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Participatory methods for developing a Bayesian network model for simulating catchment resilience under future scenarios.

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The cumulative impacts of future climatic and socio-economic change have the potential to threaten the resilience of freshwater catchments and the important socio-ecological services they provide. Working with stakeholder groups from Scottish Water (statutory corporation that provides water and sewerage services across Scotland) and the Scottish Environment Protection Agency (environmental regulator), we established a participatory method for developing a Bayesian Network (BN) model to simulate the resilience of the Eden catchment, in eastern Scotland, to future pressures. The Eden catchment spans approximately 319km², arable farming is the major land use, and the catchment falls within the Strathmore, Fife and Angus Nitrate Vulnerable Zone. The participatory method involves co-developing a BN model structure by conceptually mapping land management, water resource and wastewater services. Working with stakeholders, appropriate baseline data is identified to define and parameterise variables that represent the Eden catchment system and future scenarios. Key factors including climate, land-use and population change were combined in future scenarios and are represented in the BN through causal relationships. Scenarios consider shocks and changes to the catchment system in a 2050-time horizon. Resilience is measured by simulating the impacts of the future scenarios and their influence on natural, social and manufactured capitals within a probabilistic framework. Relationships between specific components of the catchment system can be evaluated using sensitivity analysis and strength of influence to better understand the interactions between specific variables. The participatory modelling improved the structure of the BN through collaborative learning with stakeholders, increasing understanding of the catchment system and stakeholder confidence in the probabilistic outputs. This participatory method delivered a purpose built, user-friendly decision support tool to help stakeholders understand the cumulative impacts of both climatic and socio-economic factors on catchment resilience.