The conceptual foundation of environmental decision support (Reichert et al 2015) [1]

Environmental decision support intends to use the best available scientific knowledge to help decision makers find and evaluate management alternatives. The goal of this process is to achieve the best fulfillment of societal objectives. This requires a careful analysis of (i) how scientific knowledge can be represented and quantified, (ii) how societal preferences can be described and elicited, and (iii) how these concepts can best be used to support communication with authorities, politicians, and the public in environmental management. The goal of this paper is to discuss key requirements for a conceptual framework to address these issues and to suggest how these can best be met.

We argue that a combination of probability theory and scenario planning with multi-attribute utility theory fulfills these requirements, and discuss adaptations and extensions of these theories to improve their application for supporting environmental decision making. With respect to (i) we suggest the use of intersubjective probabilities, if required extended to imprecise probabilities, to describe the current state of scientific knowledge. To address (ii), we emphasize the importance of value functions, in addition to utilities, to support decisions under risk. We discuss the need for testing "non-standard" value aggregation techniques, the usefulness of flexibility of value functions regarding attribute data availability, the elicitation of value functions for sub-objectives from experts, and the consideration of uncertainty in value and utility elicitation. With respect to (iii), we outline a well-structured procedure for transparent environmental decision support that is based on a clear separation of scientific prediction and societal valuation. We illustrate aspects of the suggested methodology by its application to river management in general and with a small, didactical case study on spatial river rehabilitation prioritization.

Keywords: Multi-criteria decision analysis; Environmental management; Societal decision support; Stakeholder involvement; Intersubjective probabilities; Multi-attribute value theory; Multi-attribute utility theory; Uncertainty; River management

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