

## Water Quality Trading with Equitable Total Maximum Daily Loads

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**Abstract :** Waste load allocation (WLA) strategies usually intend to find economical policies for water resource management. Water quality trading (WQT) is an approach that uses discharge permit market to reduce total environmental protection costs. This primarily requires assigning discharge limits known as total maximum daily loads (TMDLs). These are determined by monitoring organizations with respect to the receiving water quality and remediation capabilities. The purpose of this study is to compare two approaches of TMDL assignment for WQT policy in small catchment area of Haraz River, in north of Iran. At first, TMDLs are assigned uniformly for the whole point sources to keep the concentrations of BOD and dissolved oxygen (DO) at the standard level at checkpoint (terminus point). This was simply simulated and controlled by Qual2kw software. In the second scenario, TMDLs are assigned using multi objective particle swarm optimization (MOPSO) method in which the environmental violation at river basin and total treatment costs are minimized simultaneously. In both scenarios, the equity index and the WLA based on trading discharge permits (TDP) are calculated. The comparative results showed that using economically optimized TMDLs (2nd scenario) has slightly more cost savings rather than uniform TMDL approach (1st scenario). The former annually costs about 1 M\$ while the latter is 1.15 M\$. WQT can decrease these annual costs to 0.9 and 1.1 M\$, respectively. In other word, these approaches may save 35 and 45% economically in comparison with command and control policy. It means that using multi objective decision support systems (DSS) may find more economical WLA, however its outcome is not necessarily significant in comparison with uniform TMDLs. This may be due to the similar impact factors of dischargers in small catchments. Conversely, using uniform TMDLs for WQT brings more equity that makes stakeholders not feel that much envious of difference between TMDL and WQT allocation. In addition, for this case, determination of TMDLs uniformly would be much easier for monitoring. Consequently, uniform TMDL for TDP market is recommended as a sustainable approach. However, economical TMDLs can be used for larger watersheds.

**Keywords :** waste load allocation (WLA), water quality trading (WQT), total maximum daily loads (TMDLs), Haraz River, multi objective particle swarm optimization (MOPSO), equity

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