A Fuzzy Set Risk Analysis Technique for Water Supply under Climate Change

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The main purpose of the risk analysis techniques is to select/rank management actions for local waterworks/water authorities under climate change. Risk of water supply is influenced by the available water supply, water demand and consequences of water shortage. Due to the inherently uncertain climate change estimation, all these quantities influenced by climate change are also uncertain. Thus, the combination of water shortages and consequences may be accomplished in a risk analysis framework. Often, frequency based statistical information is unavailable so common probabilistic risk analysis may not be applicable. To this end, a non-probabilistic risk analysis is presented that is relatively simple, practical and applicable with available data/information. The method is based on simplified fuzzy set mathematics. Thus, supply, demand and consequences are represented as uncertain (fuzzy) numbers. Four main parts of the methodology include 1. formulation of alternative management actions, 2. definition of the structure of ranking criteria, 3. estimation of ranking criteria values for each management action, and 4. ranking of the management actions according to the ranking criteria. Management actions are evaluated according to several criteria. One group of criteria considers water supply risk reduction for the various users. Another group of criteria may be also necessary: one related to the realization of the actions. Both water quantity and quality risk are considered. The use of the risk analysis techniques is illustrated by a case example.