ABSTRACT

In the present study, a new framework model was conceptualised and formulated based on governing variables for water allocation; in an effort to enhance the objectivity for a reasonable and equitable allocation of water among co-basin states. The governing variables were normalised to reduce the governing variable of different co-basin states of a river basin on the same scale. In the absence of objective methods for evaluating the weights to be assigned to co-basin states for water allocation, a framework was also conceptualised and formulated for determination of the weightage of different co-basin states as a function of the governing variables. The water allocation to any co-basin state had been assumed to be proportional to its struggle for equity, which in turn was assumed to be a function of the normalised discontent, satisfaction, and weighting factors of each co-basin state. System dynamics was used effectively to represent and solve the proposed model formulation. The proposed model was applied to two river basins; namely, Vamsadhara and Cauvery river basin of India to test applicability and robustness for real river basins. The proposed model was successfully applied to the Vamsadhara river basin, and sensitivity analysis of the proposed model parameters was carried out to prove its robustness in terms of the proposed model convergence and validity over the broad-spectrum values of the proposed model parameters. The solution converged quickly to a final allocation of 1444 million cubic metre (MCM) in the case of the Odisha co-basin state, and 1067 MCM for the Andhra Pradesh co-basin state. The sensitivity analysis showed that the proposed model's allocation varied from 1584 MCM to 1336 MCM for Odisha state and from 927 to 1175 MCM for Andhra, depending upon the importance weights given to the governing variables.

In application to the Cauvery river basin, the Cauvery Water Disputes Tribunal award for water sharing among the co-basin states of the Cauvery river basin was analyzed and compared with the results obtained by using the proposed model by analyzing the same data

that was used by the tribunal. The study demonstrated that the tribunal award was unable to resolve the water-sharing problem even for a year with a normal yield in the Cauvery basin. This is because the analysis of the Cauvery basin yield data revealed that the different hydrological conditions of the co-basin states also generated normal yield in the Cauvery basin as a whole, but the tribunal did not consider this fact. The same problem persisted in the water distribution among co-basin states by the tribunal for different levels of dependability for the yields of the Cauvery basin. Although the tribunal considered the Berlin principle for a reasonable and equitable apportionment of water among co-basin states, but it primarily distributed the water based on a combination of rational as well as subjective decisions by adjusting the irrigated areas and water application efficiencies to match the demands with the available yield of the Cauvery basin. However, the results of the model demonstrated different allocations to different co-basin states depending upon the hydrological conditions of the individual co-basin states even for a normal yield of the Cauvery basin against the static allocation of water recommended by the tribunal. The model recommended that the water allocation be varied from 380 thousand million cubic feet (TMC) to 399.4 TMC for Tamil Nadu,from 278.1 TMC to 315.2 TMC for Karnataka, from 42.5 TMC to 45.2 TMC for Kerala, and from 5.6 TMC to 6.2 TMC for Pondicherry depending upon the hydrological conditions of the co-basin states during a normal yield of the Cauvery basin, against the static values of water allocation proposed by the tribunal of 419 TMC for Tamil Nadu, 270 TMC for Karnataka, 30 TMC for Kerala, and 7 TMC for Pondicherry for the normal yield of the Cauvery basin. The study demonstrated that more objectivity can be achieved in the water allocation among co-basin states by applying the proposed model, as the model can consider the effects of different governing variables in an objective manner for a reasonable and equitable distribution of water. As such, the proposed model has the potential to resolve the transboundary water allocation problems in an objective manner for a reasonable and equitable distribution of water among co-basin states.