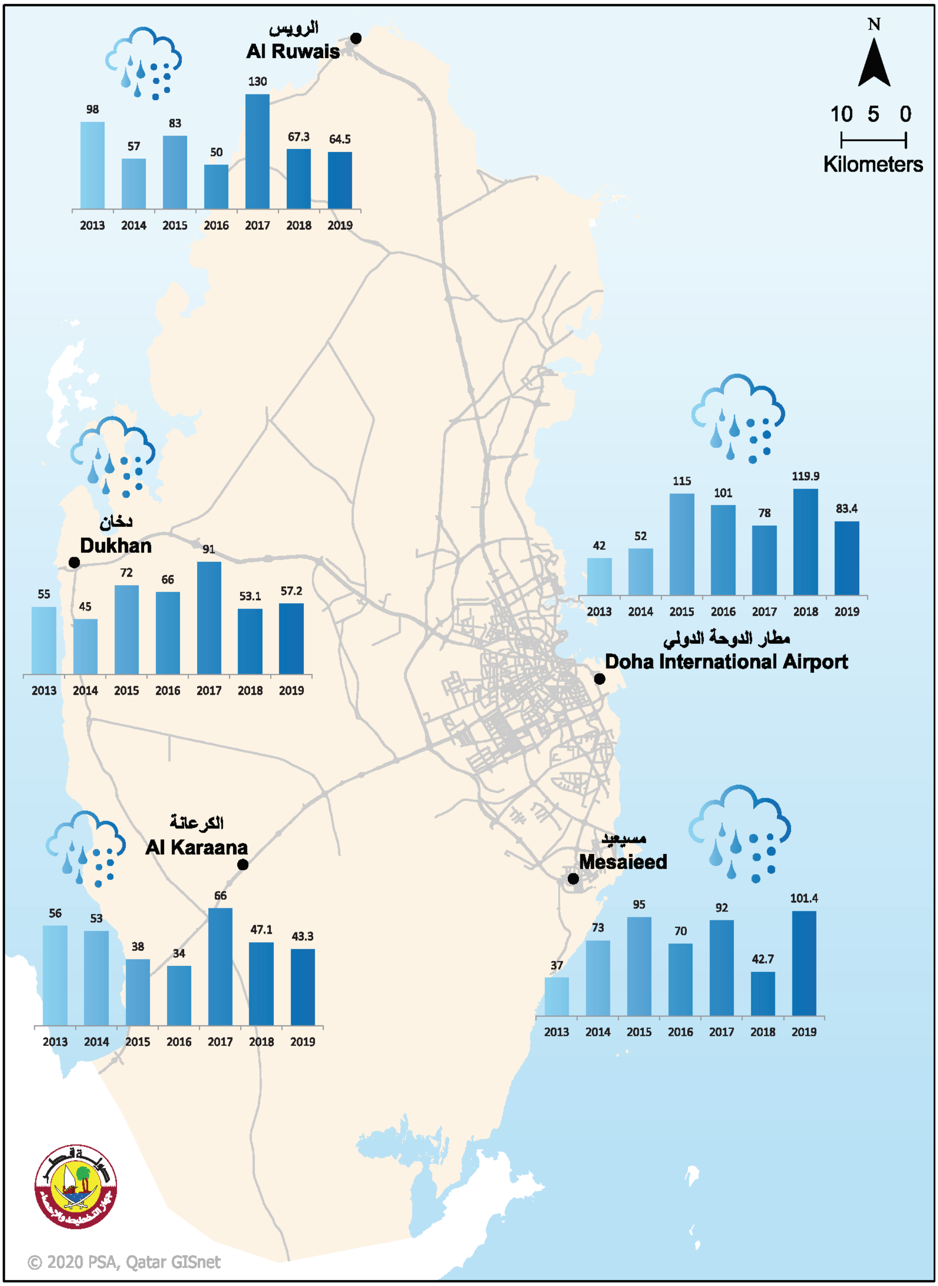
Compared to the long-term average rainfall (1962-2019), the year 2019 is considered relatively dry with a total rainfall of 83.4 mm at Doha International Airport Station; i.e. 90% of the long-term average rainfall. In 2019, the highest annual rainfall was recorded at Mesaieed Station vis-à-vis the other monitoring stations, whereas the lowest rainfall (43.3 mm) was recorded in Al-Karaana Station. (See table 3-2).

Table 3-2: Rainfall average (mm) at selected monitoring stations in Qatar 2013-2019

Station (mm)	2013	2014	2015	2016	2017	2018	2019
Mesaieed	**36.6**	**73**	**95.4**	**69.7**	**92.2**	**42.7**	**101.4**
Al-Ruwais	**98.3**	**56.5**	**82.5**	**49.8**	**129.7**	**67.3**	**64.5**
Dukhan	**54.7**	**44.6**	**72.1**	**66.4**	**90.8**	**53.1**	**57.2**
Doha International Airport	**41.6**	**52.4**	**114.5**	**101.1**	**78.4**	**119.9**	**83.4**
Al-Karaana	**56.3**	**53.4**	**37.5**	**33.6**	**66.2**	**47.1**	**43.3**

Source: Civil Aviation General Authority – QMD

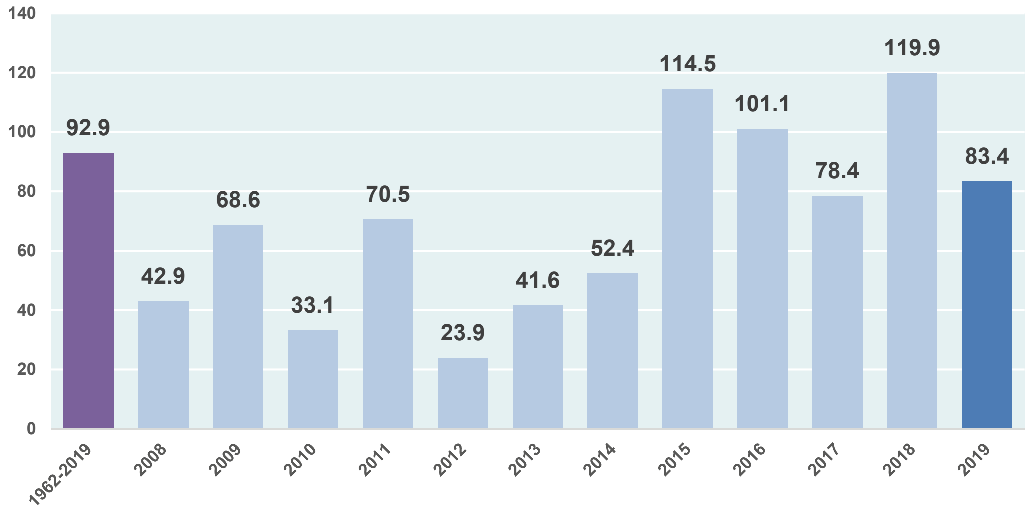
Map 2.2: Rainfall rate by years and selected stations (mm) 2013-2019



Source: Planning and Statistics Authority

Figure 3-1 below shows that the annual rainfall for all years during the period (2008–2019) was lower than the long-term annual average rainfall (1962-2019), except for 2015, 2016 and 2018. The annual rainfall rate in 2019 was 90% compared to the long-term annual rate (1962-2019).

Figure 3-1: Annual rainfall rate at Doha International Airport Station 2008-2019 compared to the long-term annual average rainfall (1962-2019)

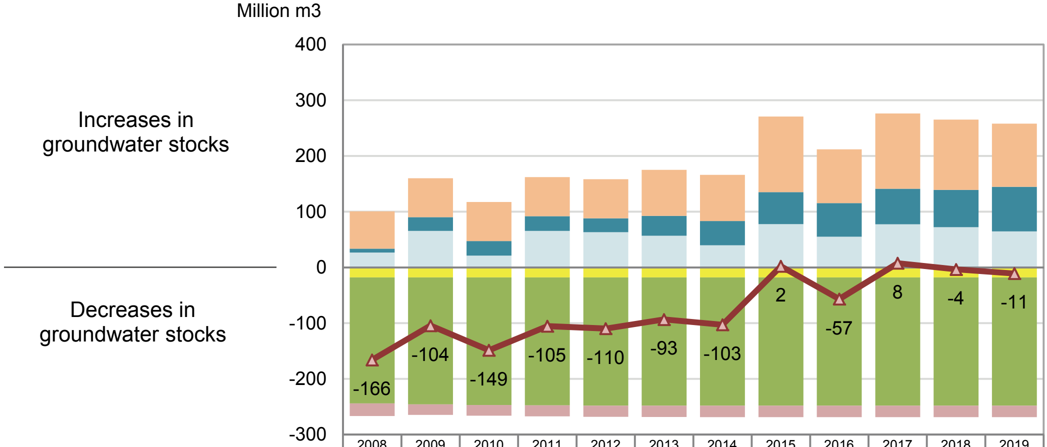


Source: Qatar Civil Aviation Authority, QMD

3.3.2 Water Balance

Figure 3-2 below displays the water balance during the period 2008-2019. The total increase in water reserve (total recharge from rainfall, artificial recharge and irrigation returns) increased from 101 million m^3 in 2008 to 258 million m^3 in 2019. However, the water balance decrease remained relatively unchanged between 267 and 269 million m^3 per year for the same period. Consequently, the decrease in the underground reserve was relatively constant between 267 and 269 million m3 per year for the same period. This, in turn, led to an annual groundwater deficit ranging between 166 and 11 million m3 for the period (2008 and 2019).

Figure 3-2: Water balance 2008-2019

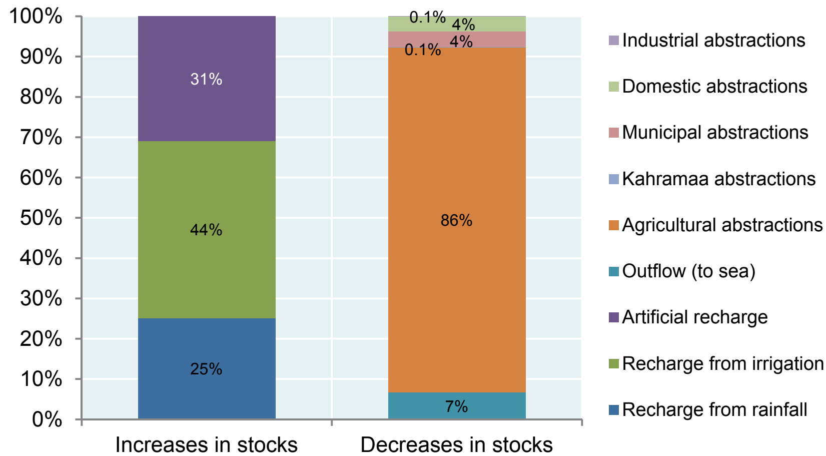


	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Municipal and industrial abstractions	-23	-19	-19	-20	-20	-20	-21	-21	-21	-21	-21	-21
Agricultural abstractions	-226	-228	-229	-229	-230	-230	-230	-230	-230	-230	-230	-230
Outflow (to sea)	-18	-18	-18	-18	-18	-18	-18	-18	-18	-18	-18	-18
Recharge wells and irrigation recharge	67	70	70	70	70	83	83	136	96	135	126	113
TSE injection	7	24	26	26	25	36	43	57	60	64	67	80
Recharge from rainfall	27	66	21	66	63	57	40	78	55	77	72	65
Water balance	-166	-104	-149	-105	-110	-93	-103	2	-57	8	-4	-11

Source: Ministry of Municipality and Environment, Ashghal and Kahramaa; computations of PSA

The artificial recharge and irrigation returns represent the largest source of additions to water reserve. The decrease in water reserve is attributed to water withdrawal for agricultural purposes. Figure 3-3 below shows the increase and decrease in water reserve in 2019.

Figure 3-3: Increase and decrease in groundwater reserve as a percentage of total water 2019



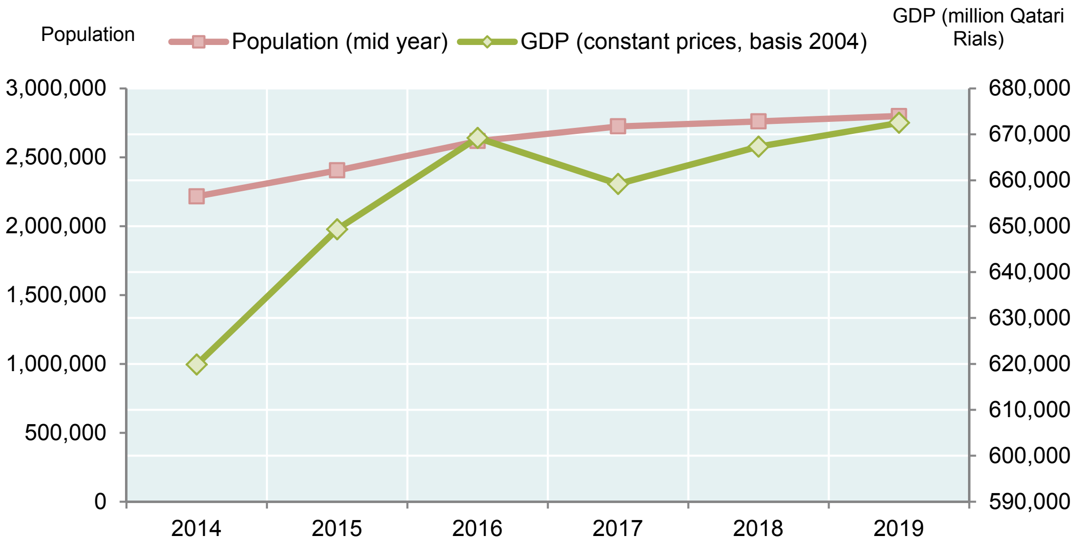
Source: MME, Ashghal and Kahramaa; computations by PSA

4. Water Production, Abstraction and Use

4.1 Rationale

Qatar's economy is rapidly growing with an ongoing population growth (mainly expatriates). Figure 4-1 below shows that during the period 2014-2019 the population rose from 2,216,180 to 2,799,202 (+26%). The annual GDP increased from QR 619,861 million to QR 672,510 million (+8%) for the same period, i.e. the average annual growth rate is 4.8% for the population and 1.5% for the GDP. The measures taken to meet the water needs of Qatar's growing economy include the production of more water, increased water reuses and increased water use efficiency.

Figure 4-1: Population and GDP Growth 2014–2019



Source: Planning and Statistics Authority

The water available for use originates from the following sources:

- Abstraction of fresh and saline groundwater.
- Seawater desalination.
- Re-use of Treated Sewage Effluent.

The potential future water sources include water generated by the GTL process, which is currently recycled in industries, where excess water is discharged without use. Data about the quantity of freshwater produced by the GTL process are currently not available.

4.2 Key Messages

a) Total water production (desalination + fresh groundwater abstraction + re-use of TSE) rose from 220 million m^3 in 1990 to 1,084 million m^3 in 2019.

b) Water demand is accompanied with economic and population growth. GDP growth is slightly higher than the growth of water demand.

c) Since 2005, abstraction from groundwater aquifers has remained at the same annual level and has not shown a remarkable growth.

d) Real water loss of desalinated water was reduced from 29% in 2008 to 2.4% in 2019.

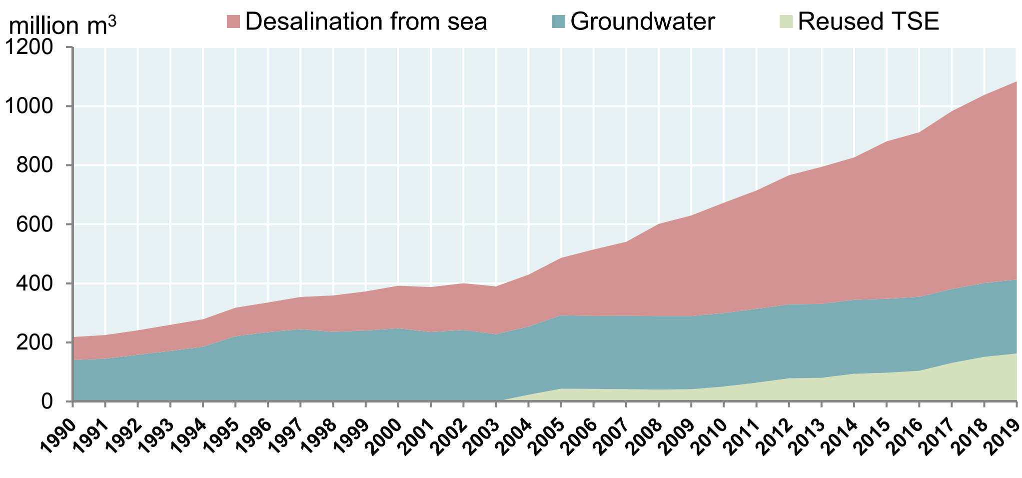
e) In 2017 and 2018, productivity of water used in all economic activities has increased.

4.3 Statistics and Indicators

4.3.1 Water Production and Re-Use

Figure 4-2 below shows that in 1990, Qatar's only sources of water were groundwater abstraction (65%) and desalinated seawater (35%). Treated wastewater for agriculture and green spaces irrigation purposes (5%) entered into use in 2004, and increased to 15% in 2019. It is noteworthy that in 2019 the main source of total water production is sea water desalination (63%), followed by groundwater abstraction (23%). The total annual water production and re-use rose from 220 million m^3 in 1990 to 1,043 million m^3 in 2019, in addition to the water produced (i.e. desalinated) by industries for their own uses.

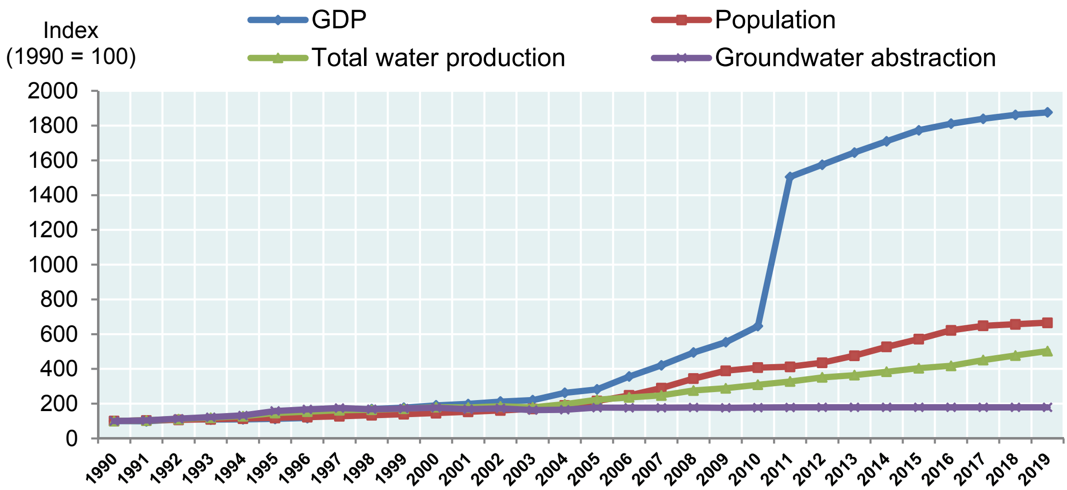
Figure 4-2: Total water production and re-use by source of water (million m^3) 1990–2019



Source: MME, Ashghal and Kahramaa

Figure 4-3 below shows that the total water production is closely related to the economic and population growth. There is a slight divergence between GDP growth rate and total water production rate (abstracted groundwater + desalinated seawater + reused TSE). In 2005, it was clear that there was no relation between the GDP growth rate and groundwater abstraction growth rate, which remained at the same level until 2019.

Figure 4-3: GDP growth rates (at constant prices), population, total water production and groundwater abstraction (index base year 1990) 1990-2019

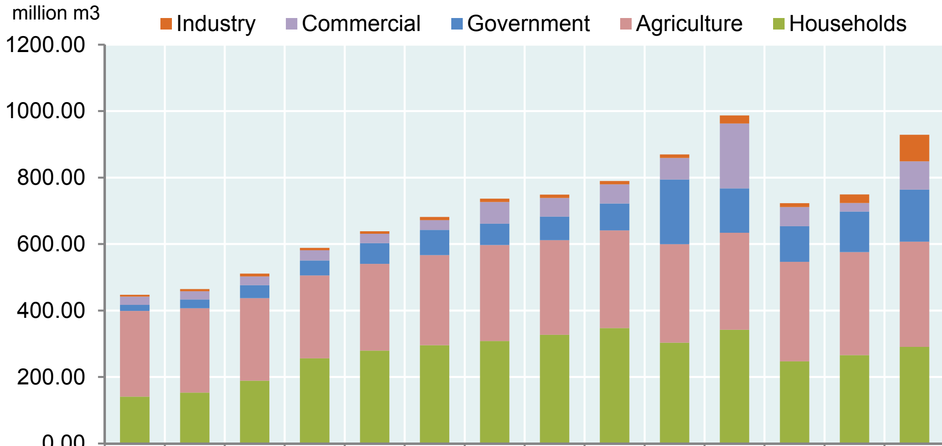


Source: PSA, MME, Ashghal and Kahramaa; computations by PSA

4.3.2 Water Use by Economic Sector

Statistics indicate that used water quantity (net of loss) increased from 447.3 to 928.9 million m^3 per year in the period 2006–2019. Figure 4-4 below shows that most of the water uses were allocated for agricultural and domestic purposes. However, the highest growth rates during the same period was in the industrial sector (+20%) and government sector (+15%), whereas the growth of water use in the agricultural sector amounted to 1% (see Figure 4-5).

Figure 4-4: Water use by economic activity (million m3) (excluding loss) 2006-2019

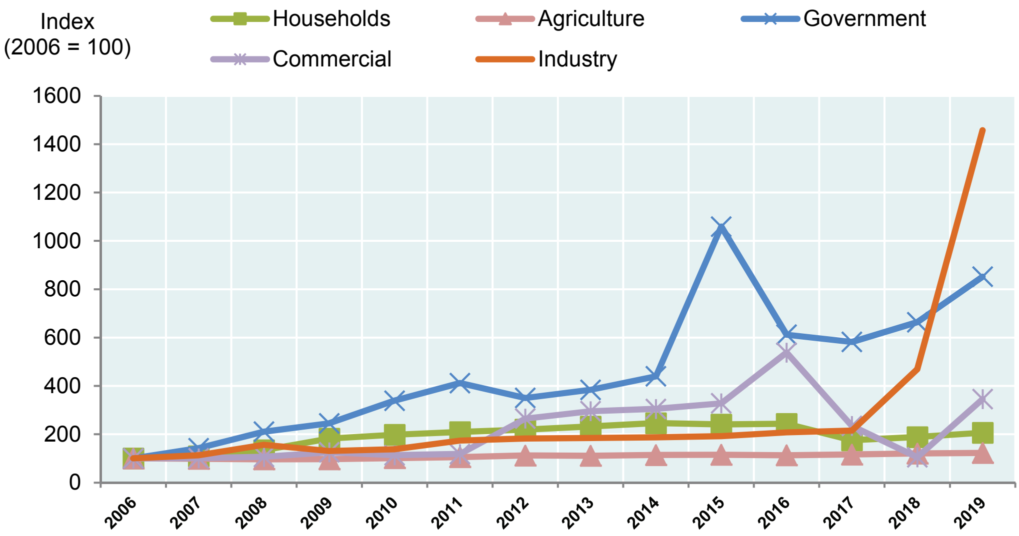


	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Industry	5.50	6.20	8.60	7.18	7.58	9.58	10.02	10.1	10.3	10.6	24.1	11.8	25.8	80.2
Commercial	24.60	24.80	26.20	30.90	27.90	29.10	65.16	56.10	57.73	64.66	195.53	57.7	25.8	85.0
Government	18.39	26.23	38.77	45.07	62.33	75.68	64.42	70.57	80.85	194.76	133.34	107.0	122.0	156.7
Agriculture	257.69	254.05	248.15	248.89	261.16	271.45	288.76	284.70	293.80	296.29	291.70	299.6	310.0	316.1
Households	141.10	153.16	189.29	256.57	279.39	295.56	308.35	327.23	347.20	303.4	342.3	247.1	265.9	291.0

*Industry includes water supplied by Kahramaa and by industrial wells.

Source: Ashghal, MME and Kahramaa, Computations by PSA.

Figure 4-5: Growth rates of water use by economic activity 2006–2019* (Index base year 2006)



*There are some differences in the water used in homes from previous years, due to the different method of computation from the source.

Source: Ashghal, MME and Kahramaa,computations by PSA

As for the per-capita water use in different sectors, except for the agricultural sector (domestic, industrial, commercial and government sectors), Kahramaa statistics (see Table 4-1) indicate the presence of several values of this index according to total water production, the authorized consumption (including and excluding water loss) and volume of water transported to the network (excluding real water loss).

Table 4-1: Annual per capita water consumption in different usages (m3/year/per capita) 2013-2019

Year	Per capita total water production	Per capita total water transported to the network (including water loss)	Per capita consumption of water transported to the network (excluding real loss)
2013	**227**	**222**	**208**
2014	**221**	**216**	**202**
2015	**220**	**214**	**203**
2016	**216**	**208**	**199**
2017	**224**	**217**	**208**
2018	**231**	**223**	**214**
2019	**242**	**234**	**224**

Source: Kahramaa

4.3.3 Water Loss

Water loss occurs during the transport of drinking water, in wastewater sewers, in septic tanks or during evacuation and transport of septic tank's wastewater.

As for desalinated water, Kahramaa has statistics for the so-called apparent loss and real loss (according to the classification of the International Water Association (IWA)). Apparent loss and real loss are defined by IWA as follows:

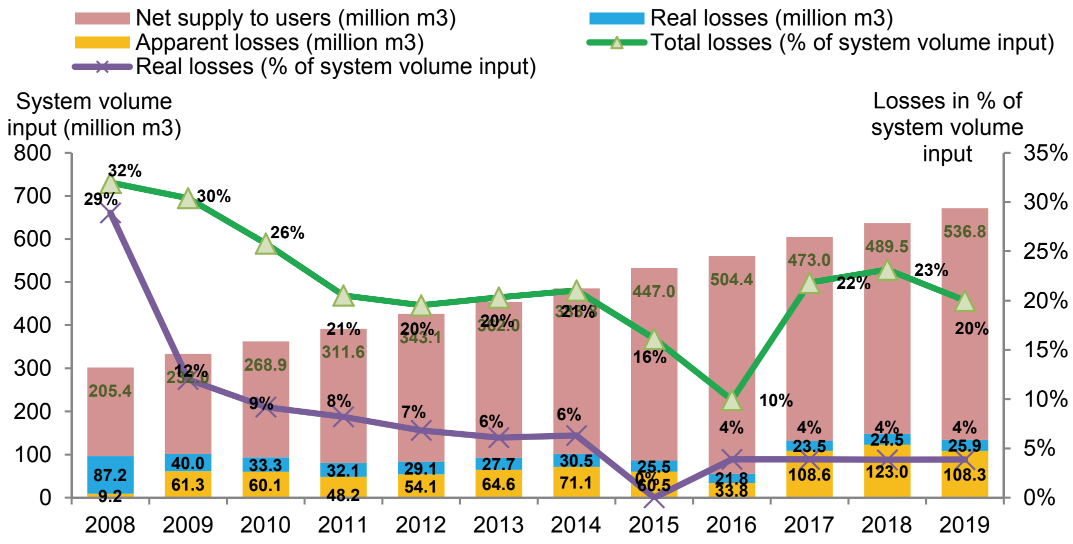
Apparent loss consists of unauthorized consumption (theft or illegal use), and all types of inaccuracies associated with production metering and customer metering. Under-registration of production meters or over-registration of customer meters leads to under-estimation of real losses. Over-registration of production meters and under-registration of customer meters lead to over-estimation of real loss.

Real loss is a physical water loss from the pressurized system, up to the point of customer metering. The volume lost through all types of leaks, bursts and overflows depends on frequencies, flow rates, and average durations of individual leaks.

Total loss is the sum of apparent loss and real loss.

With respect to analysis and indicators, it is extremely important to be explicitly clear which losses (total, real, apparent) are in discussion. The following Figure 4-6 presents the development of real loss and total loss from 2008 to 2019. Total loss has decreased from 32% to 20% and real loss from 28.9% to 4%. The Figure also shows that the total system volume input increased from 301.5 million m^3 in 2008 to 671 million m^3 in 2019. Meanwhile, the real loss in terms of volume slumped from 87 million m^3 in 2008 to 25.94 million m^3 in 2019.

Figure 4-6: Loss in distribution of drinking water 2008-2019



Source: Kahramaa

Currently, there are no statistics on loss in wastewater sewers in the State of Qatar; however, only estimates exist. In terms of water quantity, the issue of groundwater leakage into the sewer seems to be of a larger concern than the actual water loss. Leakage into the sewer mains may be responsible for the relatively high salinity of TSE of around 1,000 mg/l measured at Doha wastewater treatment plants (see Ashghal & Schlumberger study, 2013).

4.3.4 Water Use in Agriculture

Water sources for agriculture consist of groundwater and reused TSE.

Statistics of Table 4.2 below indicate that the total treated wastewater used for agriculture amounted to 55.2 million m^3 of total water used for agriculture which accounted for 285.2 million m^3 (19.4%) in 2013. Whereas it reached 86.1 million m^3 (27.2%) of total water used for agriculture which accounted for 316.4 million m^3 in 2019. According to Ashghal and Schlumberger study in 2013, water salinity at Doha wastewater treatment plants attained 1,000 mg/l, which is a major concern for water re-use in agriculture. That table also shows that from 2013 to 2019, the agricultural GDP increased from QR 710 million to QR 1,499 million (at constant prices of 2018).

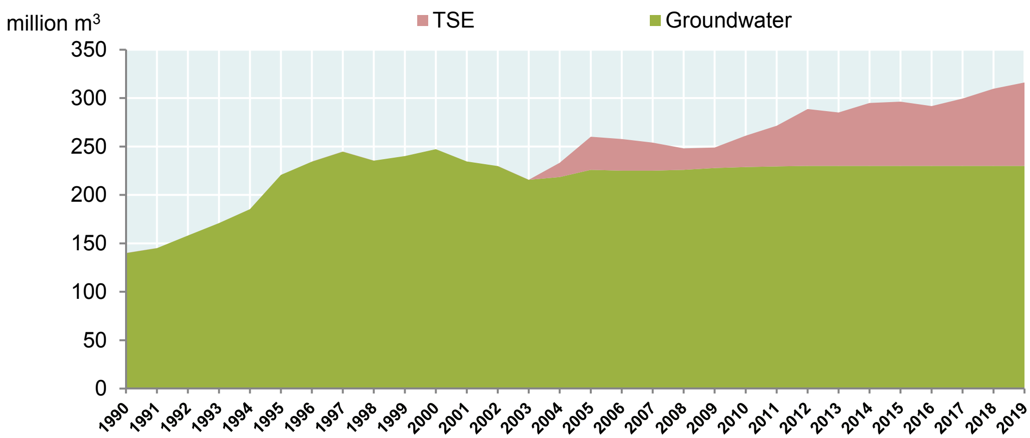
Table 4-2: Water used in agriculture by source and GDP of agriculture (at constant prices of 2018) 2013–2019

Year	Abstracted groundwater (million m3)	Productive farms (million m3)	TSE (million m3)	Total (million m3)	GDP (million QR, constant prices of 2018)
2013	**230**	**0**	**55.23**	**285.23**	**710**
2014	**230**	**0**	**64.92**	**294.92**	**889**
2015	**230**	**0**	**66.29**	**296.29**	**958**
2016	**230**	**0.12**	**61.70**	**291.82**	**1043**
2017	**230**	**0.13**	**69.51**	**299.64**	**1258**
2018	**230**	**0.3**	**79.67**	**309.97**	**1456**
2019	**230**	**0.3**	**86.1**	**316.4**	**1499**

Source: PSA, MME, Kahramaa and Ashghal.

Data about water use in agriculture is available since 1990. The following Figure 4-7 shows that the annual total water used in agriculture rose from 140 million m3 in 1990 to 316.4 million m3 in 2019. However, groundwater abstraction for agricultural purposes has roughly remained unchanged at the same level since 2005 (226 – 230 million m3/year) and additional demand has been covered by TSE since 2004.

Figure 4-7: Water use in agriculture by source of water (million m3) 1990-2019

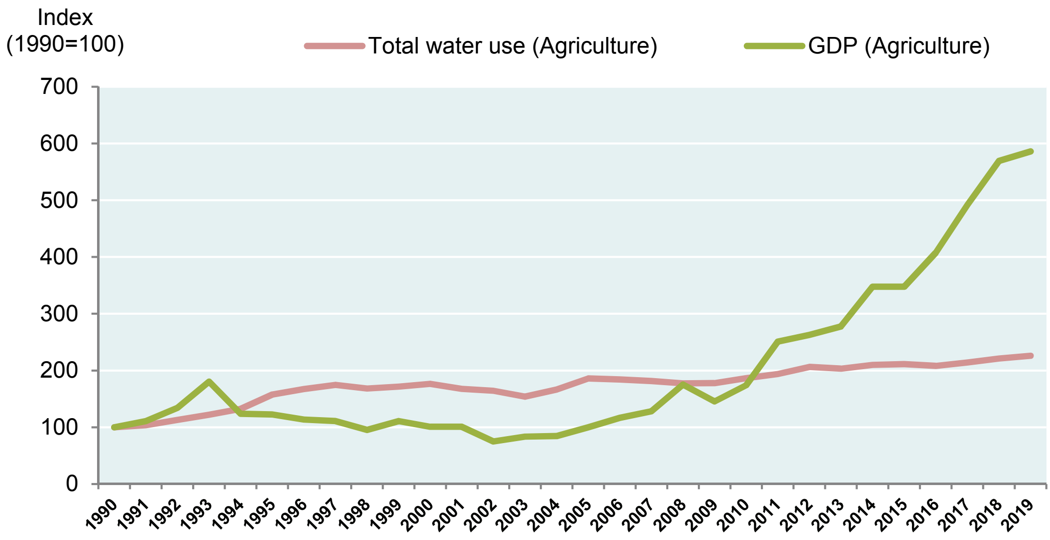


Source: MME, Kahramaa and Ashghal

Efficiency of water used in agriculture: the 1990 statistics show that 562.25 liters of water were needed to produce QR 1 of GDP in agriculture. In 2019, the figure increased to 210.8 liters.

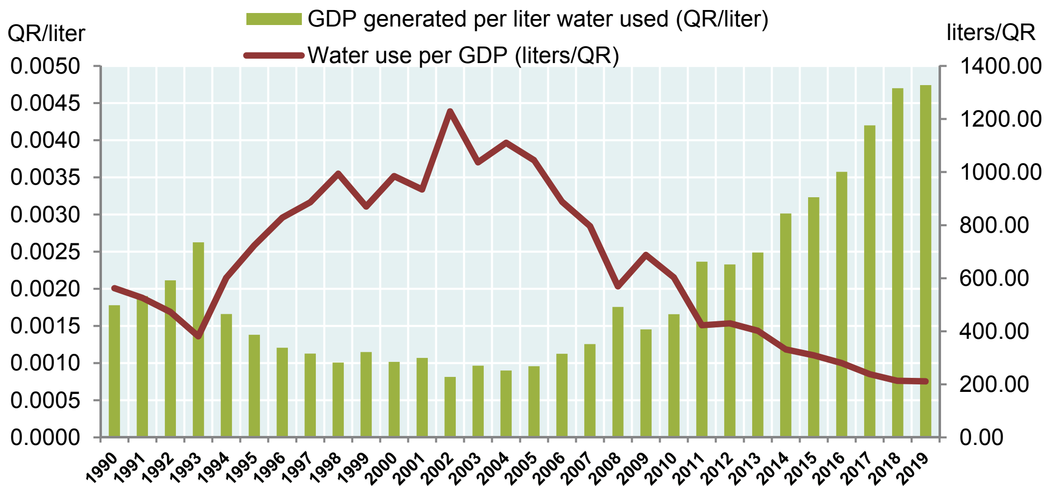
Productivity of water used in agriculture: in 2019, water productivity slightly increased from its level in 1990, as one liter of water contributed to roughly QR 0.005 of GDP in agriculture. (See Figure 4.9)

Figure 4-8: Growth rate of water used in agriculture and GDP (at constant prices of 2018) 1990-2019 (index base year 1990)



Sources: PSA, Ashghal and Kahramaa; computations by PSA

Figure 4-9: Water use efficiency (liter/QR of GDP) and water use productivity (GDP per each liter of water used) in agriculture 1990–2019 (at constant prices of 2019)



Sources: PSA, Ashghal and Kahramaa; Computations by PSA

4.3.5 Water Use in the Industrial and Construction Sector

For the sake of simplification (and in line with the actual data available), the following economic activities are aggregated under the “industrial sector” category:

- Mining and quarrying (including oil & gas)
- Manufacturing
- Electricity and water
- Building and construction

Industries in Qatar rely on three main sources of freshwater. They include water supplied by Kahramaa, water from groundwater wells for industrial purposes and seawater desalinated in industrial establishments. For this latter type (desalination), data is unavailable. Therefore, analysis can only be done for that part of water which originates from groundwater (self-abstraction by industries) and water supplied by Kahramaa.

Statistics of Table 4.3 below indicate an increase in the annual water used in the industrial sector during the period 2013 - 2019 from 10.14 million m^3 to about 34.18 million m^3. In addition, the GDP (at constant prices of 2016) of the industrial sector rose from QR 366,267 million in 2013 to QR 397,269 million in 2019.

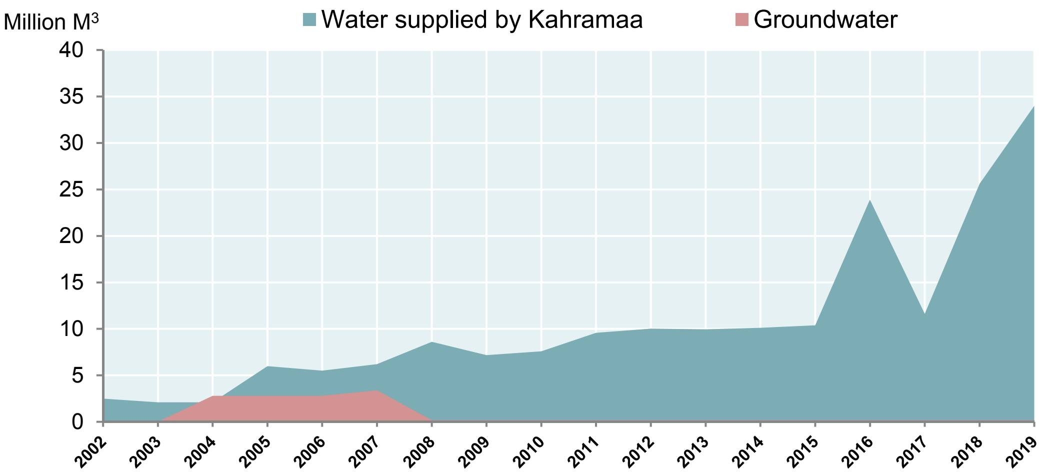
Table 4-3: Water used in industrial sector by source of water and GDP of industry (constant prices of 2018) 2013–2019

Year	Water supplied by Kahramaa (million m3)	Industrial groundwater wells (million m3)	Total water use (million m3)*	GDP (million QR at constant prices of 2018)**
2013	9.96	0.18	10.14	366.267
2014	10.12	0.18	10.3	376.759
2015	10.39	0.18	10.57	388.660
2016	23.9	0.18	24.08	404.877
2017	11.62	0.18	11.8	399.921
2018	25.6	0.18	25.78	402.950
2019	34	0.18	34.18	397.269

*Excluding desalinated industrial water
**Mining and quarrying (including oil and gas), manufacturing, electricity and water and building and construction.
Sources: PSA, MME and Kahramaa

Figure 4-10 below shows that the total water used in industrial sector increased from about 2.5 million m^3 in 2002 to 34.18 million m^3 in 2019; while the highest growth rates were registered during the period 2015 – 2019.

Figure 4-10: Water used in industry by source of water (million m^3) 2002–2019

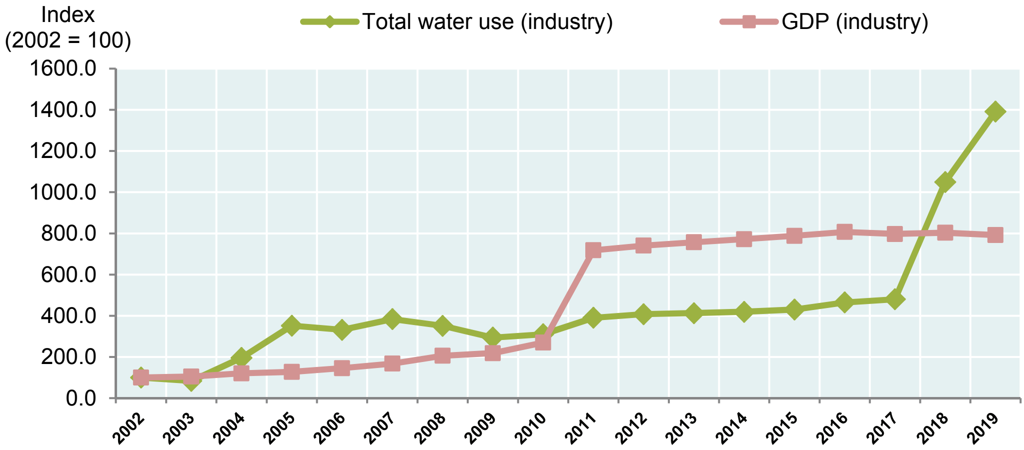


Source: MME and Kahramaa

Figure 4-11 below shows that GDP growth rate in the industrial sector is related to the amount of water used, even with improved water use efficiency and productivity. In 2010, about 0.041 liter of water was needed to produce QR 1 of industrial GDP, whereas 0.09 liter of water was needed to produce QR 1 of the same GDP in 2019. In other words, this means that the productivity of one liter of water was worth QR 24.4 of industrial GDP, whereas in 2019, the water productivity value decreased to QR 11.62 of industrial GDP per liter (See

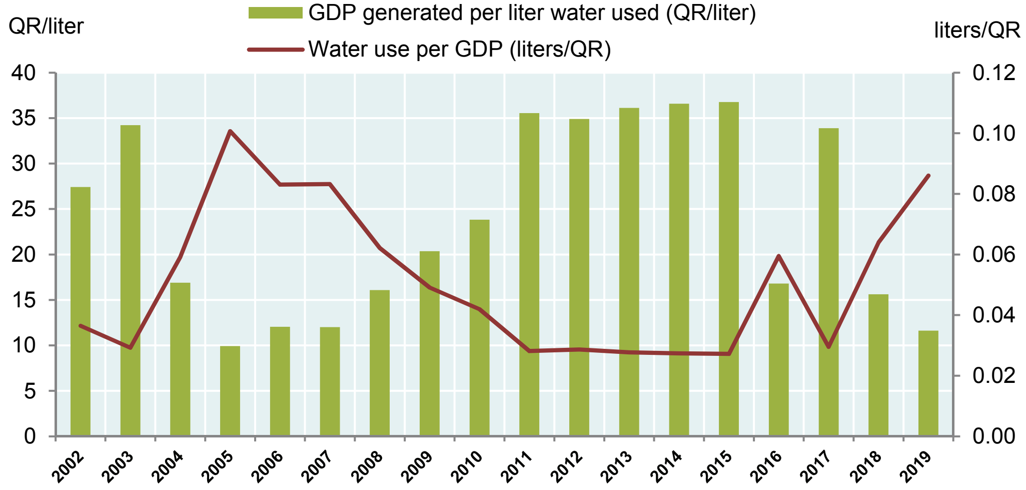
Figure **4-12**).

Figure 4-11: Growth rate of water use in industry and GDP (at constant prices of 2018) 2002-2019 (index base year 2002)



Source: PSA, MME and Kahramaa. Computed by PSA.

Figure 4-12: Water use efficiency (liter/ QR GDP) and water use productivity (GDP per liter of water used) in the industrial sector 2002–2019 (at constant prices of 2018)



Source: PSA, MME, Kahramaa and Computations by PSA.

4.3.6 Water Use in the Commercial Sector

For the sake of simplification (and in line with the actual data available), the following economic activities are aggregated under the "commercial sector" category:

- Trade, restaurants & hotels
- Transport, storage, information and communications
- Finance, insurance, real estate & business services
- Household services

Kahramaa water supply is the only known water source for the commercial sector.

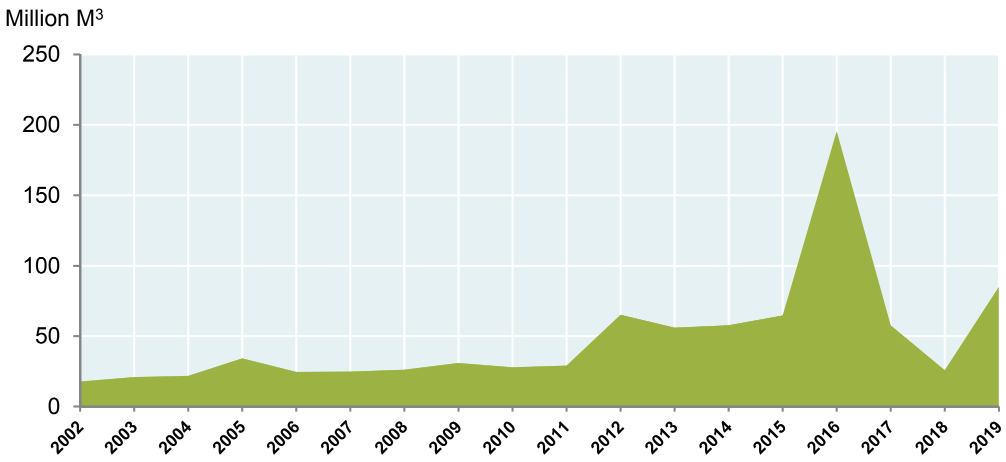
Table 4-4: Water used in commercial sector and commercial GDP (at constant prices of 2018) 2013–2019

Year	Total water use (i.e. water supplied by Kahramaa) million m3	GDP (million QR at constant prices of 2018)
2013	72.7	148,229
2014	74.97	165,545
2015	64.66	177,327
2016	195.53	179,624
2017	57.68	182,748
2018	25.8	186,751
2019	85	192,005

Sources: PSA and Kahramaa

Figure 4-13 below shows that the total water used in the commercial sector increased between 2002 and 2019 from 18 million m^3 per year to 85 million m^3.

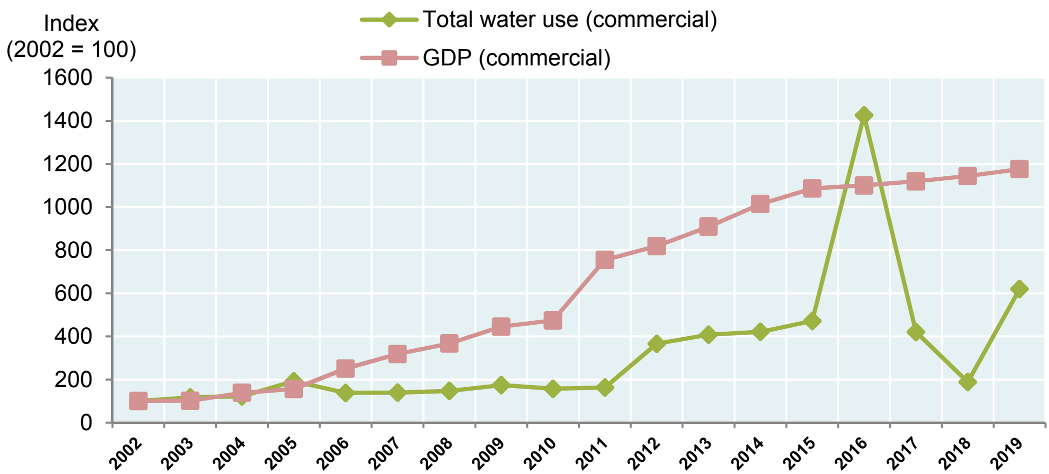
Figure 4-13: Water used in the commercial sector (million m3) 2002–2019



Source: Kahramaa

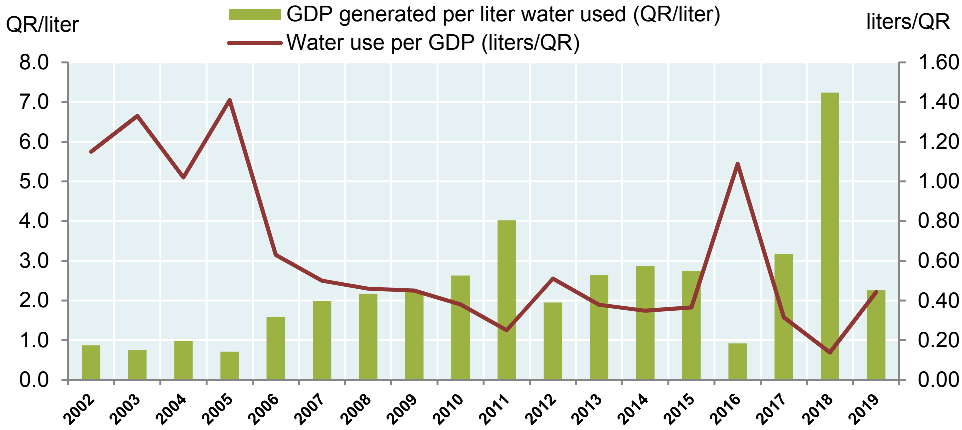
Figure 4-14 below shows that the GDP growth rate in the commercial sector is not related to the water use quantity since 2006. Figure 4-15 below shows that about 1.15 liters of water were needed to produce QR 1 of commercial GDP in 2002, whereas only 0.44 liter of water was needed to achieve the same GDP in 2019. In other words, one liter of water used for commercial activities produced QR 0.87 of GDP in 2002, while one liter of water produced QR 2.26 of GDP in 2019 (at constant prices of 2018).

Figure 4-14: Growth rate of water used in commercial sector and GDP in commercial activities (at constant prices of 2018) (index base year 2002) 2002-2019



Source: PSA, Kahramaa and Computed by PSA.

Figure 4-15: Water use efficiency (liter/ QR GDP) and water use productivity (GDP per liter of water used) in commercial sector (at constant prices of 2018) 2002–2019



Source: PSA and Kahramaa.

4.3.7 Water Use in Government Sector

Water supplied by Kahramaa and TSE used for the irrigation of green spaces is the main water source for the government sector. Statistics of table 4-5 and Figure 4-16 below show that the water use in the government sector increased from 18 million m^3 in 2006 to 156.65 million m^3 in 2019. The percentage of 49% of the water used by government originated from re-used TSE in 2019 (used for the irrigation of green spaces).

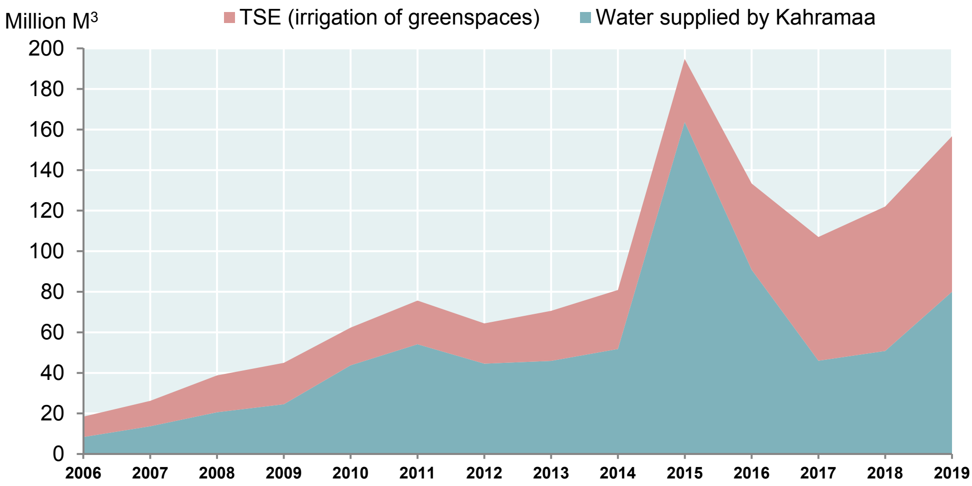
As the government sector is mainly a consumer of goods and services, a comparison-based analysis of GDP with water use in the government sector (as was done for agriculture, industry and services sectors) would not be useful, even if there are certain government services which are included in the GDP computation.

Table 4-5: Water used in government sector by source of water 2013–2019

Year	Water supplied by Kahramaa (million m3)	TSE for irrigation of green spaces (million m3)	Total water use (million m3)
2013	**45.9**	**24.67**	**70.57**
2014	**51.76**	**29.09**	**80.85**
2015	**163.67**	**31.09**	**194.76**
2016	**90.86**	**42.48**	**133.34**
2017	**46**	**61.03**	**107.03**
2018	**50.80**	**71.21**	**122.01**
2019	**80**	**76.65**	**156.65**

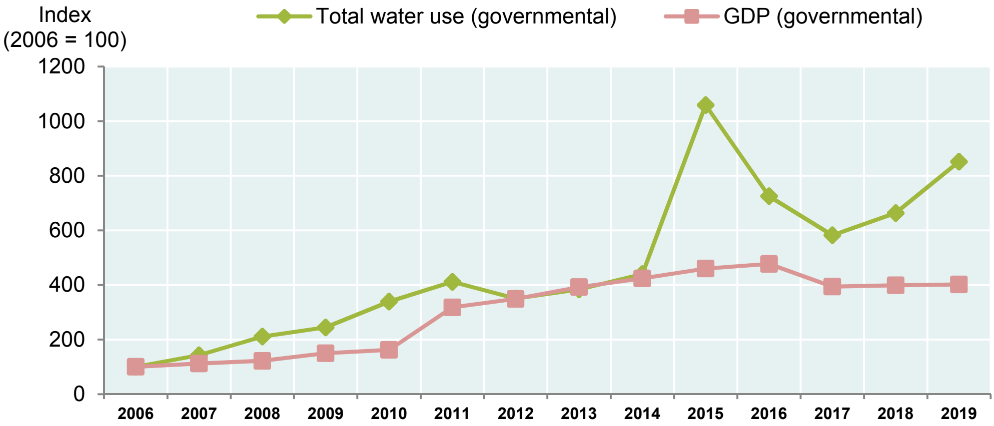
Source: Ashghal and Kahramaa

Figure 4-16: Water use in government sector by source of water (million m3) 2006-2019



Source: Ashghal and Kahramaa.

Figure 4-18: Water growth rate used in the government sector and GDP (at constant prices of 2004 and 2018) 2006-2019 (base year 2006)



4.3.8 Water Use in Domestic Sector

The water used by households depends mainly on Kahramaa water supply. However, there are also domestic wells and municipal wells, which mainly provide water for domestic use.

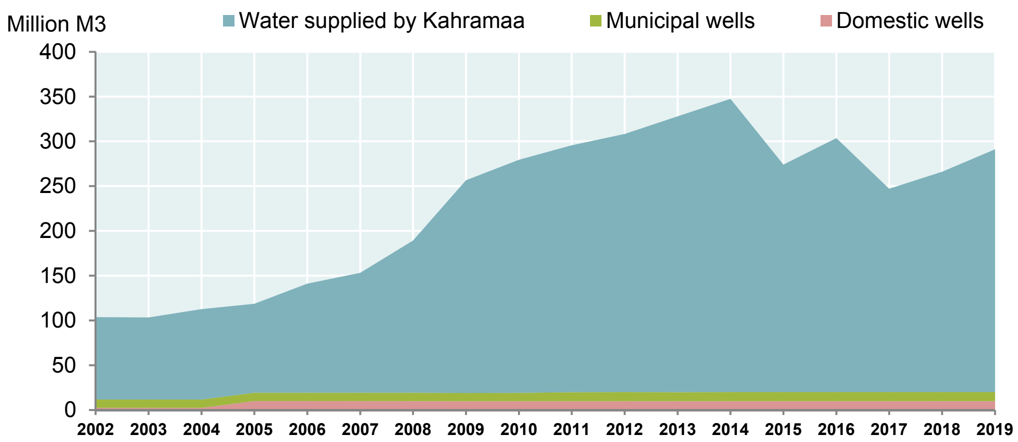
Data of water supplied by Kahramaa in Table 4-6 and Figure 4-18 show that water used by household increased threefold during the period 2002 - 2019. In 2002, household used about 92 million m^3, whereas it used about 291. 1 million m^3 of water in 2019.

Table 4-6: Water used in domestic sector by source of water 2013 – 2019

	Water supplied by Kahramaa (million m^3)	Domestic wells (million m^3)	Municipal wells (million m^3)	Total water use (million m^3)
2013	**308.02**	**9.7**	**10.2**	**327.92**
2014	**327.49**	**9.7**	**10.4**	**347.59**
2015	**253.97**	**9.7**	**10.4**	**274.07**
2016	**283.4293616**	**9.7**	**10.4**	**303.53**
2017	**227.058215**	**9.7**	**10.4**	**247.16**
2018	**2453.9**	**9.7**	**10.4**	**266.00**
2019	**271**	**9.7**	**10.4**	**291.10**

Data source: Ministry of Municipality and Environment, Kahramaa

Figure 4-18: Water used in domestic sector by source of water (million m3) 2002 – 2019



Data sources: Ministry of Municipality and Environment, Kahramaa

4.3.9 Water Use Balance

In 2019, the water quantity available for use amounted to 1198.39 million m3, including desalinated water (prior to the computation of loss), abstracted groundwater, and treated and untreated urban wastewater.

The water quantity used by the final users (including agriculture, industry, commercial, government and domestic sectors) is the water available for use minus water loss and minus wastewater discharged without re-use. Injection of TSE into aquifers is a mean to substitute over-exploitation but not a final use, and thus it is shown separately in the aggregated water balance (Table 4-8).

Table 4-7: Aggregated Water Use Balance (million m3), 2019

Description	Million m^3/year
Water potentially available for use (a)	**1198.39**
Water loss (b)	**134.21**
Discharge of wastewater without reuse (c)	**114.42**
Quantity of water injected into aquifers	**63.86**
Water used by final consumers (=a – b – c)	**949.77**

The following Table 4-8 displays the details of the water use balance.

Table 4-8: Details of water use balance (water balance million m3) 2019

Description	Water potentially available for use	Water use and loss	Remarks
Desalinated water	671		Water supplied by Kahramaa
Fresh groundwater abstraction	250.28		Including agricultural, municipal, domestic and industrial wells. Data of 2014
TSE	276.11		Wastewater discharged by urban wastewater treatment plants
Wastewater discharged without treatment	1		Discharge of untreated wastewater into lagoons
Total water potentially available for use	1198.39		Water available before loss
Untreated wastewater		1	
Apparent amount of distilled water loss		108.27	Total losses
Apparent amount of distilled water loss		25.94	
TSE discharged into lagoons		33.00	
TSE discharged into sea		0.71	

Description	Water potentially available for use	Water use and loss	Remarks
TSE injected into deep aquifers		79.71	
Water used in agriculture		316.056	Groundwater and TSE
Water used in industries and commercial activities		119.18	Water supplied by Kahramaa, water supplied by industrial wells, and water supplied by Kahramaa, including big industrial complexes and hotels.
Water used in domestic sector		291.1	Water supplied by Kahramaa, domestic wells, and municipal wells.
Water used in government sector		156.65	Water supplied by Kahramaa and TSE for irrigation of green spaces
Uses or losses of desalinated water not indicated		66.78	Such differences between water input to the system and uses or losses from the source are not indicated
Total water use and loss		1,198.39	

5. Urban Wastewater Production, Collection, Treatment and Discharge

5.1 Rationale

In the State of Qatar, the collection and treatment of urban wastewater is an important measure to re-use this water for irrigation, cooling and groundwater recharge and to protect the environment from adverse impacts of water-borne pollution. Furthermore, this infrastructure is essential to provide appropriate sanitation services for all individuals across the State (also one of the SDGs).

Since rainfall in Qatar is one of the world's lowest and since Qatar is more orientated towards integrated water resource management, treated wastewater (treated sewage effluent – TSE) is an important alternative to desalination of seawater and abstraction of Qatar's limited fresh groundwater resources. The use of TSE is an important measure to achieve more sustainable water use (see also Qatar National Development Strategy).

5.2 Key Messages

a) The capacity of urban wastewater treatment plants increased from 54,000 m^3/day in 2004 to 965,860 m^3/day in 2019.

b) All wastewater treatment plants in Qatar are equipped with at least a secondary treatment level of a wastewater treatment levels. The largest operational plant is Doha West (280 m^3/day), which provides tertiary treatment for nitrogen and phosphorus removal.

c) Urban wastewater treatment plants remove more than 99% of organic pollution.

d) In 2019, 99% of urban wastewater generated was treated at UWWTPs.

e) In 2019, 31% of TSE was used for agriculture irrigation and 28% for green space irrigation.

5.3 Statistics and Indicators

5.3.1 Urban Wastewater Collection and Treatment Infrastructure

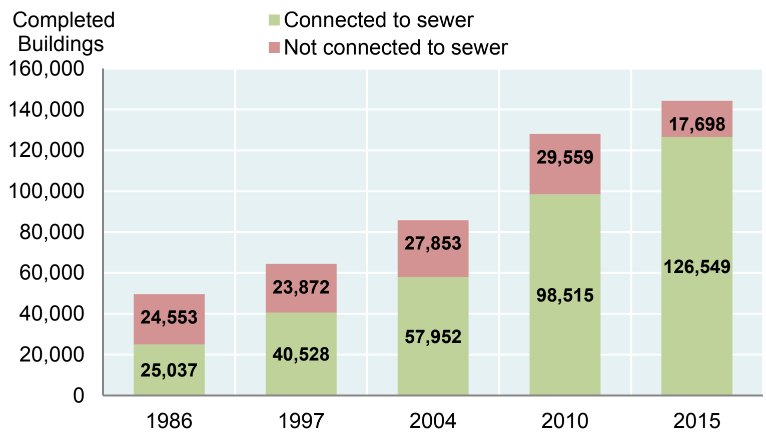
According to statistics from censuses (1986–2015), the number of completed buildings connected to public sewage increased from 25,037 (50.5% of total completed buildings) in 1986 to 126,549 (87.7% of total completed buildings) in 2015 (see Figure 5-1).

As for buildings not connected to public sewage, they are served by tankers transporting wastewater to treatment plants and sewage lagoons.

Figure 5-2 shows that the highest percentage of buildings connected to public sewage according to Census 2015 was in Doha Municipality (99.9%), whereas the lowest percentage of buildings connected to public sewage was in Al Shamal Municipality (4.13%).

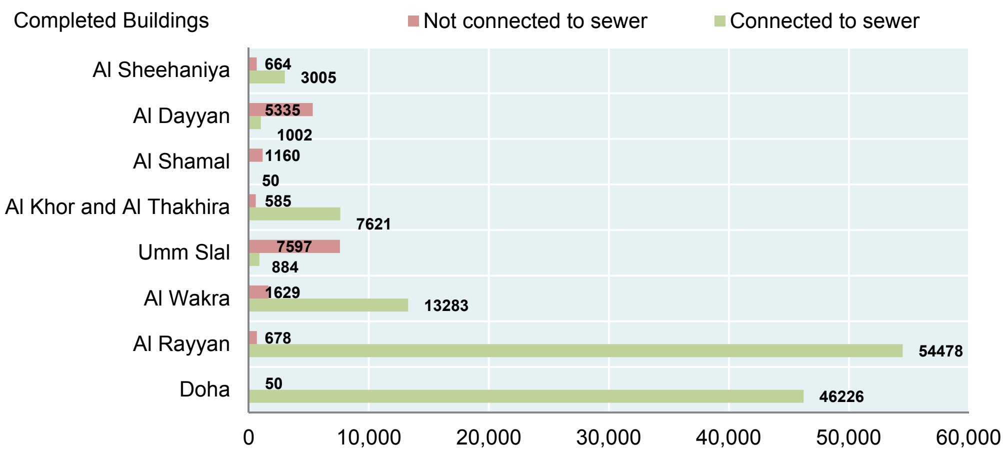
Since 2004, safe sanitation services are provided to all individuals in Qatar (refer to Qatar Sustainable Development Indicators Report, MDPS and Diplomatic Institute, 2015).

Figure 5-1 Number of completed buildings connected to public sewage; Census 2015



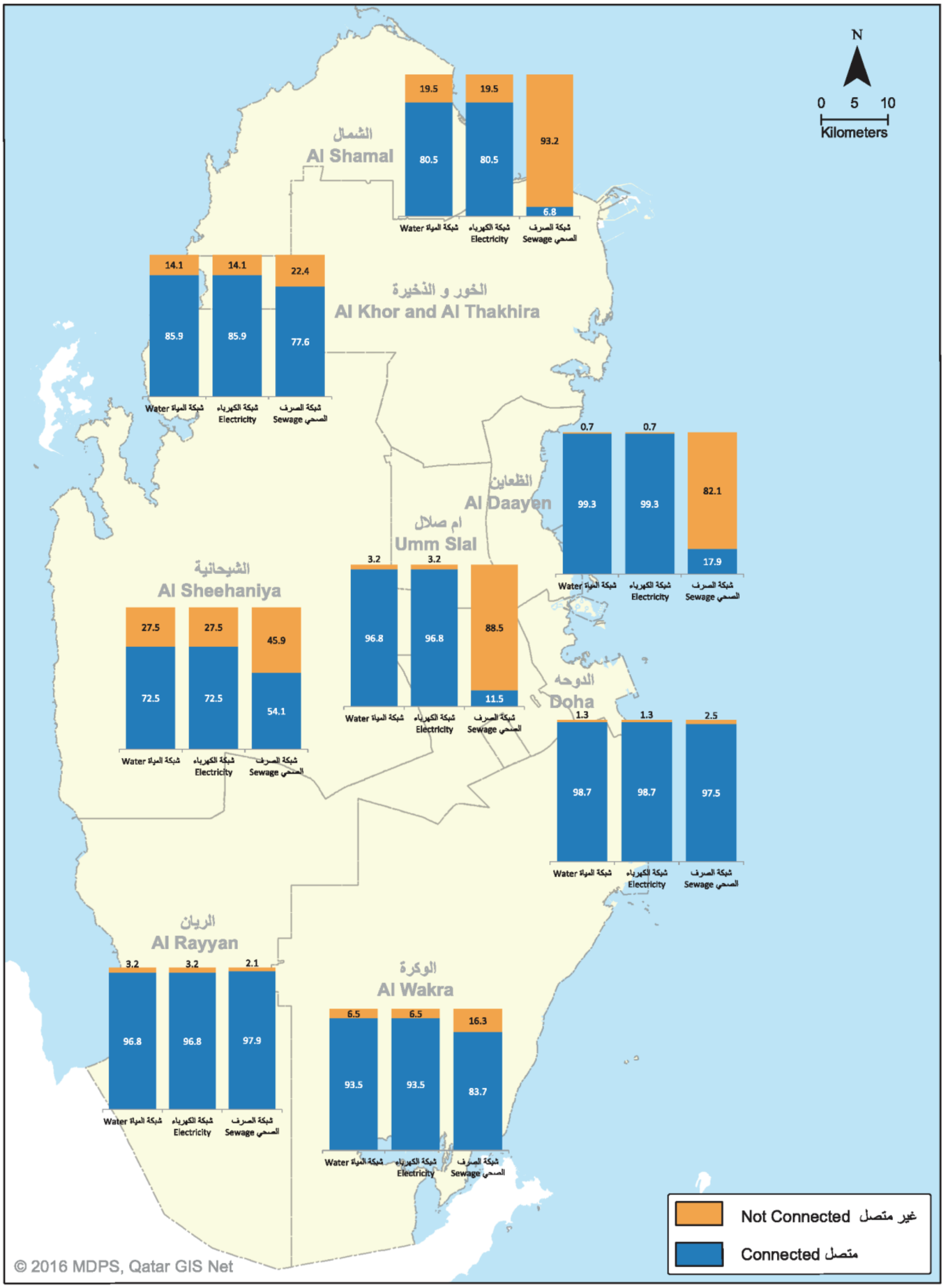
Data source: PSA

Figure 5-2: Number of completed buildings by connection to public sewage and municipality, Census 2015



Data source: PSA

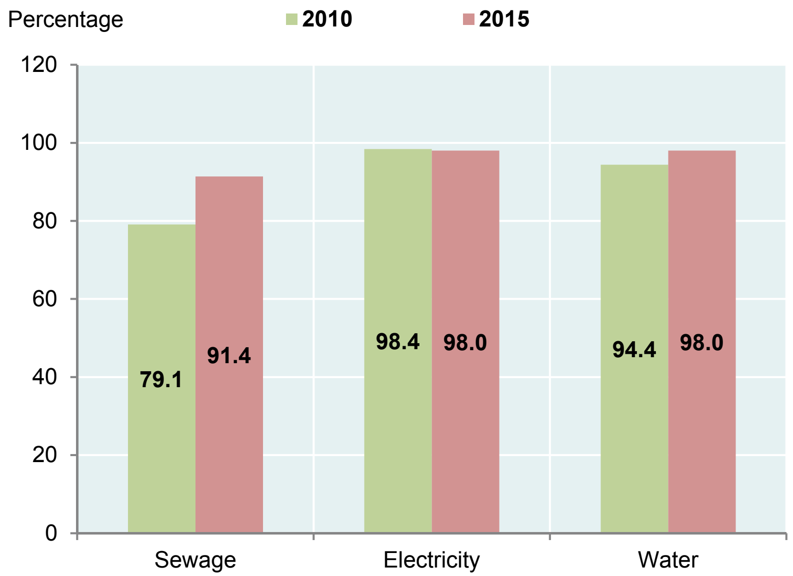
Map 5-1: Percentage of completed buildings by connection to public utilities; Census 2015



Data source: PSA

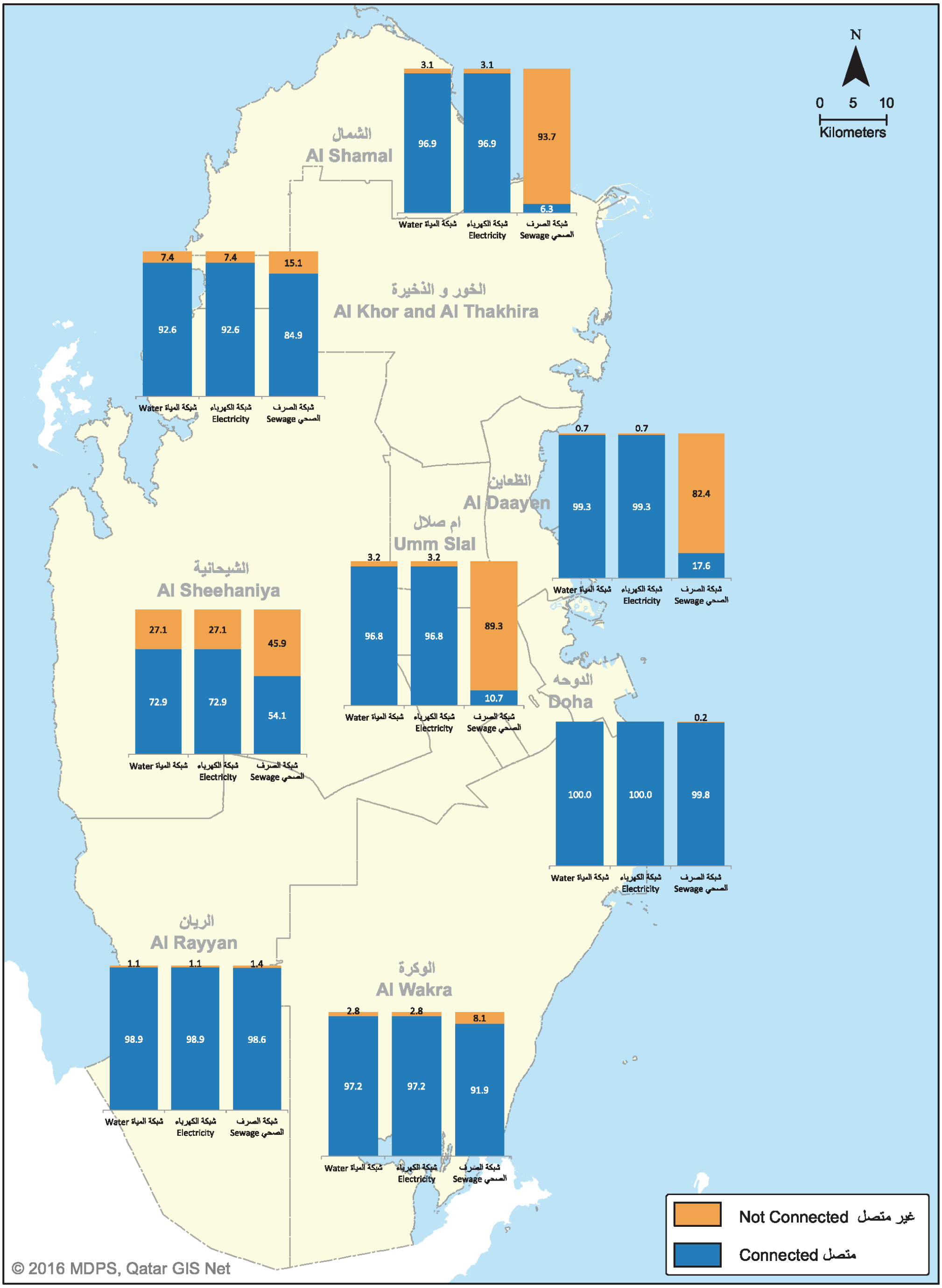
With regards to the housing units connected to public sewage, the census statistics for 2010 and 2015 indicate a significant improvement from 79.1% to 91.4%. Also, the indicators of housing units connected to electricity and water network were high during Censuses 2010 and 2015.

Figure 5-3: Percentage of housing units connected to public utilities by type of utility, Censuses 2010 and 2015



Data source: PSA

Map 5-2: Percentage of housing units by connection to public utilities, Census 2015



Data source: PSA

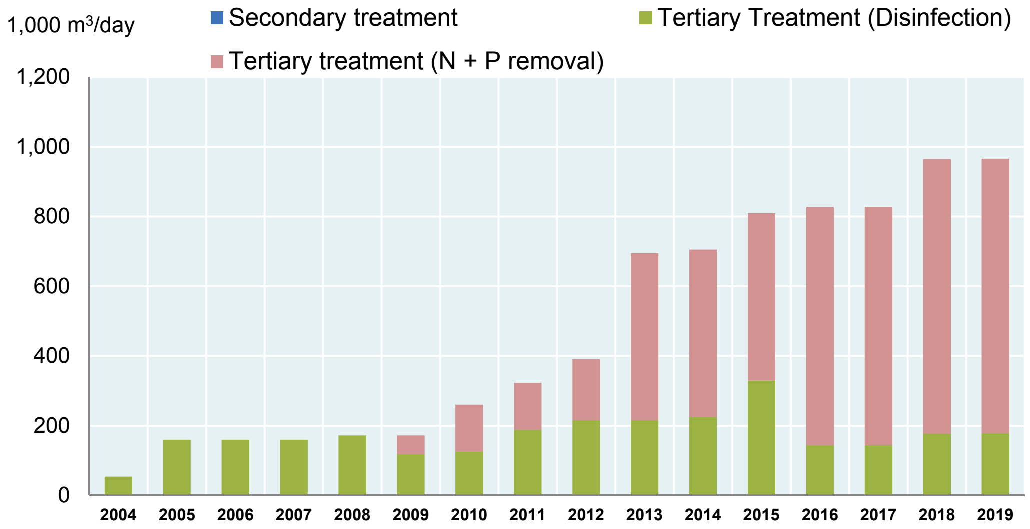
Table 5-1: Wastewater at Sewage Plants 2013-2019

Description	2013	2014	2015	2016	2017	2018	2019
Number of sewage plants	22	23	23	23	24	24	26
Total design capacity of wastewater treatment plants (m3/day)	695	705	809	827	828	965	966
Amount of collected wastewater (1000 m3 /year)	158,792	173,933	197,492	209,518	231,473	257,829	278,216
Amount of treated wastewater (1000 m3 /year)	151,883	168,949	193,854	204,392	228,668	256,467	276,114
Percentage of treated wastewater to total wastewater	95.6%	97.1%	98.2%	97.6%	98.8%	99.5%	99.2%
Treated wastewater used for agriculture irrigation (1000 m3 /year)	55,233	64,920	66,289	61,699	69,508	79,669	86,056
Amount of treated wastewater used for green space irrigation (1000 m3 /year)	24,670	29,096	31,088	42,480	61,029	71,208	76,648
Amount of treated water used for injecting groundwater (1000 m3 / year)	35,599	43,465	57,291	60,364	63,859	66,892	79,706
Amount of treated water discharged into lakes (1000 m3 / year)	35,391	31,109	38,845	39,168	33,817	38,161	33,001
Amount of treated water discharged into the sea (1000 m3 / year)	234	358	350	681	455	546	713
Dry sludge from wastewater (ton/ year)	27,170	32,066	39,717	41,551	41,554	37,688	39,096
Sludge from wastewater (1000 m3 / year)	289	543	218	197	224	202	191
Amount of wastewater not collected at sewage plant and is discharged into lakes without treatment (million cubic meters/ year)	18.0	11.3	1.7	1.9	2.4	1.62	0.995
Total surface groundwater discharged into the sea (million cubic meters per year)	64.4	63.0	75.7	89.7	95.4	100.9	90.9

...: not available
Data source: Ashghal

The number of wastewater treatment plants reached 26 by 2019. The statistics in Table 5-2 and Figure 5-4 indicate an increase in the design capacity of urban wastewater treatment from 54,000 m^3/day in 2004 to 996,000 m^3/day (an annual growth rate of 23%) in 2019. All urban wastewater treatment plants have been equipped with at least secondary treatment methods, ensuring, to a large extent, the elimination of organic pollution. The Al Shamal Station was modernized in 2018 to be capable of tertiary treatment (disinfection), as the design capacity for treating urban wastewater was raised to 600 cubic meters per day in 2018. As well, Doha West Station, the design capacity for treating urban wastewater was raised to 280,000 cubic meters per day in 2018. The Al Jeryan and Al Shamal Mobile Station in 2019 also started work on the tertiary treatment (disinfection), and the Umm Salal Station has stopped functioning since 2018. In 2018, the Doha West Station held the lion's share in terms of the station's design capacity, providing 29% (it started in 2004), followed by the Doha North Station with 25% and the Doha South Station with 21% of the total design capacity of the stations.

Figure 5-4: Hydraulic design capacity of wastewater treatment plants by type of treatment 2004-2019



Data source: Ashghal

Table 5-2: Hydraulic design capacity of operating wastewater treatment plants by type of treatment, (1,000 m3/day) 2013-2019

Year	Secondary treatment	Tertiary treatment (disinfection)	Tertiary treatment (N+P removal)	Total
2013	**2.1**	**213.4**	**479.5**	**695.0**
2014	**2.1**	**223.4**	**479.5**	**705.0**
2015	**2.1**	**327.8**	**479.5**	**809.0**
2016	**2.1**	**141.8**	**683.5**	**827.4**
2017	**2.1**	**142.3**	**683.5**	**827.9**
2018	**1.95**	**175**	**788**	**964.6**
2019	**1.95**	**176**	**788**	**965.9**

Data source: Ashghal

Table 5-3 statistics refer to all urban wastewater treatment plants in Qatar by the type of treatment, the design capacity of the plant, and the amount of wastewater received.

Table 5-3: Urban wastewater treatment plants by type of treatment, design capacity and amount of wastewater received 2019

UWWTP	Type of Treatment	Hydraulic Design Capacity		Amount of Wastewater Received (1,000 m^3/year)
		(1,000 m^3/day)	(1,000 m^3/year)	
Al-Jamiliyah PTP	Secondary (sterilization)	0.54	197.1	130
Al-Khuraib PTP		0.06	21.9	31
Slaughterhouse PTP		0.18	295.65	101
Ras Abu Fontas PTP		0.54	197.1	111
Al-Dhakhira PTP	Tertiary (disinfection)	3.2	1168	1538
Al-Khor PTP		9.72	3547.8	6083
Al Shamal PTP (3)		0.6	219	197
Barwa Al Baraha PTP		12	4380	3656
Barwa City STW		15	5475	1871
Barwa Msaimeer PTP		1.5	547.5	298
Barwa Sailiyah PTP		1.5	547.5	299
Barwa Village PTP		1	365	210
Doha West STW Old plant		54	19710	13114
Duhail PTP		0.81	295.65	62
Industrial Area STW		60	21900	19853
Al Ghazal		0.44	160.6	155
Al Shihaniyah		1345	490.925	621
Al Karanah		10	3650	3409
Jeryan (2)		0.25	91.25	40
North Camp Mobile Station (2)		1	365	163
Barazan (1)		3.3	1204.5	259
North Camp		0.245	89425	184
Doha North STW	Tertiary (N and P removal)	244	89060	41382
Doha West STW (1)		280	102200	88925
Doha South STW		204	74460	82566
Lusail STW		60	21900	13058
Total (4)		965	352243.3	278215

(1) The design capacity of the station was raised in 2018

(2) Al Jeryan Station and North Camp Mobile Station started operating in 2019

(3) The plant was upgraded with tertiary treatment type (disinfection) in 2018

(4) Total: Excluding Slaughterhouse

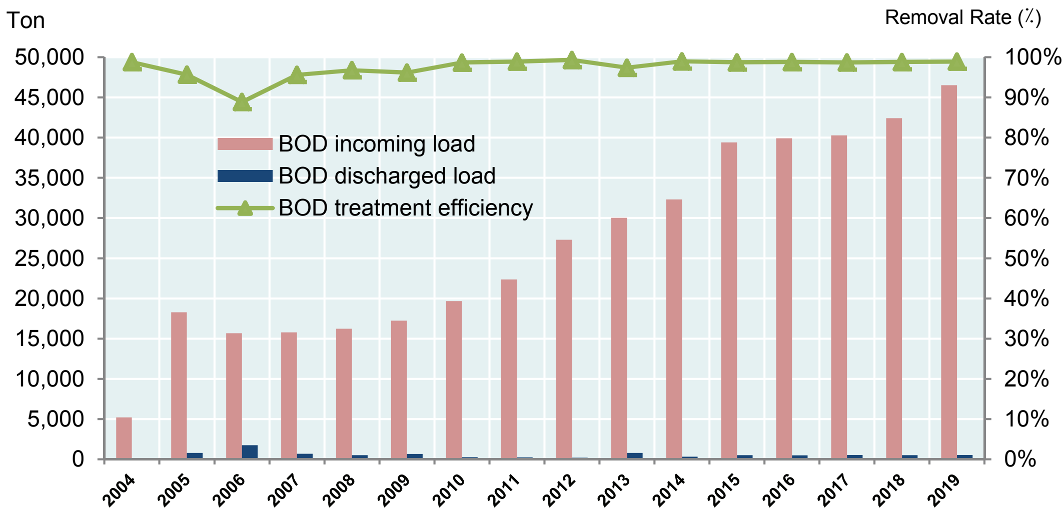
Note: Umm Salal station has stopped working since 2018.

Data source: Ashghal

5.3.2 Treatment Efficiency of Urban Wastewater Treatment Plants

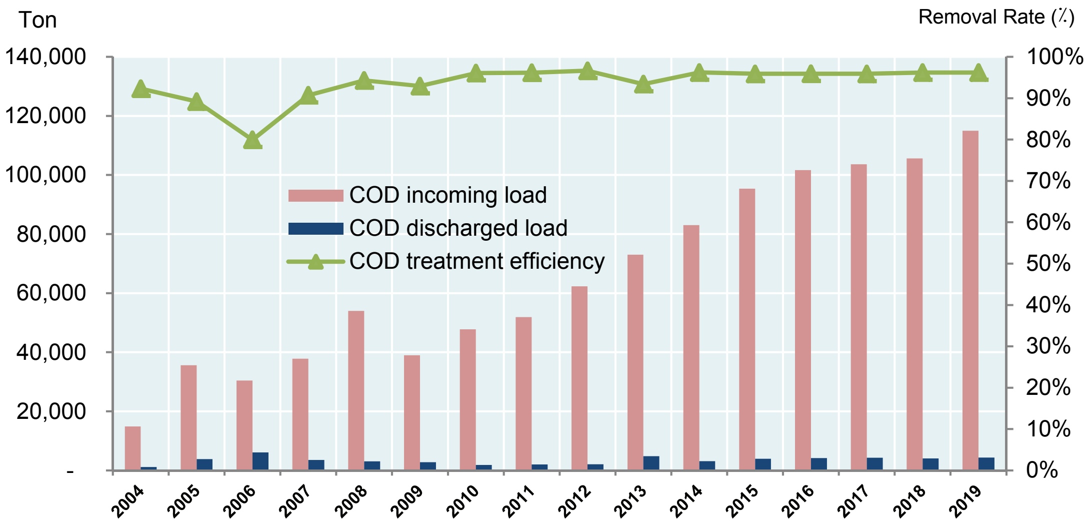
Figure 5-5 and Figure 5-6 show that Organic pollution in terms of BOD5 has been removed by more than 99% in most of the years during the period 2004-2019. In terms of COD, the removal rates reached more than 96% in most of the years during the period 2004-2019.

Figure 5-5: Treatment of BOD5, 2004-2019



Data source: Ashghal; calculated by PSA

Figure 5-6: Treatment of COD, 2004-2019

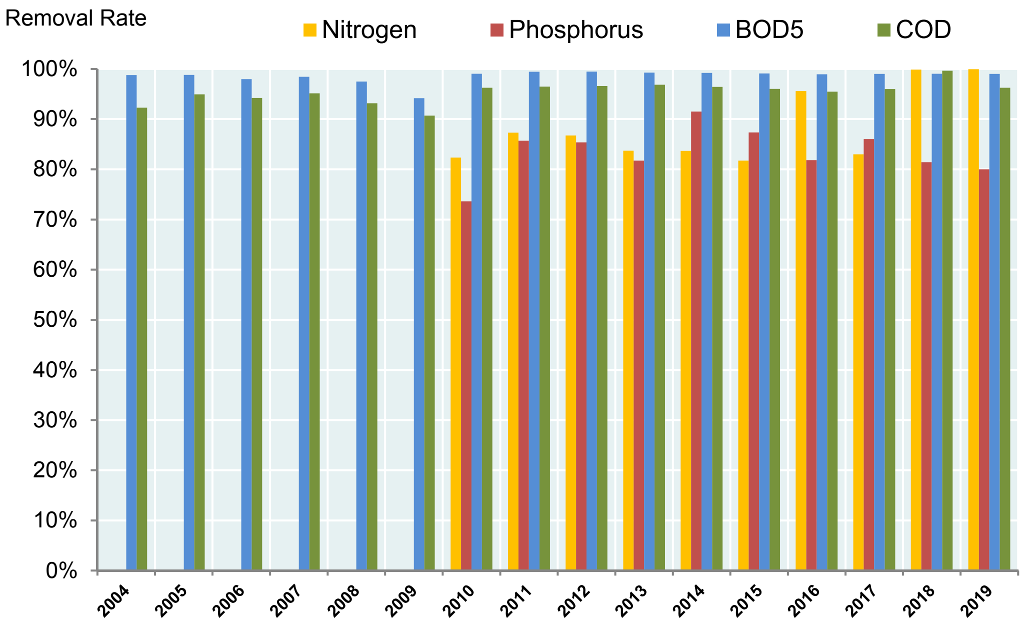


Data source: Ashghal; calculated by PSA

Doha West Plant, Qatar's largest UWWTP with its treatment capacity, has been upgraded with nitrogen and phosphorus removal capacity since 2009. The design capacity has been raised to treat the wastewater generated by urban areas. The urban area has reached a design capacity of 280,000 m^3/day since 2018, and it has been equipped with nitrogen and phosphorus removal capacity since its commissioning in 2004. (See Figure 5-7).

It is followed by Doha North Station, Qatar's second largest UWWTP in terms of design capacity to treat wastewater generated from urban areas, as the design capacity reached 244,000 m3/day in 2019, and it is equipped with nitrogen and phosphorus removal capacity since its commissioning in 2014.

Figure 5-7: Rates of BOD5, COD, total nitrogen and phosphorus removal at UWWTP Doha West 2004–2019



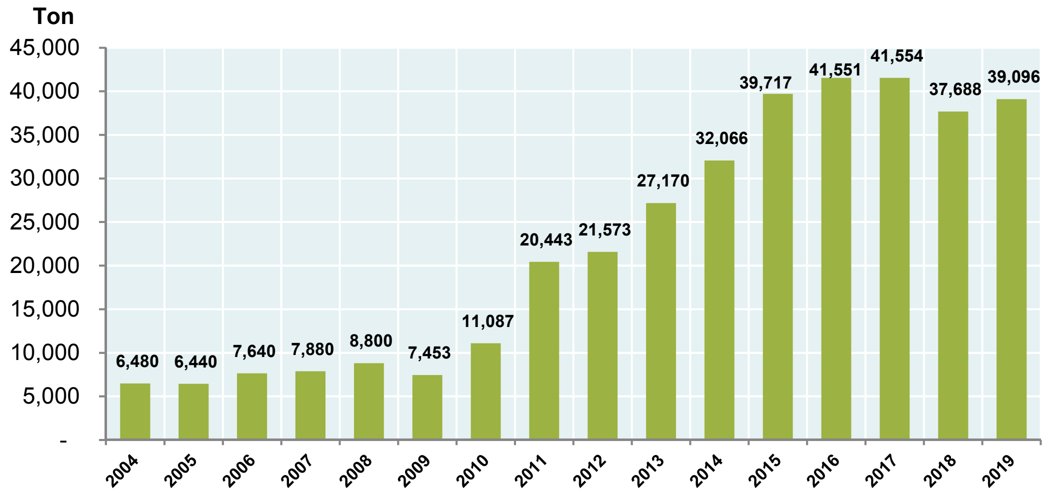
Data source: Ashghal; calculated by PSA

5.3.3 Sewage Sludge Generation

With the increase of treatment design capacity of the UWWTPs, the generation of sewage sludge has also increased.

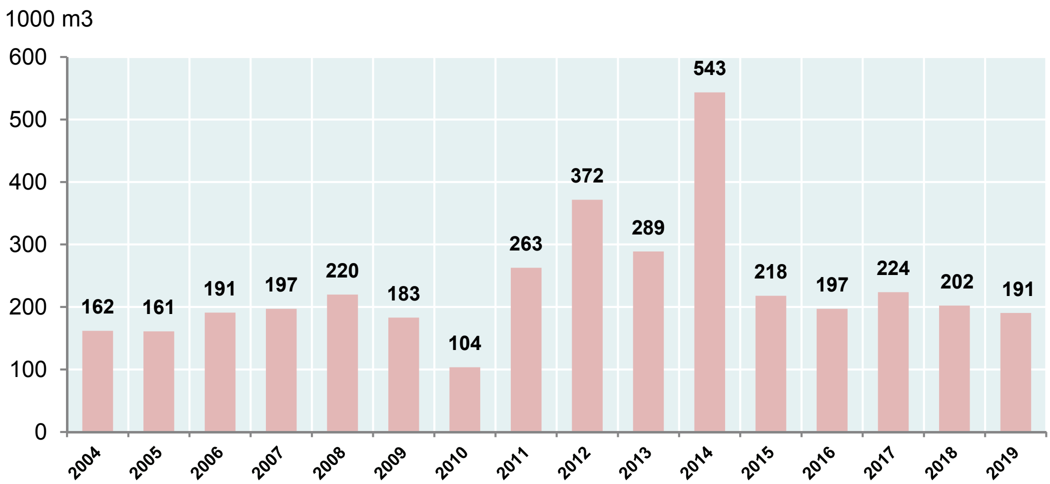
In 2004, 106,000 m^3 of sewage sludge were generated, amounting to 6,480 tons of dry solids (water content was about 96%). In 2019, the UWWTPs in Qatar already generated 191,580 m^3 of sewage sludge. Due to the reduced water content (about 79%), the sewage sludge contained 39,096 tons of dry solids. (See Figure 5-8 and Figure 5-9).

Figure 5-8: Generation of sewage sludge at urban wastewater treatment plants by mass (tons of dry solids) 2004-2019



Data source: Ashghal

Figure 5-9: Generation of sewage sludge at urban wastewater treatment plants by volume (1,000 m3) 2004-2019



Data source: Ashghal

5.3.4 Urban Generated, Collected and Treated Wastewater

In Qatar, the urban wastewater is collected by sewage network and by tankers. All of the wastewater connected to sewage network is treated at UWWTPs. Also, the wastewater generated from households which collected by tankers is treated at UWWTPs, whereas most of the wastewater collected by tankers is discharged into lagoons (lakes) without treatment, which were mainly collected from non-household sources.

Statistics of

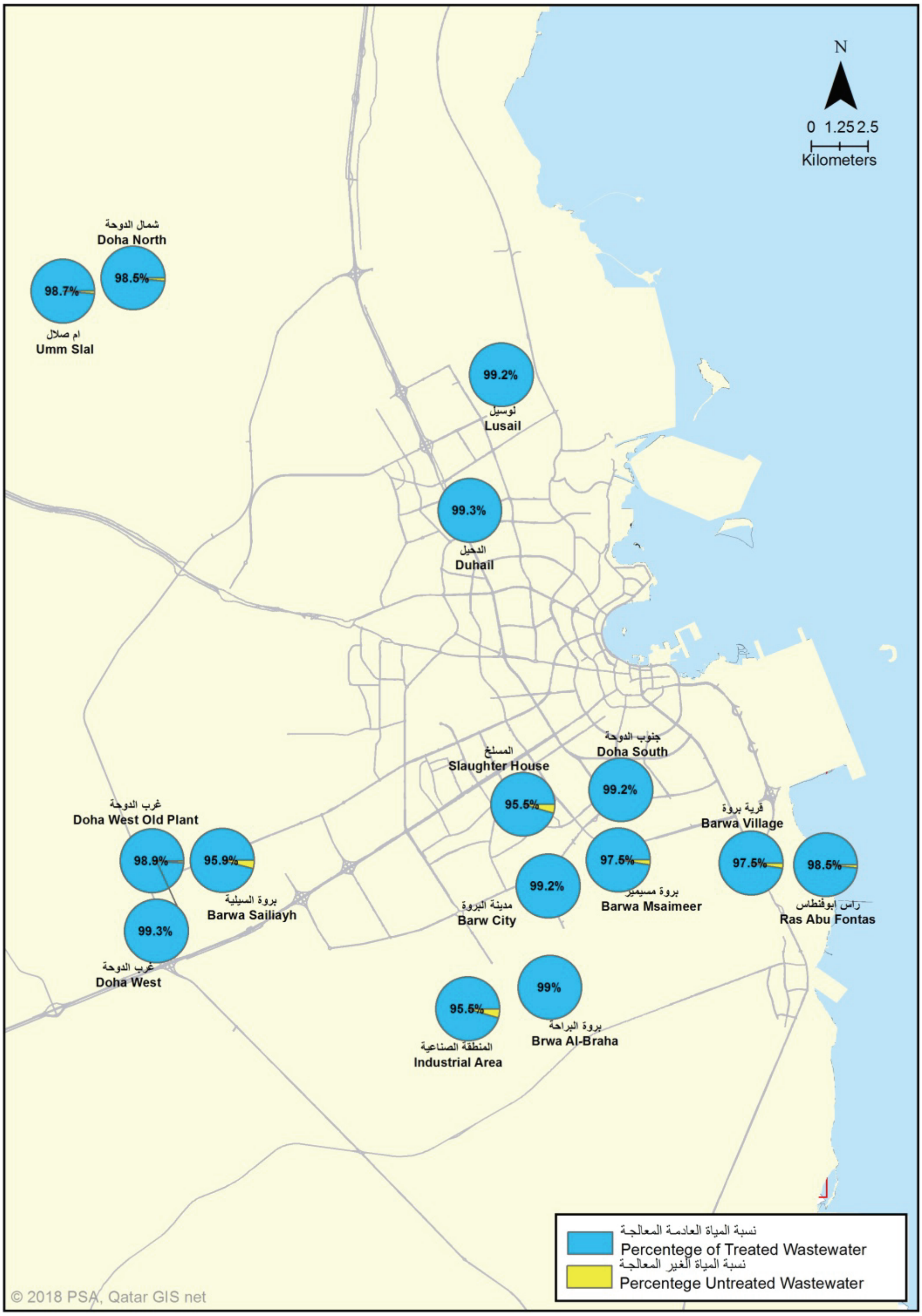
Table 5-4 show that the total of collected wastewater increased from 176.83 million m^3 in 2013 to 279.21 million m^3 in 2019, where about 1% of total wastewater generated (99 million m^3) was discharged into lagoons without any treatment in 2019.

Table 5-4: Urban wastewater generated by method of handling and discharge without treatment (million m3) 2013-2019

Urban Wastewater (million m^3/year)	2013	2014	2015	2016	2017	2018	2019
Total urban wastewater generated m^3	176.83	185.24	199.19	211.46	233.91	259.45	279.21
of which treated m^3	158.79	173.93	197.49	209.52	231.47	257.83	278.22
of which secondary treatment m^3	0.27	0.30	0.31	0.27	0.35	0.31	0.27
of which tertiary treatment m^3	157.89	168.65	193.54	209.24	231.12	257.52	277.94
of which discharged without treatment m^3	18.04	11.3	1.7	1.94	2.44	1.62	0.99

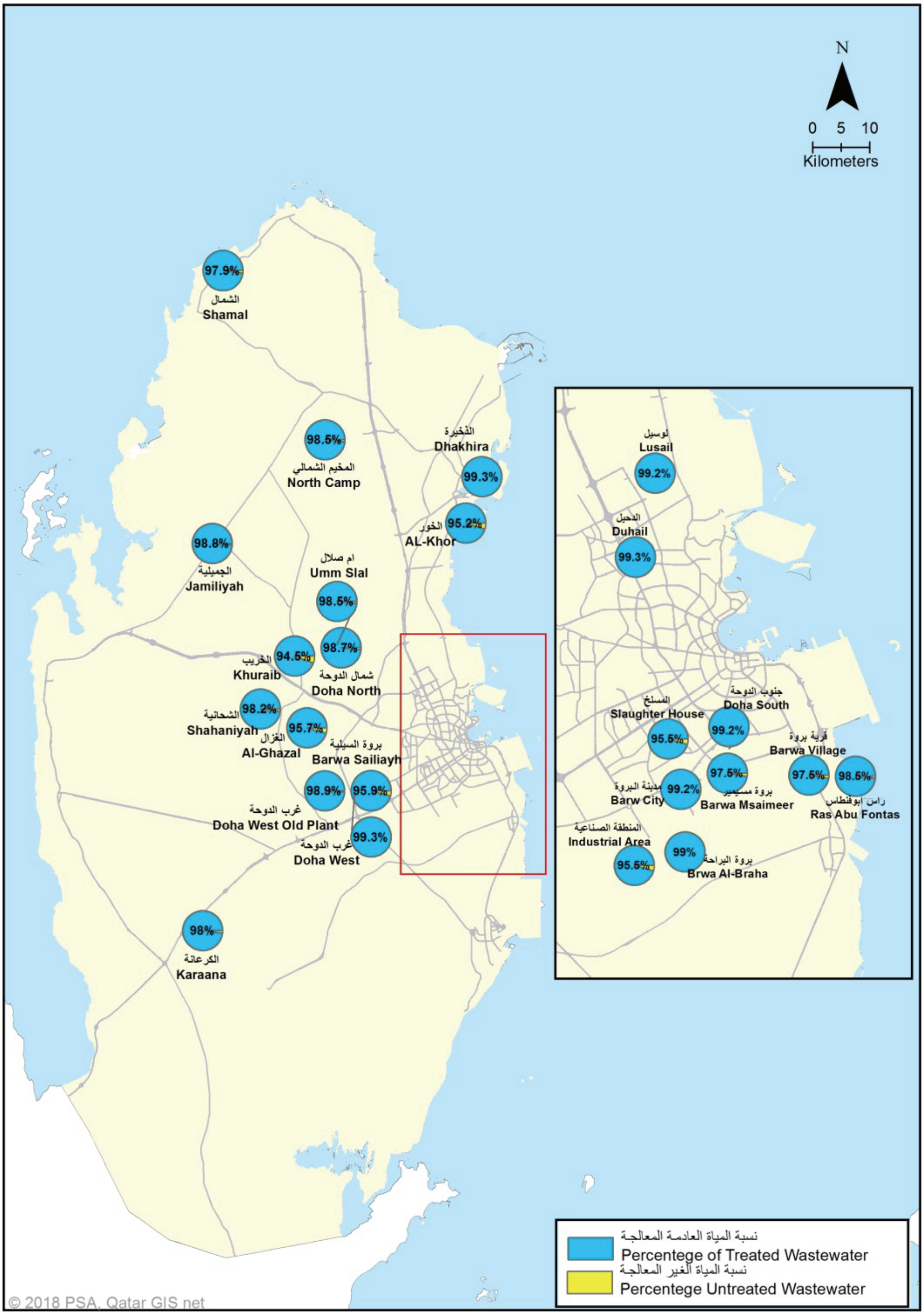
Data source: Ashghal

Map 5-3: Percentage of treated wastewater to total wastewater by UWWTPs, 2019



Source: PSA

Map 5-4: Percentage of treated wastewater to total wastewater by UWWTPs for Doha Municipality, 2019

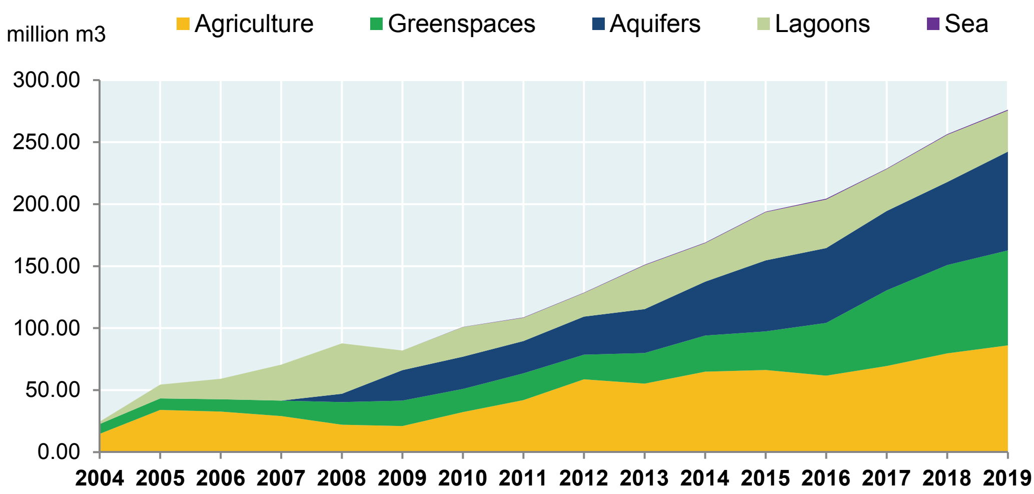


Source: PSA.

5.3.5 Discharge and Re-Use of Treated Sewage Effluent (TSE)

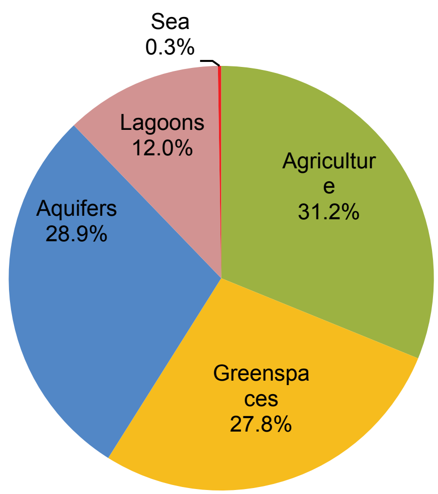
With the expansion of the wastewater treatment design capacity since 2004, the production of treated sewage effluent (TSE) in 2019 increased by about 10 folds compared to 2004, from around 25 million m^3 (2004) to about 278 million m^3 (2019). Agriculture has become the most important user of TSE (31% in 2019), followed by the governmental sector (28% of TSE used for green space irrigation). In 2019, about 29% of wastewater was used for deep injection into aquifers and about 12% was discharged into lagoons unused. (See Figure 5-10 and Figure 5-11).

Figure 5-10: Use and discharge of treated sewage effluent (TSE) (million m3) 2004-2019



Data source: Ashghal

Figure 5-11: Percentage of use and discharge of TSE, 2019



Data source: Ashghal, calculated by PSA

6. Groundwater Quantity and Quality

6.1 Rationale

One of the key concerns of water management in Qatar is the ongoing depletion of its groundwater aquifers due to abstraction and pollution. The groundwater depletion can be monitored by changes of groundwater levels and changes of water quality. Overexploitation of groundwater can lead to intrusion of seawater and deep saline groundwater into freshwater aquifers, and thus increase the salinity and concentration of dissolved substances. High concentrations of salinity and dissolved substances can make the water unusable for drinking and agricultural purposes. According to FAO, water can be classified by salinity concentration as shown in Table 6-1 below.

Table 6-1: Classification of saline waters according to FAO by conductivity, salinity concentration and water quality

Water Quality	Salinity Concentration (mg/l)	Conductivity (dS/m)	Type of Water
Drinking and irrigation water	<0.7	<500	Non-saline
Irrigation water	0.7 – 2	500 - 1,500	Slightly saline
Primary drainage water and groundwater	2 – 10	1,500 - 7,000	Moderately saline
Secondary drainage water and groundwater	10 – 25	7,000 - 15,000	Highly saline
Very saline groundwater	25 – 45	15,000 - 35,000	Very highly saline
Seawater	>45	>45,000	Brine

Water salinity of less than 0.7 dS/m does not usually cause a problem in traditional irrigation methods. But when water salinity is higher than 3.0 dS/m, serious problems often arise with most crops, causing yield reduction or farm abandonment (see Water and Agriculture Vision for Qatar by 2020).

To demonstrate the level of groundwater degradation, this chapter reviews statistics on groundwater levels, salinity (conductivity) and total dissolved substances (TDS) in the main aquifers in Qatar.

Qatar Electricity and Water Corporation has provided us with the latest data on groundwater quality during the period from April 2012 to September 2014 in order to analyze the results. There are no sample collection campaigns on an annual basis, but samples are collected once in April and again in September.

6.2 Methodological Aspects

Extreme values may have a strong influence on the overall results of the assessment of groundwater salinity and depletion. Statistical assessments are therefore conducted on the following basis:

1. Calculation of median (50 percentile) values of salinity and conductivity for each aquifer. This assures that single extreme values will not influence the overall assessment.
    a. Calculation including the results of all monitoring wells.
    b. Calculation Excluding monitoring wells in coastal areas (area code “K”).
2. Calculation of mean values of salinity and conductivity.
    a. Including all monitoring wells.
    b. Excluding wells with area code “K”.
3. Calculation of number of wells that fall under the different FAO salinity classes and presenting also which ones of them fall into the area code “k”.

6.3 Key Messages

1. According to FAO salinity classification, all wells in Qatar were classified as medium salinity during the period 1998-2014.
2. The percentage of high saline wells declined from 17% in 1998 to 16% in 2016.
3. The highest percentage of wells with slightly saline water (lowest salinity class which can be found in Qatar) are in the aquifers Doha, South and North Qatar, whereas the highest percentage of high salinity wells are found in Wadi Al-Urayq and Al-Mashabiya aquifers, as well as in South Qatar.
4. Most of the aquifers show an increasing trend towards high salinity.
5. The groundwater levels in Central and North Qatar do not show any clear trend. They are slightly above sea level. However, the groundwater level in Al-Mashabiya is significantly below sea level with a tendency to decrease.

6.3.1 Statistics and Indicators

6.3.1.1 Salinity

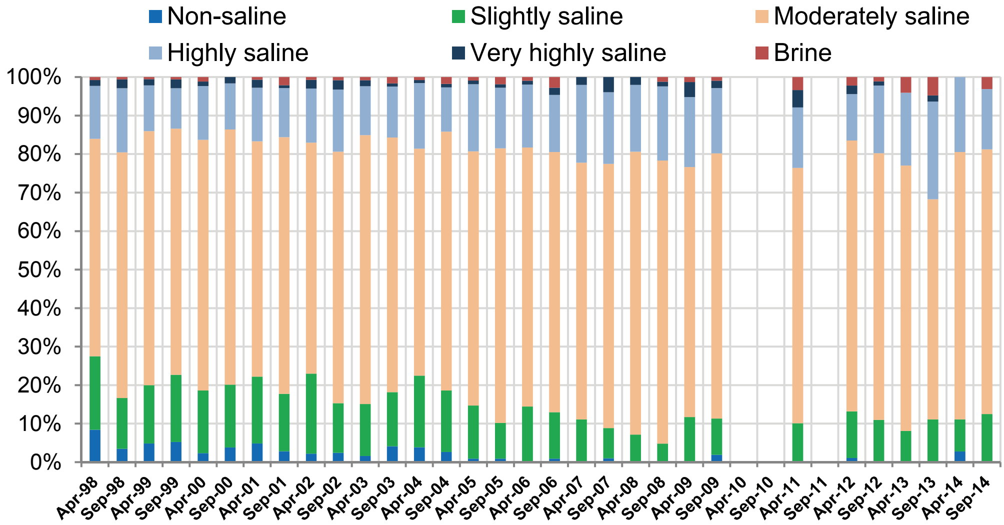
Figure 6-1 below presents the percentage of wells in Qatar according to FAO salinity classification for the observation period April 1998 – September 2014. Figure 6-2 presents the same information without considering wells in coastal zones (area code K).

Statistics indicate that from April 1998 to September 2014 the percentage of non-saline wells diminished from 8% to 0%. The percentage of slightly saline wells (classified by FAO as irrigation wells) decreased from 19% to 11% (20% to 12% according to Figure 6-2), whereas the percentage of wells classified as highly or very highly saline increased from 17% to 20% (14% to 19% according to Figure 6-2). In 2012 [(1)] , 69% (70% if coastal areas excluded) of wells were classified as moderately

(1) Data of 2013 and 2014 are not available from the source about wells classified with area code K

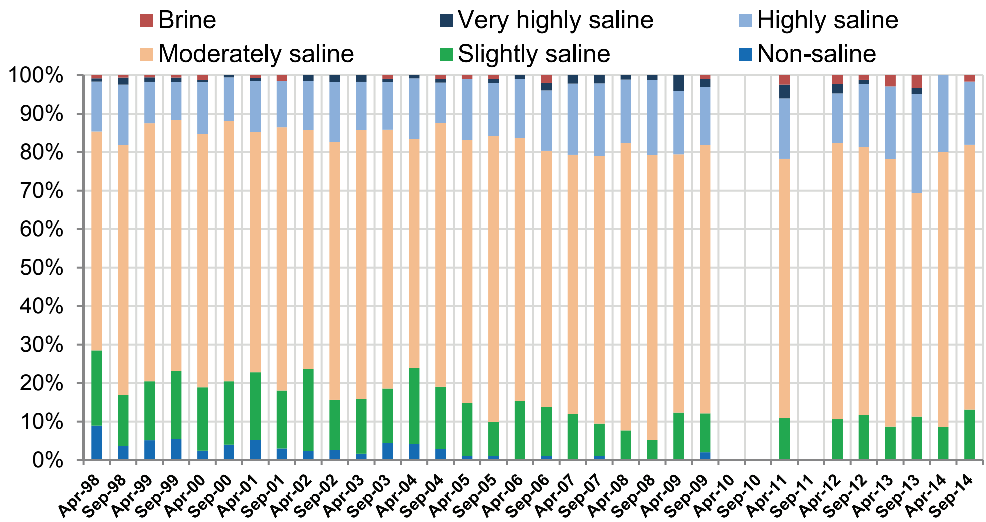
saline, making their waters harmful to sensitive crops, causing high soil salinity and increasing the risk of higher sodicity (see Water and Agriculture Vision for Qatar by 2020).

Figure 6-1: All wells in Qatar by FAO salinity classification April 1998 – September 2014



* Data of 2015 and 2019 are not available from the source

Figure 6-2: All wells in Qatar, excluding those in coastal sub-catchments, by FAO salinity classification, April 1998 – September 2014 *

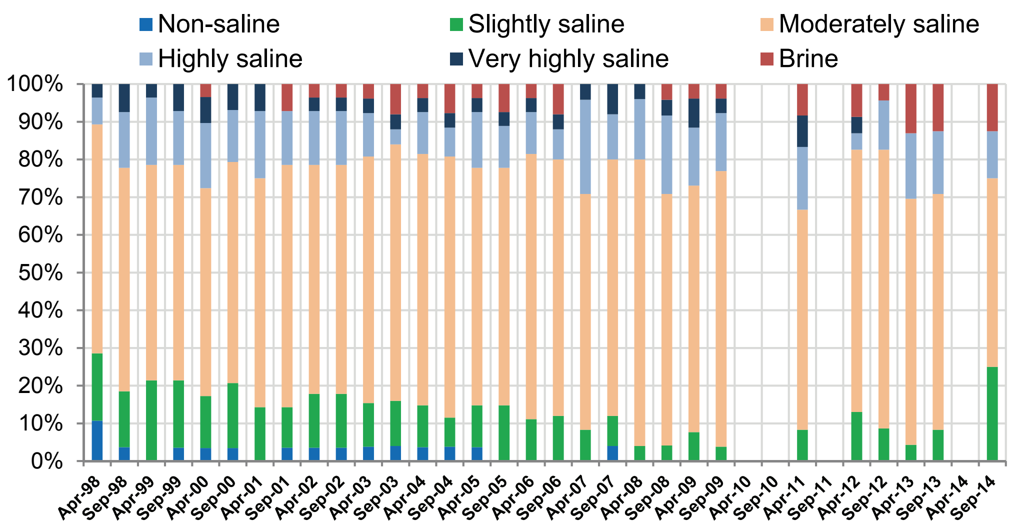


* Data of 2013 and (2015- 2017) are not available from the source about wells classified with area code K (area wells coastal)

The following example demonstrates the salinity trend according to FAO salinity classification in North Qatar and Al-Mashabiya:

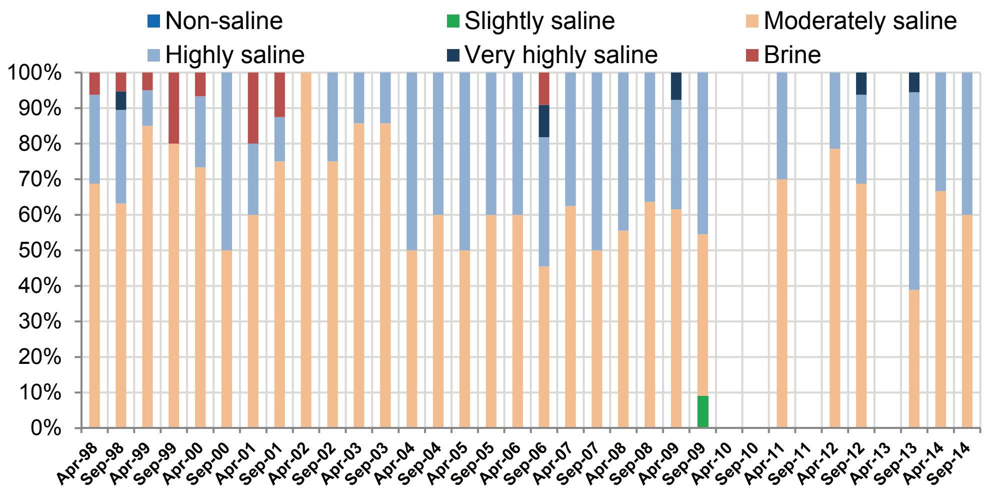
- In North Qatar, no well ever produced non-saline water since 2008. The percentage of wells with highly saline water, very highly saline water and brine has increased from 11% in April 1998 to 13% in September 2014. Also in September 2014, no well was non-saline, while 25% were slightly saline, 50% moderately saline, 13% highly saline and 13% brine. (See Figure 6-3 below).
- In Al-Mashabiya, no well ever produced non-saline water since 1998. The percentage of wells with highly saline water, very highly saline water and brine was 40% in April 1998 and in September 2014, with seasonal variations in the years in between. In September 2014, no well was non-saline or slightly saline, while 60% were moderately saline and 40% highly saline. (See Figure 6-4 below).

Figure 6-3: Percentage distribution of wells in North Qatar by FAO salinity classification April 1998 – September 2014 *



* Data from (2015- 2019) are not available from the source.

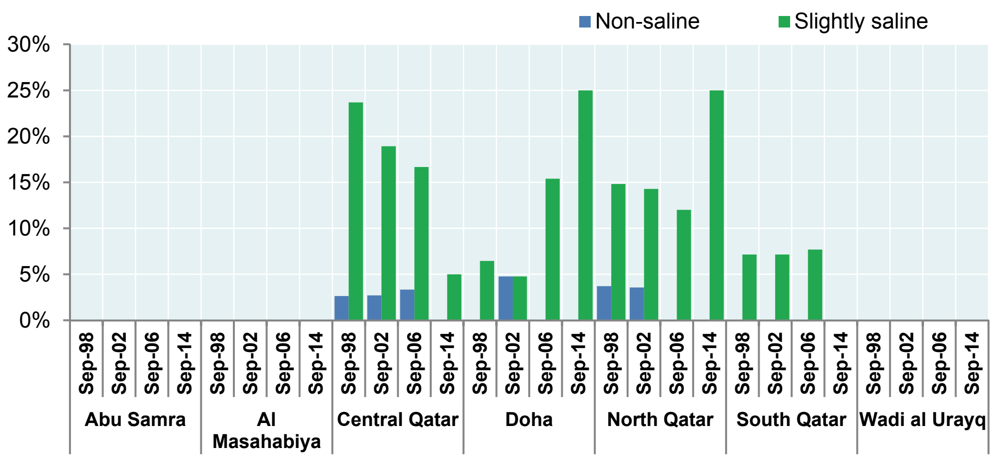
Figure 6-4: Percentage distribution of wells in Al-Mashabiya by FAO salinity classification April 1998 – September 2014 *



* Data of 2015 and 2019 are not available from the source

Figure 6-5 below indicates the percentage of wells classified as non-saline or slightly saline in different areas of Qatar from September 1998 to September 2014. It is noted that all wells located in three areas (Abu Samra, Al-Mashabiya and Wadi al Urayq) are moderately or highly saline. The percentage of wells with slightly saline or non-saline water decreased in two areas (Central and North Qatar), whereas it increased in Doha and South Qatar. However, in September 2014 there was no longer any non-saline well.

Figure 6-5: Percentage of wells classified as non-saline and slightly saline in different aquifers September 1998 – September 2014 *



* Data of (2015 – 2019) are not available from the source

Table **6-2**, as well as Figure 6-6 and Figure 6-7 show the median trend of salinity by conductivity (dS/m) and total dissolved solids (TDS in ppm) for four aquifers in Al Mashabiya, South Qatar, Central Qatar and North Qatar.

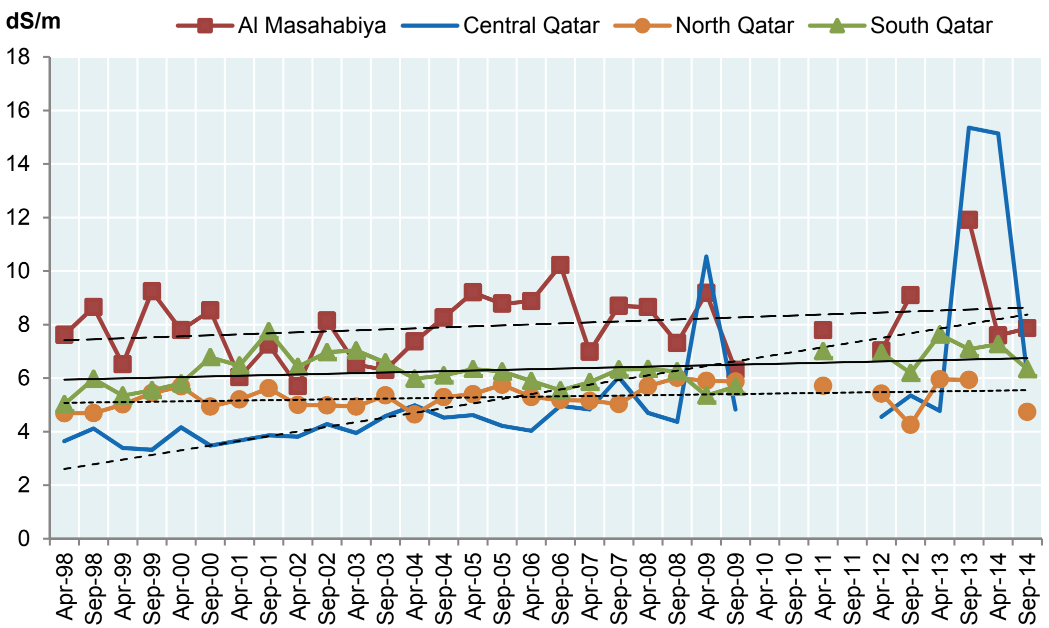
It can be noted that over the entire period 1998-2014, all four aquifers were moderately saline, but with a constantly rising salinity (conductivity). According to available data, TDS was slightly decreasing in Al Mashabiya, North Qatar and South Qatar.

Table 6-2: Observations of salinity in aquifers, 1998 – 2014*: Minimum and maximum median values (median of all wells per aquifer and observation period) and development trend.

Aquifer	Conductivity (dS/m)			TDS (ppm)		
	Min	Max	Trend	Min	Max	Trend
Al Mashabiya	5.70	11.91	Increasing	3780	7368	Slightly decreasing
North Qatar	3.32	15.36	Increasing	2420	9210	Increasing
Central Qatar	4.25	6.01	Slightly decreasing	2550	3610	Slightly decreasing
South Qatar	5.03	7.75	Increasing	3205	4580	Slightly decreasing

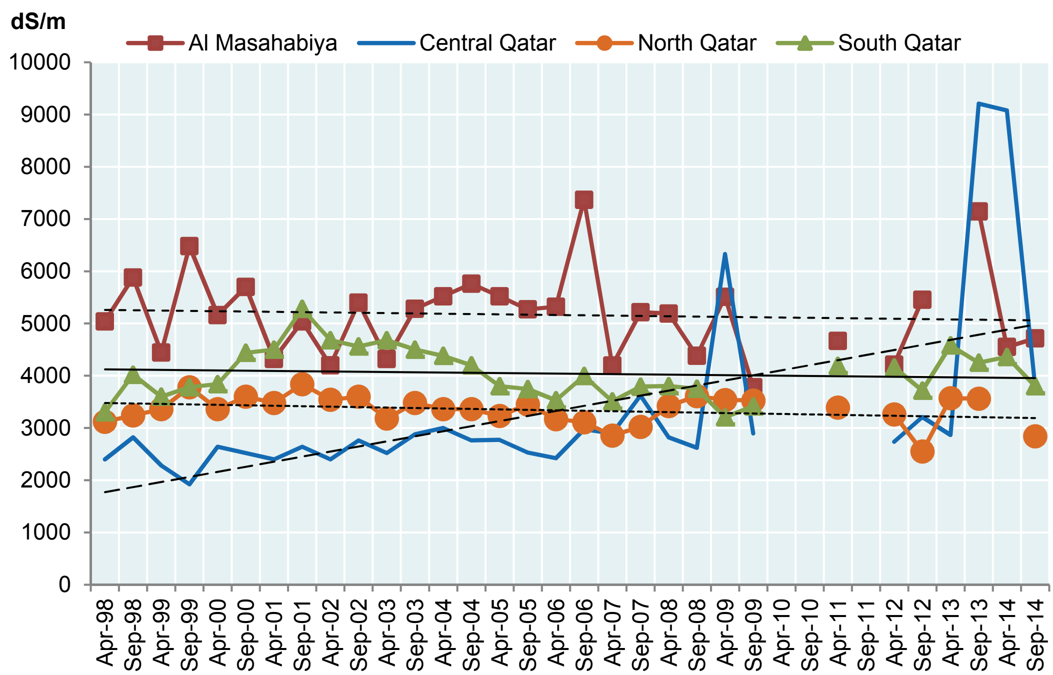
* Data of 2015 - 2019 are not available from the source

Figure 6-6: Trend of conductivity in selected aquifers (median) April 1998-September 2014 *



* Data of 2015 - 2019 are not available from the source

Figure 6-7: Trend of TDS in selected aquifers (median)
April 1998 - September 2014 *



* Data of 2015 - 2017 are not available from the source

Figure 6-8 and Figure 6-9 below show that the aquifers with the highest observed salinity (median of conductivity and TDS) in 2014 were in Wadi Al Urayq, Al-Mashabiya and South Qatar.

Figure 6-8: Conductivity in September 2014 (median of all wells per aquifer)

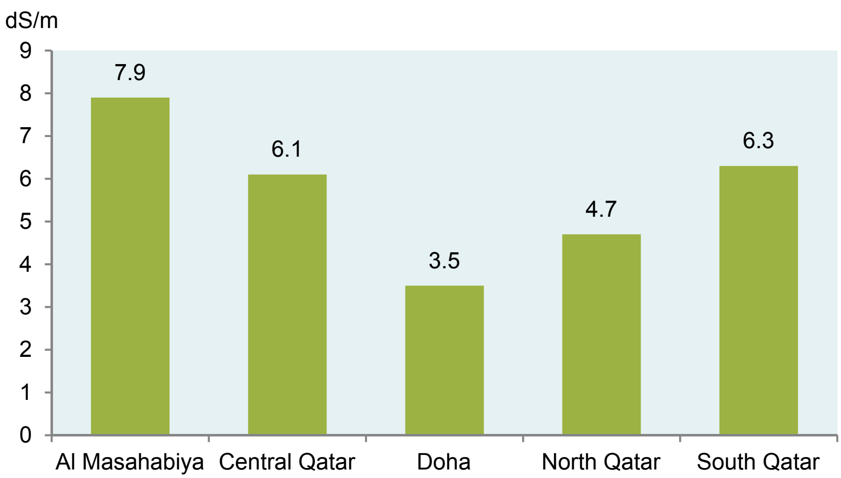
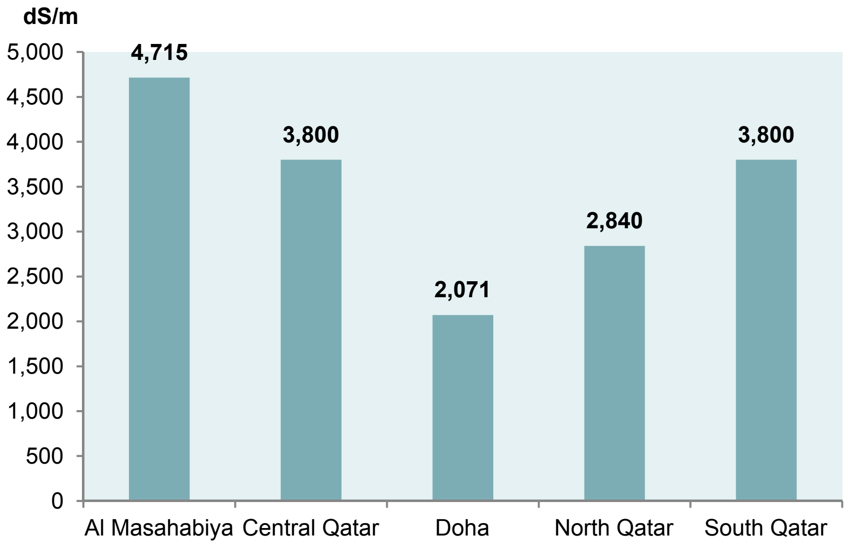


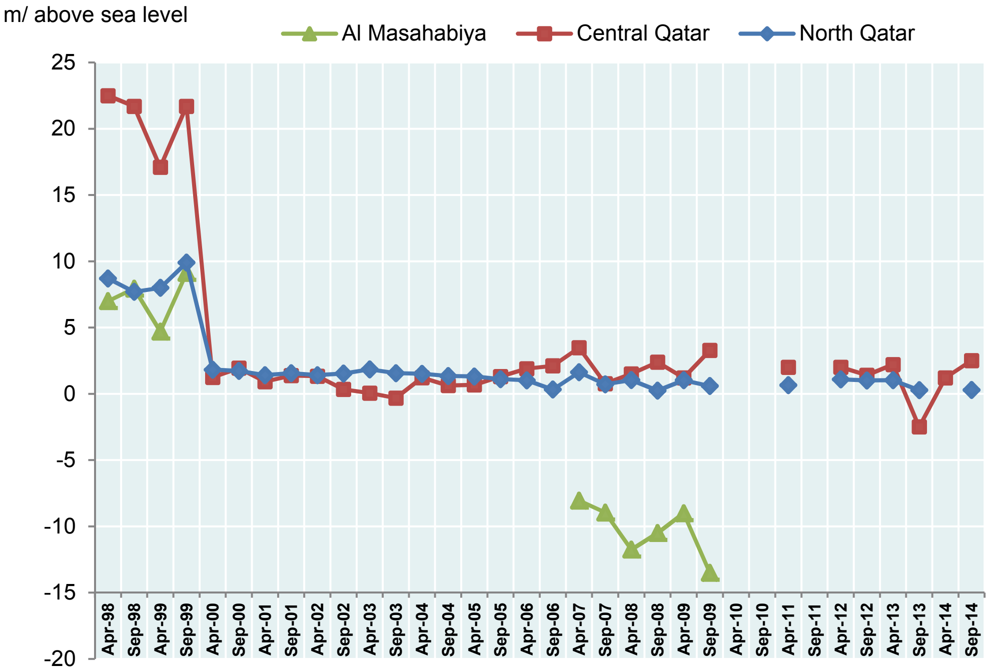
Figure 6-9: Total dissolved solids (TDS) September 2014 (median of all wells per aquifer)



6.3.2 Groundwater Levels

Reliable time series for the levels of groundwater from sea level in selected aquifers are available from April 1998 to September 2014. Figure 6-10 shows the median of the observed levels of groundwater from sea level in aquifers in North Qatar, Central Qatar and Al Mashabiya. Accordingly, the groundwater level in North Qatar shows a decreasing trend as it was only 1 meter above sea level in 2012 (median). The groundwater level in Central Qatar was volatile over time, but it showed no significant long-term trend (median) and recorded two and a half meters higher than sea level in September 2014. In the short observation period for Al- Mashabiya, a downward trend can be seen as the median of the observed groundwater levels was already 14 meters below sea level in September 2009.

Figure 6-10: Levels of groundwater aquifers in North Qatar, Central Qatar and Al-Mashabiya (median of all available observations), April 1998 – Sep. 2014*



* Data of 2015 - 2019 are not available from the source

Glossary

BOD5	**Biological Oxygen Demand**	الطلب البيولوجي على الأكسجين (٥ أيام)
COD	Chemical Oxygen Demand	الطلب الكيميائي على الأكسجين
ds/m	Deci Siemens per meter	وحدة قياس درجة السريان أو توصيل التيار الكهربائي (ديسي سيمنس لكل متر)
FAO	Food and Agriculture Organization of the United Nations	منظمة الأغذية و الزراعة للأمم المتحدة (فاو)
GDP	Gross Domestic Product	الناتج المحلي الإجمالي
LTAA	Long-term Annual Average	المتوسط السنوي طويل الأمد
PSA	Planning and Statistics Authority	جهاز التخطيط والإحصاء
MME	Ministry of Municipality and Environment	وزارة البلدية والبيئة
MoEI	Ministry of Energy and Industry	وزارة الطاقة والصناعة
QMD	Qatar Meteorological Department	إدارة الأرصاد الجوية
UWWTP	Urban Wastewater Treatment Plant	محطة معالجة مياه الصرف الصحي في المناطق الحضرية
WHO	World Health Organization	منظمة الصحة العالمية
WMO	World Meteorological Organization	المنظمة العالمية للأرصاد الجوية

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