A SYSTEM DYNAMICS APPROACH TO ANALYZE WATER RESOURCES SYSTEMS

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In closed models the systems are influenced by their history through feedback links from output to the inputs which is the actual behavior in the real world events. This paradigm is the main focus of system dynamics (SD) approach. The methodology, developed by Forrester (1961) and refined over the last 40 years, was initially applied in industrial and business systems management but have been expanded to a diversity of fields (see *e.g.* Forrester, 1971,1973; Meadows et al., 1974; Kelly, 1998; Sterman, 2000; Simonovic et al., 1997; Simonovic & Fahmy, 1999 and Simonovic, 2002).

The elements of water resources systems and their relationships can be addressed by SD major concepts such as causal loop diagrams (feedback loops), and stock-flow variables. In this paper the system dynamics approach was applied to analyze the dynamic mechanisms of the urban water system in Tehran – the capital of Iran.

Seven mechanisms were identified as: Water withdrawal; Pollution; Population growth; Growth of per capita water consumption pattern; Technical capacity building for water distribution network; Technical capacity building for water regulating; Providing financial resources. In Fig. 1 the causal loop diagram of technical capacity building for water distribution network is demonstrated as an example.

Simulation of Tehran urban water system for the existing and the future conditions was done after all the mechanisms were formulated. Based on the dynamic simulation it was found out that continuation of the existing conditions in Tehran will result in water crisis. That is because of the failure in the distribution technical capacity building mechanism. Three scenarios were developed for tackling the crisis. These scenarios include *"Omitting the water transfer limitation from neighbouring basins"*, *"Allocation of enough financial resources for network maintenance"*, and *"Intensifying controlling policies in order to reduce the water consumption pattern"*. Based on the results of simulation of the scenarios, the second one was found to be the most effective to mitigate water crisis in Tehran.

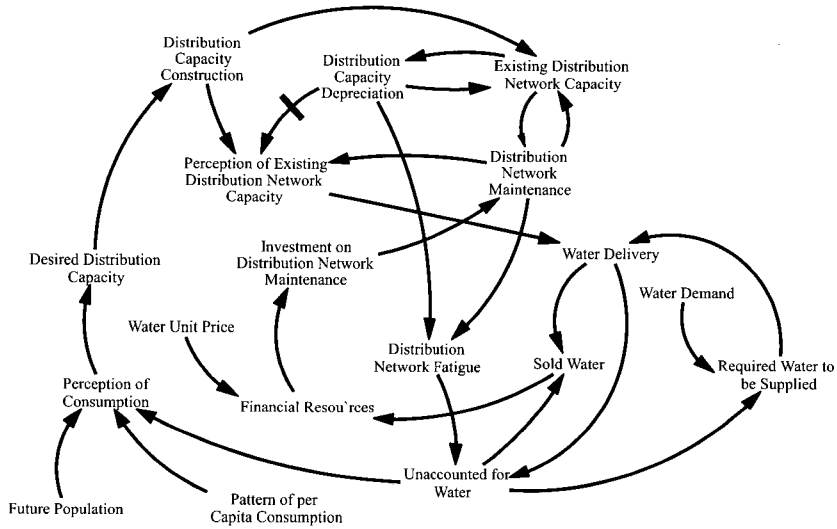

Fig. 1 Causal loop diagram of technical capacity building for water distribution network in Tehran

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