The rate at which groundwater reservoirs are being depleted is increasing

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In what parts of the world and to what degree have groundwater reservoirs been depleted over the past 50 years? The Frankfurt hydrologist Prof. Petra Döll has been researching this using the global water model WaterGAP. She has arrived at the most reliable estimate to date by taking into consideration processes which are important in dry regions of the world. The values calculated were compared with monitoring data from many different wells and data from the GRACE satellites. These satellites measure changes in the Earth's gravity field. Döll has come to the conclusion that the rate at which groundwater reservoirs are being depleted is increasing, but that the rate is not as high as previously estimated.

90 percent of water consumption is due to irrigation for farming purposes. Only the comparatively small remainder is used for potable water and industrial production. As an example, 40 percent of the cereals produced around the world is irrigated. However, in many cases this results in increased scarcity of water resources and puts a burden on ecosystems. In dry regions, the amount taken from groundwater reservoirs can easily exceed the amount being replenished, so that the groundwater reservoir is overused and depleted.

"By comparing the modelled and measured values of groundwater depletion, we were able for the first time to show on a global scale that farmers irrigate more sparingly in regions where groundwater reservoirs are being depleted. They only use about 70 percent of the optimal irrigation amounts", explains Petra Döll from the Institute of Physical

Geography at the Goethe University.

The rate at which the Earth's groundwater reservoirs are being depleted is constantly increasing. Annual groundwater depletion during the first decade of this century was twice as high as it was between 1960 and 2000. India, the USA, Iran, Saudi Arabia and China are the countries with the highest rates of groundwater depletion. About 15 percent of global groundwater consumption is not sustainable, meaning that it comes from non-renewable groundwater resources. On the Arabian Peninsula, in Libya, Egypt, Mali, Mozambique and Mongolia, over 30 percent of groundwater consumption is from non-renewable groundwater.

The new estimate of global groundwater depletion is 113,000 million cubic meters per year for the period from 2000 to 2009, which is lower than previous, widely varying estimates. This can be considered to be the most reliable value to date, since it is based on improved groundwater consumption data which takes the likely deficit irrigation into account, and since the model results correlate well with independent comparative data.

The increased use of groundwater for irrigation also results in a rise in sea levels: According to Döll's calculations, sea level rise due to groundwater depletion was 0.31 millimetres per year during the period from 2000 to 2009. This corresponds to roughly one tenth of the total sea level rise.

More information: Döll, P., Müller Schmied, H., Schuh, C., Portmann, F.T., Eicker, A., (2014): "Global-scale assessment of groundwater depletion and related groundwater abstractions: Combining hydrological modelling with information from well observations and GRACE satellites". *Water Resour. Res.* 50, DOI: 10.1002/2014WR015595

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