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Climate change and urban growth will pose a major challenge to urban water supply

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Water scarcity can be both a natural and human-made phenomenon and defined as the point where there are insufficient water resources to satisfy long-term average requirements. In other words, refers to long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system, and hence provides an indication for unsustainable use or even mismanagement of available resources. Especially in low and middle income countries water scarcity is of concern as freshwater resources are scarce and robust urban water infrastructure is insufficient.

There are currently 3.9 billion people globally living in urban areas, and around one in three (1.5 billion) of them live in large cities of more than 750,000 inhabitants. Although cities have built extensive urban water supply systems, about one quarter of the population of large cities is water stressed today, i.e. have their water supplied from water-stressed river basins or where groundwater resources are used in an unsustainable way. Considering the impacts of climate change, socio-economic developments and further increasing urbanization, the competition for freshwater resources is likely to become a key concern for urban and rural population, economy, and the environment. Hence, the management of urban water supply very likely becomes a key challenge.

We used the integrated global water modeling framework WaterGAP3 to evaluate current and future water supply of 482 large cities. This includes the simulation of renewable freshwater availability as well as sectoral water withdrawals and water consumption over the entire time series from 1971 to 2070. Furthermore, the modeling framework was enhanced by the implementation of urban water transfers representing the water supply of 482 large cities and taking into account the location of withdrawal points from surface water, groundwater and desalination plants.

Overall, our results show that urban water demand may increase by 80% in 2050. More than 27% of cities studied, containing 233 million people, will have water demands that exceed surface-water availability. Considering the effects of global warming and urbanization, the total urban surface-water deficit is projected to reach 1,386–6,764 million m^3. An additional 19% of cities, which are dependent on surface-water transfers, have a high potential for conflict between the urban and agricultural sectors, since both sectors cannot obtain their estimated future water demands. Further results indicate that because of inter-basin transfers, many cities shift their water deficits to river basins far outside of the cities and remotely impact millions of people, economy and aquatic ecosystems.