

An Assessment of Covid-19 Pandemic and Weather Conditions on Current Water Usage and Availability: a Case Study in Istanbul

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Background

Water is a fundamental part of life in any society. It is vital for people's health and well-being, agriculture, businesses and the environment. In managing water well there must always be enough water for environmental purposes as our environment is the ultimate source of all our wealth and health and, in effect, we hold such environmental resources in trust for future generations. In the future, it is also expected that ensuring water needs for drinking, industrial, agricultural and other uses will be one of the most important challenges for societies. Already, this has been a problem in some part of the world [1] partly because of climate change [2], [3].

Emergencies, such as the Covid-19 pandemic [4] can compound the pressure on water usage and availability that are already under pressure from climate change in some parts of the world. Water systems might come under pressure from the way water use changes under pandemic lockdown conditions (particularly perhaps in periods of hot weather) and priority might be given to much more extensive use of chemical cleaning and disinfecting agents which again would cause changes in water use patterns or put supplies under pressure if these were already limited. Many governments adopted a similar approach to managing the pandemic and went into an approach to lockdown that changed water use patterns by asking people to "stay home". This caused water to be used differently for washing hands and, for example, disinfecting streets. Fig 1 illustrates the similarity of approach in many different parts of the world.

As a first step in understanding the importance of such compound risks (climate x Covid-19) we have quantified the changes in water use and water reserves in the city of Istanbul, Turkey during the period in which Turkey went into and emerged from the initial lockdown state.



Fig 1. Street disinfection photos from different countries during the Covid-19 Pandemic, clockwise from top-left: Turkey, UK, Ethiopia, and UAE [5]-[8]

Data

Water consumption data sets were extracted from municipality's annual reports by requesting the information from Istanbul Municipality. Daily temperature and precipitation data sets for Istanbul were downloaded from NOAA at <https://www.ncdc.noaa.gov/cdo-web/search?datasetid=GHCND> and see: https://www1.ncdc.noaa.gov/pub/data/cdo/documentation/GHCND_documentation.pdf

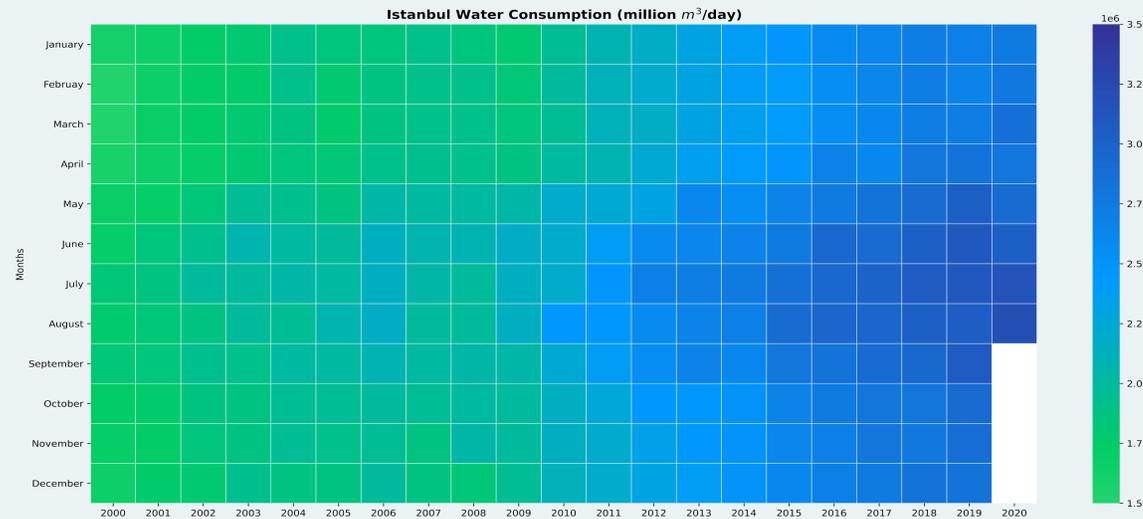


Fig 2. Monthly water consumption (m^3/day) from January 2000 to August 2020 in Istanbul

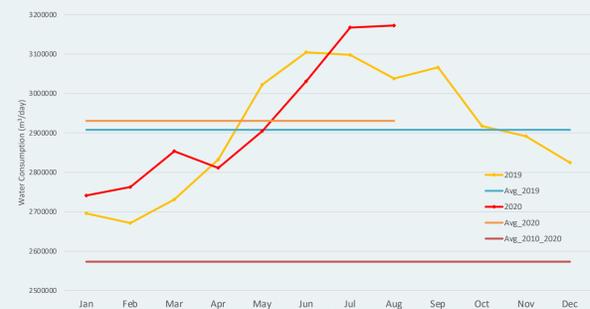


Fig 3. Monthly water consumption (m^3/day) in 2019 and 2020 with yearly averages in Istanbul

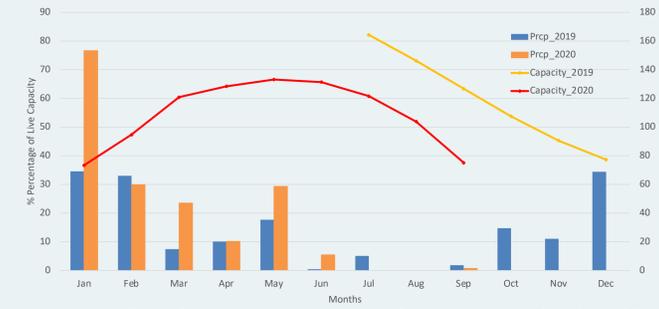


Fig 4. Comparison of water reservoirs live capacity (%) and total monthly precipitation (mm) in Istanbul

Water Use

While people are advised to stay at home as much as possible, the demand for water will likely increase in domestic settings and decrease in many business settings and in schools. In some circumstances such as inability to supply enough water for domestic use, the increase in use and change of the pattern of use could cause local water shortages, perhaps due to infrastructure failure or capacity limitations. Instances of this may have occurred elsewhere, such as in the United Kingdom in local areas.

Water consumption in Istanbul, Turkey has gradually increased since the 2000s as the population and other factors such as industrialization, and higher quality of living. Fig 1 illustrates that water use was high in summer and after 2012 consumption increases further.

However, when this year's (2020) consumption has been analysed, the consumption in March, when Covid-19 started to spread in Turkey, is surprisingly higher than normal from 2,762,787 to 2,853,472 m^3/day . This could reflect additional water use due to the increased emphasis on hygiene measures such as hand washing or street disinfection. In April, when the government decided to lockdown in big cities, including Istanbul, perhaps because people didn't want to stay in a highly populated city and went to their hometown, there is a decrease in water consumption in April by 42,210 m^3/day .

Since June, when Covid-19 cases started to decrease, people have returned to Istanbul, and water consumption has gradually increased by 141,609 m^3/day .

Impact on Water Reserves

When looking at precipitation for 2019 and 2020, Istanbul had very wet periods in 2020. In particular, May and June 2020 had almost double the 2019 values. In Fig 3 illustrates rainfall values were higher in the first half of 2020, except in February. In Istanbul, there are ten different water resources supplying water for the Asian and European part of the city and the capacity of them is 868.7 million m^3 in total. Even though the first half of 2020 was relatively rainy, due to higher water consumption, caused by both Covid-19 and increased population, water reservoirs started to decrease from %66.58 in May to %60.78 in July. As summer period was dry, reservoirs level decreased to its lowest level, %37.58 in September. This may indicate (Fig 5) that Covid-19 may be adding to existing water reserve and consumptions considerations.

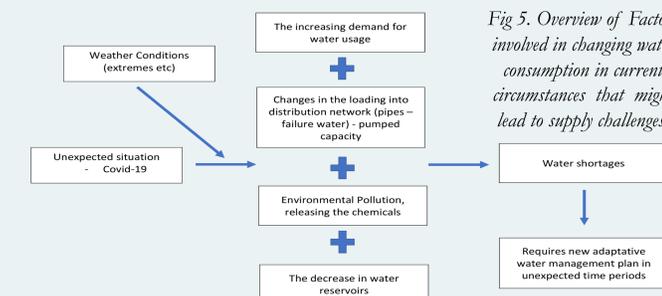


Fig 5. Overview of Factors involved in changing water consumption in current circumstances that might lead to supply challenges.

Emergent Water Issues

Other water issues must also be considered during the Covid-19 period. For example, when released into the environment, bleach and other chemicals release chlorine that reacts with organic matter in soil, water, and air to form a range of organochlorine compounds. These compounds could be toxic to wildlife, carcinogenic or mutagenic, and accumulate in the food chain and eventually impact humans. Once sprayed, sanitizing solutions enter the water cycle through the sewer system or in the form of runoff and into mixed drainage systems. Not all water passes through a treatment facility before entering the natural environment. Thus, the products used for hygiene purposes during Covid-19 times may end up in rivers and the sea. Additionally, the disinfection products may also infiltrate the soil, and having far-reaching impacts on land, plants, and animals. Since the purification process used by most water treatment plants is achieved by bacterial action the introduction of chemicals in high concentrations (such as bleach or nitrates) can have a significant impact on treatment plants. More evidence is needed on these issues.

Conclusion

Under the unexpected time periods such as Covid-19 Pandemic, water consumption can rise and supplying water to public and other uses could be at risk due to higher demand, changes in pumped capacity and failures in pipes, both resulting from changes in use patterns. As a result of higher consumption, which is not only related to use of drinking water but also related to additional household and municipal uses, water reservoir levels decreased even though there were many rainy days.

Additionally, using more disinfection products may increase the level of chemicals used in disinfection in the wastewater. These may also reach the environment without any treatment from the system failure (such as leakage). Disinfecting the streets would likely cause direct interaction between chemicals and environments (streets, parks, gardens, ground water).

Due to lack of available data, it is really hard to show how the situation is serious in any specific areas, and to deal with the unforeseen problems for environmental management. In order to manage water and environmental problems effectively in unexpected time periods, new approaches and adaptive management plans, including greater transparency and data availability, will be necessary to deal with any pandemics that may occur in the future.

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