

## **Managing the competing water demands from off-stream and in-stream users—a conceptual framework**

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**Abstract** Satisfying the demands of freshwater for growing population, industrialization and urbanization appears to be an enormous challenge to continuing to run the economic wheel without undermining the ecosystem needs. Environmental water allocation is widely acknowledged; however, it is implemented in few countries mainly in developed regions, even though dependency on flow is more pronounced in developing countries. Environmental water requirements are often ignored in traditional water allocation decision-making in these countries. Available environmental flow assessment methodologies focus more on conservation and restoration of the aquatic ecosystems, rather than taking the economic value of water into consideration. However, it is observed that economic aspects play a critical role in the implementation of environmental flow. A conceptual model for water allocation based on marginal benefits from sectoral water-use is proposed in this study to ensure environmental water allocation. An economic–hydrological model is conceptualized in which the economic return from all water uses is to be correlated with river discharge. The derived marginal benefit functions are targeted for both off-stream and direct in-stream uses through analysis of the economic return from off-stream extractions and the variation of in-stream use benefit in terms of flow level fluctuation. Two marginal benefit functions are proposed for the optimization analysis by maximizing consumer surplus and minimizing demand deficit. Such analyses will explore the extent of trade-offs associated with establishing environmental water allocation and subsequently will help in achieving environmental and economic sustainability by having equity between all users.

**Key words** environmental flow; in-stream use; off-stream use; marginal benefit; optimal allocation