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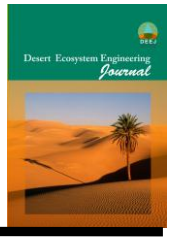

Simulating Surface Water Allocation and Identifying Systemic Archetype Using Vensim Software: A Case Study of Qorveh Dehgolan's Basin

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Extended Abstract

Introduction: Modeling the allocation of water resources systems in the world has been considered from different perspectives. One of the most important differences in modeling is between linear and dynamic approaches. The term linear refers to a common approach in modeling with a mechanical conception of events that justifies phenomena with unilateral cause and effect relationships. On the other hand, in the dynamic approach, which is also applied in the present study, the system is first broken down into smaller components, the mutual causal relationships between the components are defined, and finally, the combination of their results determines the system's performance. Together with each other, Causal relationships create a Generic Archetype that helps identify the problems and solve them, which could especially be helpful in water resources management. This study sought to simulate surface water allocation in the agricultural sector of Qorveh Dehgolan's basin, dealing with future problems by identifying generic archetypes.

Materials and Methods: in the study area, drinking water, the water used in industry, and some part of the water used in agriculture are supplied from groundwater's. Thus, the researchers attempted to measure the amount of surface water consumed by the agricultural sector. To this end, first, the model was simulated on an annual scale. Then, after ensuring the model's accuracy, it was implemented on a monthly scale using the Vensim software. Moreover, behavior and condition tests were performed to validate the simulated model, proving the model's high accuracy.

Results: To ensure that the decrease in rainfall does not affect discharge, a comparison of rainfall trends and river discharge was performed in two selected stations, and the results showed that the decrease in river discharge was due to consumption. After that, has been evaluated model in annual scale, we used average values

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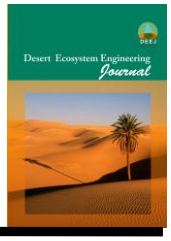

of RMSE and MAE in all stations, results show values equal 0.4 and 0.10 respectively, on the other hand, the test of limit conditions was confirmed high accuracy of the model.

In the next stage, the average percentage of computational withdrawals was calculated for the annual scale, and the results showed that the maximum and minimum percentages of water consumption are equal to 27.79 and 19.53 for Dehgolan and Golbalagh stations, respectively. These values indicate a deficit equal to 50% of the water requirement throughout the simulation period. Then, simulations were performed on a monthly scale before and after dam activity. Before operating the dams in the region (until 1390), the RMSE and MAE values were calculated as 0.74 and 0.39, respectively, which confirmed the model's efficiency. Then the impact of dams on the region's behavior and the causes of their occurrence was considered. Despite an intense decrease in discharge, the activity of generic archetypes, such as growth limit, failed fixes, and escalation, have expanded the under-cultivation area in all zones from 1390 to 1395, with the HassanKhan under-cultivation zone being expanded by 4.5 times compared to the previous conditions.

Discussion & conclusion: Simulating the dams' post-operation performance model shows that the dams' output can be increased up to 2 times in the best case. An increase in growth-limit patterns failed solutions, and escalation has led to the construction of dams in this region to deal with water shortages crisis and to supply more water, and, thus, to the expansion of under-cultivation areas in all zones with the assumption of the existence of adequate water supplies. Therefore, in addition to the critical decrease in Qorveh and Dehgolan aquifers' water level throughout the 1369-1390 period, the region's discharge rate has dropped by 72% compared to its rate at the beginning of the period (from 1390 to 1395), and by 114% compared to the whole study period due to recent extractions, while according to most of the meteorological station, the precipitation rate has not been decreased so critically.

On the other hand, the under-cultivation areas in zones where dams are constructed such as Soral, Sang Siah, and Golbalagh, or under-cultivation areas in areas located downstream of those zones, including Hassan Khan, have been expanded by 2.40, 3.56, 3.93, and 4.5 times compared to the study period's average rate in response to the escalation. As the growth limit and failed solutions have not been applied to these zones yet, this part of the basin has increased the irrigation efficiency from 37% to 45% to maintain the equilibrium. Therefore, considering the observed behaviors, it could be argued that if appropriate measures are not taken to manage water consumption properly, the dams' minimum output and their reservoirs' dryness would be highly expected.

Keywords: Qorveh Dehgolan, System Archetype, System Dynamics, Vensim, Water Allocation.