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The inequality of water scarcity events: who is actually being affected?

Ted I.E. Veldkamp (1), Yoshihide Wada (2), Matti Kummu (3), Jeroen C.J.H. Aerts (1), and Philip J. Ward (1)

(1) Institute for Environmental Studies, VU University, Amsterdam, Netherlands (ted.veldkamp@vu.nl), (2) Utrecht University, Utrecht, Netherlands, (3) Water and Development Research Group, Aalto University, Espoo, Finland

Over the past decades, changing hydro-climatic and socioeconomic conditions increased regional and global water scarcity problems. In the near future, projected changes in human water use and population growth – in combination with climate change - are expected to aggravate water scarcity conditions and its associated impacts on our society. Whilst a wide range of studies have modelled past and future regional and global patterns of change in population or land area impacted by water scarcity conditions, less attention is paid on who is actually affected and how vulnerable this share of the population is to water scarcity conditions. The actual impact of water scarcity events, however, not only depends on the numbers being affected, but merely on how sensitive this population is to water scarcity conditions, how quick and efficient governments can deal with the problems induced by water scarcity, and how many (financial and infrastructural) resources are available to cope with water scarce conditions. Only few studies have investigated the above mentioned interactions between societal composition and water scarcity conditions (e.g. by means of the social water scarcity index and the water poverty index) and, up to our knowledge, a comprehensive global analysis including different water scarcity indicators and multiple climate and socioeconomic scenarios is missing.

To address this issue, we assess in this contribution the adaptive capacity of a society to water scarcity conditions, evaluate how this may be driven by different societal factors, and discuss how enhanced knowledge on this topic could be of interest for water managers in their design of adaptation strategies coping with water scarcity events. For that purpose, we couple spatial information on water scarcity conditions with different components from, among others, the Human Development Index and the Worldwide Governance Indicators, such as: the share of the population with an income below the poverty line; mean year of schooling; the ratio between urban and rural population; import and export rates; political stability; corruption; and government effectiveness. Moreover, we also take into account the accessibility of fresh water bodies and markets.

Underlying water scarcity conditions were estimated as follows: (1) yearly water availability was calculated at 0.5º x 0.5º over the period 1971-2099 using daily discharge and run-off fields from the global hydrological model PCR-GLOBWB, forced with different climate change scenarios; (2) statistical methods were applied to fit probability density functions to time-series of yearly water availability and to estimate water availability for a number of return periods covering the current, 2030, and 2050 conditions; (3) water availability results were assembled with scenario estimates of water consumption and population density which resulted in a series of water scarcity estimates.