
# Implications of salinity pollution hotspots on agricultural production

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## Background & objectives

Salinity pollution is a global problem but tends to be more severe in arid and semi-arid regions because of

- lower dilution capacity of rivers and lakes,
- more irrigation areas for agriculture, and therefore, higher total dissolved solids (TDS) loadings from irrigation return flows.

The main objective of this study is to analyse potential environmental impacts as well as risks of TDS loadings and water quality degradation on agricultural food production. The focus is on developing countries in Africa, Asia, and Latin America.

## WaterGAP3 modeling framework

The WaterGAP3 modeling framework (**Fig. 1**) was used to simulate hydrological, water use, and water quality conditions on a global scale for the time period 1990-2010. The WorldQual module computes monthly TDS loadings and in-stream concentrations from various point and diffuse sources (**Fig. 2**) with a spatial resolution of 5 arc minutes (8.2 x 8.2 km at the equator).

National values for percentages of primary, secondary, and tertiary wastewater treatment of sewage treatment plants (STPs) are downscaled to the grid-cell level to define a cell-specific reduction rate.

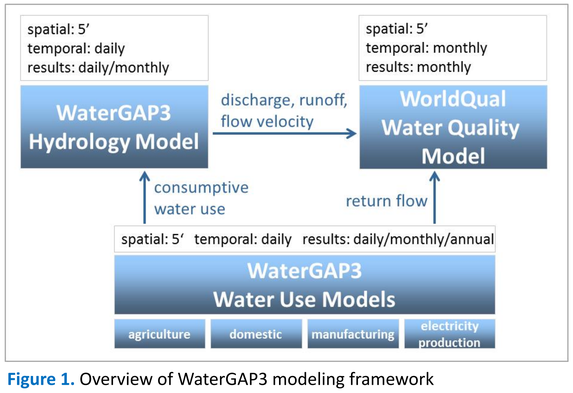


**Figure 1.** Overview of WaterGAP3 modeling framework

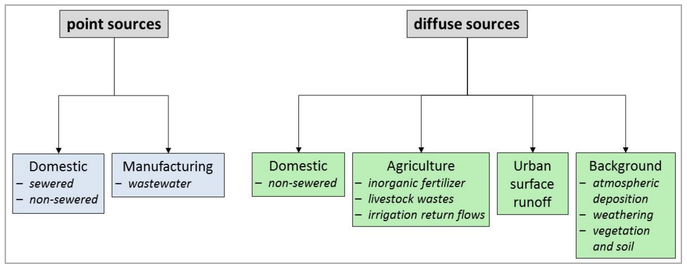


**Figure 2.** Pollutant loading sectors in WorldQual

Additionally, reduced treatment efficiency due to deficiencies of STPs is taken into account.

## Main findings

River concentrations vary from month to month because of the variability of river conditions and pollution intake. Severe and moderate salinity pollution affects around one-tenth of all river stretches in Latin America, Africa and Asia and is of concern because it impairs the use of river water for irrigation, industry and other uses (**Fig. 3**).

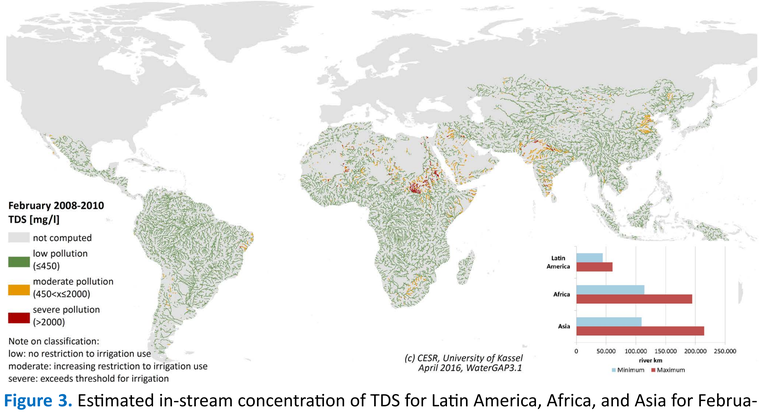


**Figure 3.** Estimated in-stream concentration of TDS for Latin America, Africa, and Asia for February 2008-2010. Bar charts show minimum and maximum monthly estimates of river stretches in the severe pollution class per continent

Most of the salinity loading to rivers comes from natural background sources. The main anthropogenic source is return flow from irrigated areas which transfers large amounts of salts from cropping areas to surface waters followed by the manufacturing sector.

Restrictions on use for irrigation start at a concentration of TDS of 450 mg/l, a concentration that is not unusual where waste loadings are significant.

In Asia, 157 million ha are under irrigation for food production of which 49-77 million ha are located along river stretches with moderate to severe pollution levels posing a risk to agricultural poduction and food security (**Fig. 4**).

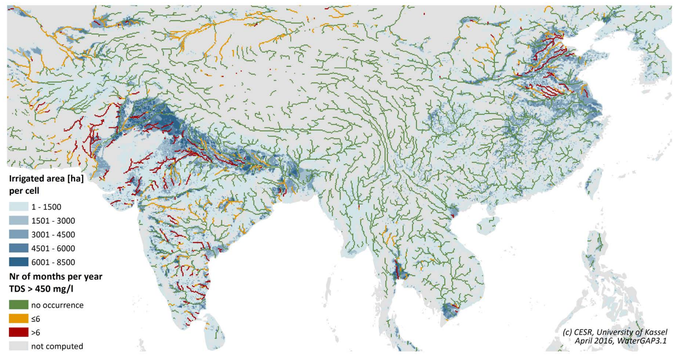


**Figure 4.** Frequency (months/year) in which moderate or severe pollution levels of TDS occur in river stretches entering irrigated areas over the period 2008-2010

## Conclusions & perspectives

Irrigated agriculture is the most relevant water use sector globally and the dominant anthropogenic source of salinity pollution. Upstream land uses affect the quality of water entering the irrigated area downstream and reduce water availability of adequate quality for irrigation purposes. In total, a range of 121,000 to 442,000 km of river stretches in Latin America, Africa, and Asia are in the moderate to severe pollution class of which about 73 per cent flow through irrigation areas.

Monitoring and assessing water quality is essential for understanding the intensity and scope of the global water quality challenge. Hotspot areas of water pollution can be used to set priorities for data collection.