

Systematic evaluation of centralized versus decentralized wastewater systems at different connection rates: a case study for a Ukrainian small town

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Abstract

The article concludes the approach and results of a systematic evaluation of different wastewater management concepts for Hlyniany, a small town in Western Ukraine. Layouts of centralized, semi-centralized and decentralized sanitary sewer systems were developed. Based on a multi-criteria evaluation, including technical, environmental, societal and economic aspects. An adapted version of COFAS method was used to evaluate the resilience of the system layouts under consideration of local level demographic and land-use changes as well as economic projections. Investment costs and expected annual costs were compared in a probabilistic framework. Constructed wetlands were evaluated as most advantageous treatment technology. Decentralized system layout was most resilient against demographic and economic changes. With 1200-2000 EUR/capita decentralized systems had distinctively lowest investment costs at all connection rates. For connection rates below 50 percent investment costs of centralized treatment are by far highest with up to 30000 EUR/capita. While for higher connection rates centralized and semi-centralized options are similar in a range of 3500-5000 EUR/capita. Expected annual costs are more similar for all system layouts but also lowest for decentralized option. Results suggest that decentralized system layout with constructed wetland as treatment technology is most favourable for the boundary conditions of small Ukrainian towns. Nonetheless, discussion with local stakeholders emphasizes the importance of accompanying capacity development for potential future implementation.

Keywords

constructed wetland, connection rate, centralized and decentralized wastewater systems, resilience