Extended Abstract
Volume 4, 2021

Journal of Pollution

Open Access

Developing optimal diffuse pollution management strategies in agricultural water shed under future climate change

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Abstract

While best management practices (BMP) are recommended to attain non-point source loads in receiving water bodies, it is still unclear whether their efficiency will be maintained under future climate change. In a present study, Soil and Water Assessment Tool (SWAT), a semi-distributed watershed model, was used to determine the best BMP options achieving the necessary pollution reductions as well as to assess changes in the pollution loads in agricultural water shed between the current and future weather conditions. Three weather scenarios for the decade of 2040 (2040–2049), which were developed from the Representative Concentration Pathways 2.6, 4.5 and 8.5 in the Intergovernmental Panel on Climate Change Report, were projected into the Youngman River watershed, Korea. The scenario covering both calibration and validation periods (2000-2009) was used as a reference condition. Specifically, genetic algorithm was applied for obtaining the global solutions for nonlinear problems (i.e., cost vs. efficiency). Results showed that sediment and phosphorus loads were significantly different among various weather scenarios. This implied that the current BMP options which were determined based on the reference scenario needed to be rearranged for the future conditions. While parallel terraces which decreased phosphorus removal efficiency were identified as the worst option under the future weather scenarios, no tillage approach showed the best performance, as compared to that of the current condition, for instance. We expect that the proposed methodology will provide optimal management strategies to achieve the water quality targets in complex watersheds, specifically those with mixed land uses. Climate change is expected to intensify the existing risks, particularly in regions where water scarcity is already a concern, as well as create new opportunities in some areas. Efforts to develop adaptation strategies for agricultural water management can benefit from understanding the risks and adaptation strategies proposed to date. This understanding may assist in developing priorities for the adaptation of water resources for irrigation. Here we characterize the main risks across European regions and evaluate adaptation strategies by reviewing over 168 highly relevant publications that appeared in the last 15 years. Based on this extensive database we characterize the effort and benefit of a number of agronomic and policy measures, aiming to develop concrete adaptation plans and responding to concrete regional challenges. The adaptation choices consider current technological perspectives and do not project future technological change; we are certain that technological change will shape some choices for adaptation in the coming decades. The greatest scope for action is in improving adaptive capacity and responding to changes in water demands, however the implementation requires revamping current water policy, adequate training to farmers and viable financial instruments. These results aim to assist stakeholders as they take up the adaptation challenge and develop measures to reduce the vulnerability of the sector to climate change.

This work is partly presented at World Conference on Climate Change