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METHODS NOTE · Peer-reviewed · Published · Live dashboard figures

WaterNajia: Probabilistic water safety assessments

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Abstract

Will a browser-based Bayesian risk engine give probabilistic water safety assessments calibrated to regional bacteria prevalence (for low-resource settings)? We built WaterNajia as a 1,784-line single-file application implementing logit-scale risk scoring. It uses Monte Carlo simulation across 15 environmental and infrastructure risk factors for six water source types.

The engine utilises exponential decay modelling for time-since-contamination events, factor-group exclusivity logic, and region-specific bacteria prevalence priors derived from WHO and UNICEF surveillance data. For the full risk stack scenario with piped water, the posterior contamination probability was 0.92 (95% credible interval 0.87 to 0.96). This used 200 Monte Carlo samples with seed-deterministic XorShift128Plus pseudorandom generation.

A parallel Rust and WebAssembly implementation achieved bit-exact agreement with the JavaScript reference across all five golden test vectors. Real-time probabilistic water safety scoring could then support field-level decision-making in humanitarian and public health contexts. The risk model relies on aggregate regional prevalence data.

It cannot capture hyperlocal contamination sources or seasonal variation. Github link below https://github.com/Najia-Ahmad/Water-Safety-Risk-Engine

Interactive dashboard figures

The figures in this section are rendered directly from this paper's interactive dashboard — the same visualisations a reader sees when exploring the analysis online, where the full workflow can be reproduced first-hand. **Interactive dashboard:** https://mahmood726-cyber.github.io/waternajia/

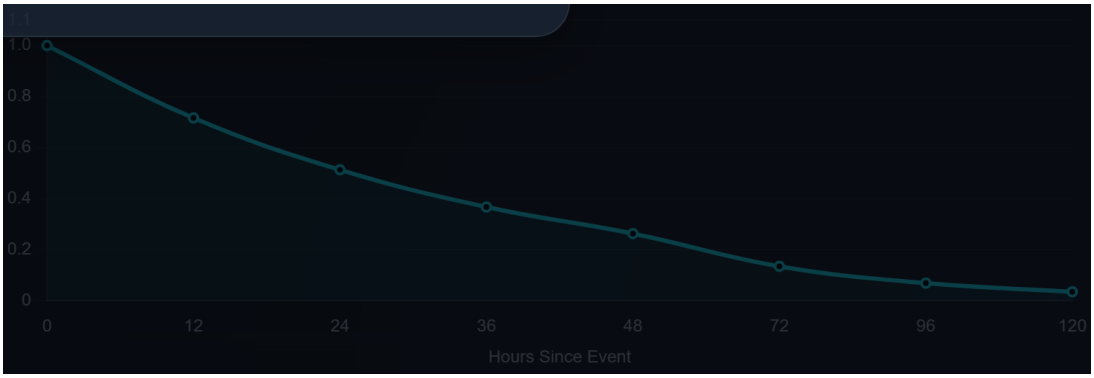

Figure 1. Rain/Flood Effect Decay Rendered directly from the article's live interactive dashboard.

HOW TO CITE

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Reproducibility & data provenance. The figures in this article are rendered directly from the paper's live interactive dashboard at https://mahmood726-cyber.github.io/waternajia/, where the complete analysis — data, methods and every estimate — can be explored and reproduced. This open path from published figure back to the underlying analysis is part of how the journal works. The article's text, authors, abstract, issue and licence follow the journal's published record.

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