

# How Should Diverse Stakeholder Preferences Shape Evaluations of Complex Water Resources Systems Robustness to Deeply Uncertain Changes?

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Robustness analysis has emerged as a significant tool for assisting long-term planning of large-scale water infrastructure projects confronting future deeply uncertain climate and socio-economic changes. A growing number of studies have shown that the methodological choices that underpin the quantification of robustness strongly influence how stakeholders will perceive vulnerabilities within their systems. Large scale water projects involve multiple actors and sectors with a diverse range of interests and risk aversion, creating a daunting challenge for formulating robustness assessments that adequately captures diverse and potentially conflicting interests.

Here, we explore the impacts of methodological choices on the robustness of the Inchampalli-Nagarjuna Sagar (INS) mega water transfer project. The INS project is a multi-actor and multi-sector water transfer from the Godavari basin to the Krishna basin in Southern India. We identify, develop and test a diverse suite of robustness metrics representing different levels of risk aversion as well as various actors-sectors involved. Socio-economic and ecological sectors are represented by irrigation and water supply sector, and minimum environmental flow requirements, respectively. We evaluate the robustness of a suite of dynamic adaptive state-aware strategies to operate the INS project against the status quo of no water transfer and a strategy proposed by regional authorities. All of the alternatives are evaluated across a range of climatic scenarios that explore changes in the Indian Summer Monsoon and the demands in both the basins. The results show that the choices of actor-sector and their level of risk aversion has a large influence on robustness estimates. We also find that the ranking of decision alternatives varies significantly across choices of actor-sector considered in robustness evaluation. However, we were able to identify a few decision alternatives that consistently attain high robustness ranking across these choices. Our analysis indicates that large scale water projects need to employ broad exploratory robustness analyses that better engage with conflicting stakeholder objectives and that help to clarify how differences in risk aversion shape the vulnerabilities of preferred actions.