

# Economically Efficient Standards to Protect the Netherlands Against Flooding

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## Abstract

In the Netherlands, flood protection is a matter of national survival. In 2008, the Second Delta Committee recommended increasing legal flood protection standards at least tenfold to compensate for population and economic growth since 1953; this recommendation would have required dike improvement investments estimated at 11.5 billion euro. Our research group was charged with developing efficient flood protection standards in a more objective way. We used cost-benefit analysis and mixed-integer nonlinear programming to demonstrate the efficiency of increasing the legal standards in three critical regions only. Monte Carlo analysis confirms the robustness of this recommendation. In 2012, the state secretary of the Ministry of Infrastructure and the Environment accepted our results as a basis for legislation. Compared to the earlier recommendation, this successful application of operations research yields both a highly significant increase in protection for these regions (in which two-thirds of the benefits of the proposed improvements accrue) and approximately 7.8 billion euro in cost savings. Our methods can also be used in decision making for other flood-prone areas worldwide.

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