

“New Thinking in Sustainability: A System Dynamics Approach” Case Study: Karaj watershed, Tehran, Iran

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A sustainability assessment on socio-economic and ecological system requires a systemic perspective in order to address the close relationship between the environmental and socio-economic process. Among all complicated systems, watersheds have been widely acknowledged to be the appropriate unit of analysis for many water resources planning and management problems. Since many of the environmental processes and socio-economic activities within a watershed system are too complex, dynamic, and spatially variable, we need to take a systemic perspective in order to address the close relationship between the included sustainability indicators. The Karaj watershed with 1,070 km², is considered one of the most important water resources in Tehran, the capital and the most populous and strategic city in Iran. Recently the quality of water is one of the most important challenges in the study area inasmuch as the National Security Council has passed some action plans to reduce and prevent the water pollution in this area. The aim of this research is the development of a new thinking with a system dynamics approach to deal with sustainability issues. Much research has been carried out piecemeal on different aspects of the Karaj watershed. However to disentangle drivers and dynamics of change in this complex system, we need to put these pieces together and analyze the system as a whole. In this research we apply a qualitative model of the Karaj watershed socio-economic and ecological system using Vensim PLE software. We then investigated the model system through loop analysis and finally examined effects of changes on the system state and structure. This model allowed us to investigate system-wide chain reactions resulting from disturbances. We found that in different sub-systems including environmental, socio-economic, and institutions there are disturbing parameters which are related together when we see them as an integrated system. Delays, policy resistances, and rule beating are three major system traps in the Karaj watershed system that bring the whole system in unsustainable situation. Also we discovered population has a dual balancing and reinforcing role with respect to sustainability of the Karaj watershed. This controversy comes from the migration out of area and high potential tourism activity especially during the spring and summer. By understanding different pathways that regulate a single process, we obtained multiple tools with which to manage changes. These changes in the Karaj watershed system have been discussed according to Meadows leverage points; places to intervene in a system. This model is simple and usable to assess system-wide effects of management policies, and can serve as a paving stone for future quantitative analysis of system dynamics at local scales.