

Policy Brief

May 2019

Water Quality and Salinity in the Euphrates and Tigris Rivers



OVERVIEW

The Water Quality Taskforce (TF-WQ) aimed to understand the trends and causes of degraded water quality in the Euphrates and Tigris river basin (Euphrates-Tigris). With a focus on both natural and anthropogenic sources, TF-WQ assessed the quality of water in terms of total dissolved solids (TDS) and nitrogen in the Euphrates-Tigris system. Using national data from Country Partners, open source academic data and literature and expert contributions from local stakeholders, the taskforce focused on the prevalence and spatial dynamics of salinity and nitrate contamination in the basin. Through the analysis, it was determined that certain hot spot areas of the basin are affected by both salinity and nitrate pollution; their sources can be attributed to a combination of natural basin conditions and human development related causes. The findings suggest that improved water management strategies are critical for the prevention of further water quality degradation.

FURTHER STEPS

- The CPET Programme has been successful in bringing Country Partners to collectively resolve the recognised overall deterioration of water quality in the Euphrates-Tigris system, identify sources of pollutants, and to address the more difficult matter of water quality hotspots. This has not been an easy process and it is critical that the foundations that have been established are cemented and built upon.
- Standards, agreement on most appropriate water quality model(s), use of those model(s), increased data capture and data sharing, support in the use of remote sensing data and the application of GIS, are all aspects of cooperation which a future project of CPET could engage in with Country Partners.
- A further project of CPET would also, if remitted to do so, seek to research additional water quality parameters – and the extended impacts of poor water quality of these parameters on community, agriculture, economic growth, and the environment.
- As a multi-disciplinary programme, the previous work of CPET can be carried forward to continue to build the cross-linkages with Society, the Economy (agriculture, urban, industrial), and the Environment.

WATER QUALITY IN THE EUPHRATES AND TIGRIS RIVERS

INTRODUCTION

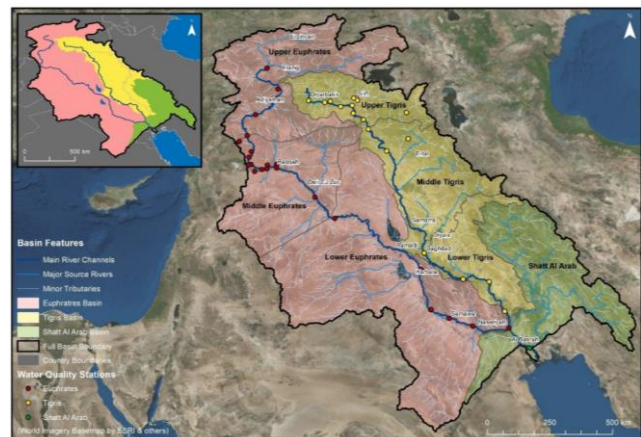
Protecting and maintaining the quality of the available water in the Euphrates-Tigris at acceptable levels for human consumption and utilization is of great concern for all basin countries. At present the wastewater discharges and agricultural return flows entering the basin environments do, at times, exceed effluent quality criteria. The situation is further exacerbated by widespread secondary salinization of agricultural lands, predominantly in the middle and lower parts of the basin, inadequate capacity of wastewater treatment plants, and the impacts of climate change.

The elevated levels of nitrate and TDS in the waters of both the Euphrates and Tigris rivers lead to a diverse set of health and environmental problems and limit the use of available water for designated beneficial purposes. Runoff and soil erosion from fertilized agricultural lands are thought to be the main contributors to higher concentrations of nitrogen in the environment. Nitrates, in excess, promote and support the growth of algae and cyanobacteria, seriously degrade aquatic ecosystems, and impair the further use of water for drinking, industrial, agricultural, recreation, and other purposes. Similarly, elevated levels of TDS present health risks and affect the aquatic ecosystem and agricultural yield. There is a clear inverse relation between crop yields and TDS concentrations.

The Country Partners from Turkey, Syria, and Iraq (including KRG) supplied data to meet the needs of taskforce activities from their respective national data sources. The taskforce also used other relevant data from trusted open sources available online such as peer-reviewed journals and reports by organizations that have operated in the region. The taskforce conducted a thorough review of available literature on the subject to close gaps in available data, develop water quality standards for drinking, urban and agricultural uses of water, assess the causes of water pollution (mainly nitrates and TDS) and discuss the possible effects of water pollution on both the environment and agriculture. Using sampling data at various points along the river channel between 2006 and 2011, data points were interpolated using the Inverse Distance Weighted (IDW) method to estimate TDS and nitrate values for the entire lengths of the main river channels of the Euphrates, Tigris, and Shatt

Al Arab, in order to model the spatial dynamics of water quality in the rivers. Along with the GIS-based spatial water quality analyses, TF-WQ also conducted the following analyses:

- Assess the temporal trends in the data to identify any peak months or years for pollution spikes
- Understand the wastewater treatment capacities in the basin across the three countries of analysis
- Analyse and map the dams in the basin to investigate if these diversions of natural flows impacted the water quality
- Investigate the dynamics of agriculture, industry, environmental and human health, as well as climate, to understand how they factor into the dynamics of water quality identified through the analyses.
- Calibrate the HYPE hydrology model to capture nutrient transport trends in the basin



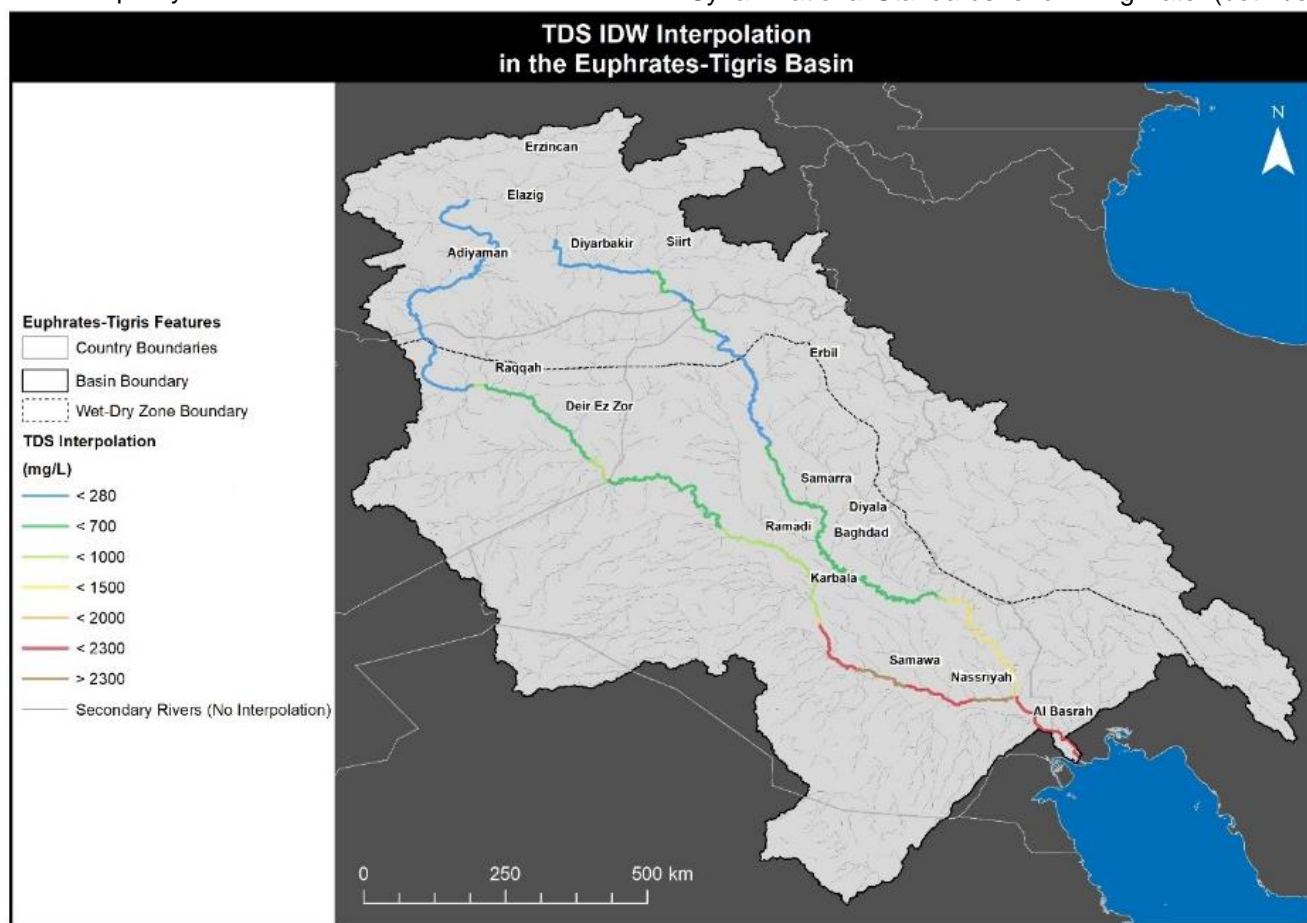
Location of water quality monitoring stations used in the analysis.

STUDY FINDINGS

The taskforce report on water quality analyses TDS and nitrate concentration levels in Euphrates and Tigris rivers from their headwaters, through their confluence into the Shatt Al Arab, until they finally drain into the Gulf. The main source of data was sampled point data provided by the project Country Partners. TF-WQ has found that the intensive anthropogenic activities have brought about a deterioration in the quality of water at many locations along the Euphrates and Tigris rivers. The main sources of water pollution in the basin include wastewater discharges, agricultural return flows (drainage), lower flow volumes due to upstream development, and urban runoff. Natural factors such as the high evaporation rates, climatic variability, accumulation of TDS and sediments, poor drainage,

and low soil quality also contribute to the deterioration of water quality in the basin.

water), as well as the Iraqi National Standards and the Syrian National Standards for drinking water (both use



Interpolation of TDS sample data in the Euphrates, Tigris, and Shatt Al Arab rivers between 2006 and 2011

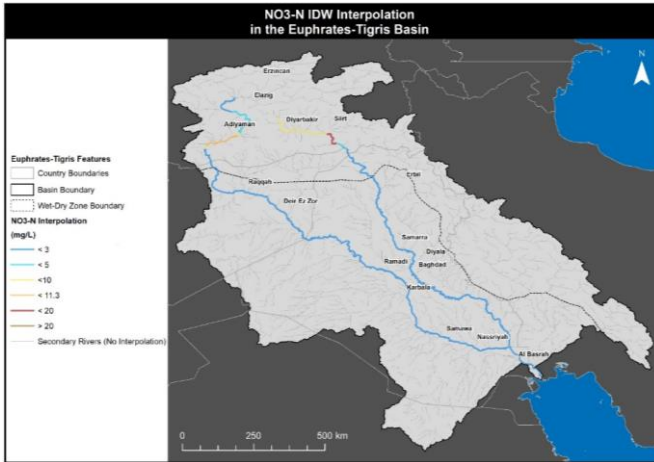
The taskforce found that for most of the basin, the TDS concentration remains within the World Health Organization's (WHO) Irrigation Water Standards (< 700 mg/L for 'Excellent' and < 2000 mg/L for 'Good' water), the Turkish National Standards (< 280 mg/L for high quality water, < 700 mg/L for low polluted water), and the Syrian and Iraqi National Standards (< 1500 mg/L and < 1000 mg/L respectively). However, large portions of the lower parts of the Euphrates, Tigris, and Shatt Al Arab fall outside of these ranges. Basin development has altered the quantity and quality of water entering the Euphrates-Tigris system; when combined with geologic and climatic conditions that make the region prone to salinization, the natural conditions and anthropogenic factors exacerbate each other and cause increased salinity in the basin.

Overall, the nitrate concentration levels in both the Euphrates and Tigris rivers meet the European Water Framework Directive standards (< 5.0 mg/L NO₃-N for drinking and < 10.0 mg/L NO₃-N for agriculture), the Turkish National Standards (< 3.0 mg/L NO₃-N for high quality water, and < 10.0 mg/L NO₃-N for low polluted

the 11.3 mg/L NO₃-N cut-off), in most of the locations along these rivers. The Tigris River has high nitrate concentrations in some locations due to the agricultural activities practiced along the river. Additionally, in both the Tigris and Euphrates, the nitrate concentrations increase near the main cities where wastewater treatment plants and industries discharge wastewater that exceeds discharge standards. Pollution also increases where intensive agriculture is practiced.

The deterioration in the quality of the Euphrates and Tigris waters at critical hotspots calls for immediate action by decision-makers in the riparian countries to halt completely the offending point and diffuse sources of pollution into these rivers. The inclusion of water quality parameters additional to TDS and nitrates in future phases of the programme should further clarify the causes of water quality degradation and their effects on human health and the environment. The development of water quality models would certainly help the countries to make future predictions, develop possible scenarios, and

improve water resources planning and development in the Euphrates-Tigris basin.



CONCLUDING REMARKS AND RECOMMENDATIONS

The Water Quality Taskforce sought to understand the variations and magnitude of key parameters in the Euphrates and Tigris basin. Due to data and time constraints, the taskforce members agreed to focus on the causes and effects of the elevated levels of TDS and nitrate on water quality. TDS was selected due to the widespread salinity challenges in the basin. Nitrate was selected to understand the effects of agricultural activities in the basin on water quality. The study findings revealed hotspot areas and the extent of water quality deterioration across the basin due to higher concentrations of TDS and nitrate. Significant spatial variability in the impact of these two contaminants was observed. The taskforce identified critical hotspots in the basin for TDS and nitrate concentrations, with challenges that must be addressed. Improving the water quality will have ripple effects within the basin and will help ensure a safety and sustainability of communities, economies, and ecosystems in the basin for decades to come.

Policy Recommendations

1. Cooperative management is key to improved basin water quality. This includes increased monitoring, data capture and, most especially, data sharing
2. Water quality requires significantly more study – both cause and effect. The CPET programme has, looked only at TDS and nitrate pollution. This must be extended to other critical parameters (oxidation, phosphates, trace elements, other inorganic pollutants and, perhaps most notably,

3. bacteriology)
3. Trans-boundary policies and frameworks needed to be negotiated and agreed upon
4. There needs to be agreement on water quality standards. These could be country-specific but must be equitable regarding downstream countries and users.
5. There are critical links to hydrology (storage and allocation), agriculture (water use, water use efficiency, drainage, salinization), and the urban/industrial nexus (industrial discharge, wastewater treatment and discharge) that must be addressed to maintain water quality.
6. Minimum environmental flows (including flows to the marshes) are critical in maintaining water quality and need to be assessed for all river reaches. The impacts of this extend beyond the rivers and affect the marshlands and Gulf as well.
7. Agricultural practices, and especially irrigation and drainage, need to take account of the impacts of salinity through return flows
8. All countries need to pay attention to the effective management of wastewater treatment plants, and the enforcement of discharge standards
9. All countries need to enforce standards regulating industrial effluent discharge. Discharge of water of poor quality is in effect a water use and should be addressed in terms of its impact on the resource.
10. Further studies into the impacts on human and environmental health from degraded water quality are key to understanding the full range of effects from the phenomenon.

Key Messages

The Country Partners still need to reach consensus on defining acceptable water quality standards for different designated uses across the Euphrates and Tigris basin.

In selecting the most suitable model, the countries should agree on the expectations, data requirements and the levels of detail needed for the joint modelling activities.

The Country Partners should collectively agree on the best water quality model that would be acceptable to all.

Looking to the future, it is imperative that the countries of the Euphrates and Tigris pursue enhanced collaborative efforts to develop transboundary policies and frameworks to address the water quality challenges of the basin.

While the project facilitated the sharing of key national data between country partners, access to more water quality data is needed for comprehensive investigations and to be able to develop sound recommendations for informed decision-making by policymakers in all basin countries. The Country Partners should explore more opportunities and initiatives in data sharing.