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EXTENDED ABSTRACT

Modeling the Effect of Consumption Pattern on Per Capita of Urban Water with System Thinking (Case Study: City of Birjand)

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1. Introduction

Nowadays, considering the scarcity of water resources and the increasing growth of population and water demand, Water resource management be deemed to be essential. One way for managerial to deal with the crisis of water scarcity and protect existing water resources, is the management of the Demand and water use in the urban sector. Iran, with an average annual rainfall of 250 mm, is one of the dry countries in the world. The rapid growth of the population over the past few decades and the lack of attention to its control over the country's planning priorities and the inappropriate pattern of energy and water consumption have faced Iran with serious challenges in this regard. Considering the significant reduction in water resources available on a global scale and the importance of achieving sustainable development goals, the study of factors affecting water resource management has been considered more than ever. In order to compare the country's situation in the region, comprehensive information is needed on the amount of per capita consumption and the minimum amount of water needed to achieve a human development pattern.

So far in Iran, a study has not been conducted to establish a systemic relationship between the parameters affecting the consumption pattern in the urban sector and modeling the interaction between the pattern of consumption and per capita water as well as the sources of urban water supply using a dynamic system approach.

2. Methodology

2.1. *System dynamic*

The system dynamic method is a modeling and simulation methodology that is specially designed to solve long-term, chronic and dynamic management problems. This approach focuses on understanding how to interact with physical processes, information flows, and management policies how these factors create a dynamic variable. The set of feedback relationships between these compounds expresses the structure of the system.

2.2. *Vensim software*

Vensim software is a simulation software and a graphical object-oriented modeling environment. In this software, the graphs are constructed with a series of first-order pair differential (often nonlinear) equations,

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which are solved by the Euler or Rang-Kuta method. The modeling method in this software is to make the progress of the generalities to details so that the functions and connected components are gradually increased until a complete model gets ready to run.

This study aimed to determine the role of water consumption patterns on the quantity of urban water resources city of Birjand in South Khorasan province was performed. In this study, having regard to the parameters of affecting water demand, such as population, temperature, precipitation, holidays, water price, reducing consumption components and bath time and also with System Thinking and Vensim software, was examined the effect of these parameters on urban water use and their effect on groundwater resources city of Birjand under the different scenarios, and also-defined policies for the protection and preservation of the city water supplier sources.

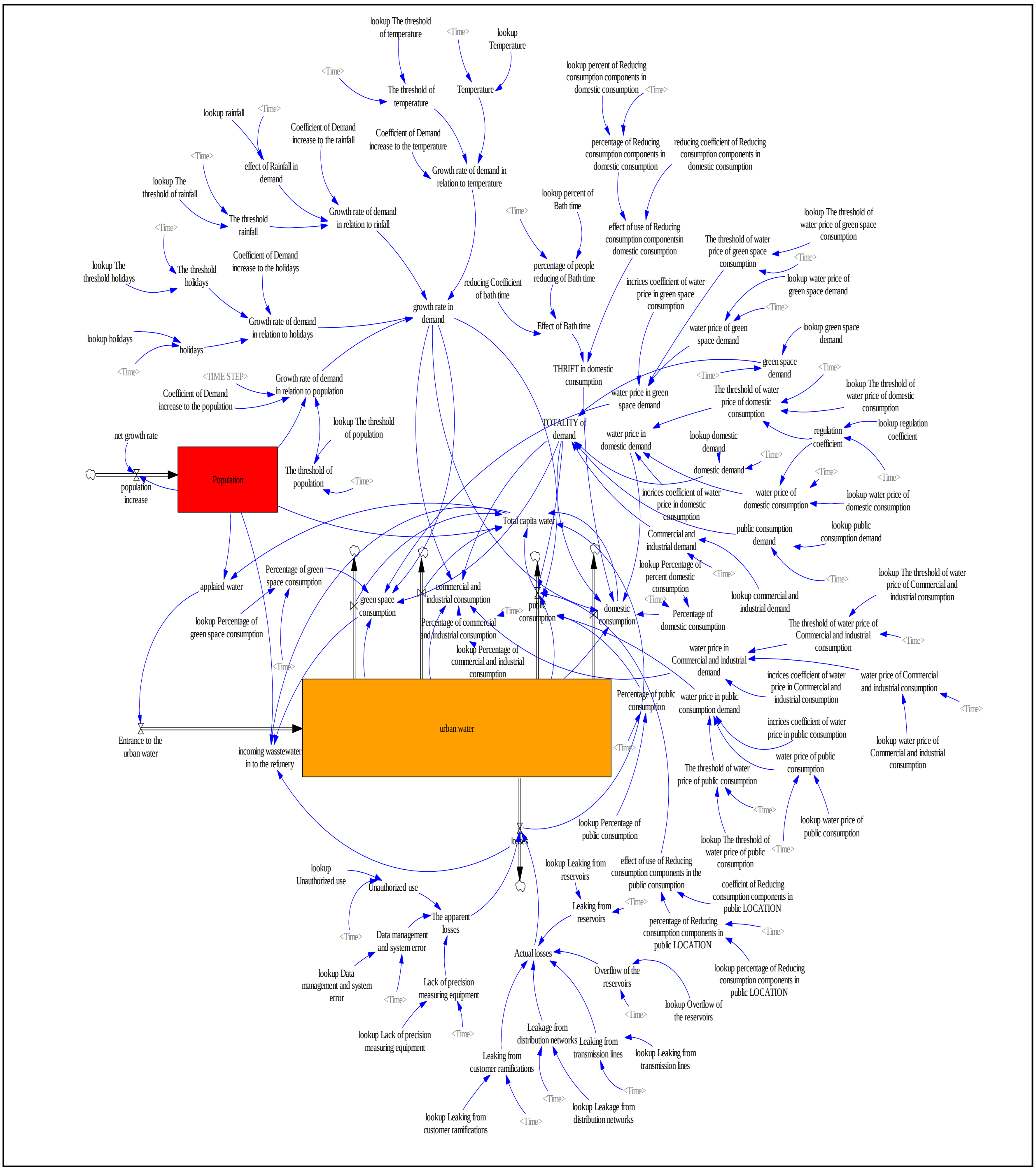

Fig. 1. Urban water model

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3. Results and discussion

The results show that, generally per capita urban water is increasing every year, with the difference that considering the upon defined policies reduce this increase, so that in all scenarios, in policy 3 that the consumption management policy is simultaneously through the government and consumer, about 20-30% relative to policy 4 which is the usual condition of the study area, we face a per capita decline each year. Of course, it should be noted that the annual of difference in water per capita in urban decreases in both policies 3 and 4 due to the decline of groundwater in the Birjand Plain.

The results also indicate that the volume of underground water in the Birjand plain, which is the main source of water supply in Birjand, has fallen in different scenarios, but this decline in policy 4, which is in fact the same as the current situation in the study area, compared to other policies, it has a steeper slope. It is also noticeable that this drop in the groundwater reservoir decreases dramatically by applying management policies, so that in the policy of 3, 2 and 1, there is a lower drop in the reservoir.

4. Conclusions

The results of these options show that with the continuation of existing conditions in the region and without change in the pattern of urban water consumption in the city of Birjand, will be a growing trend of per capita water consumption of citizens and this causes will be picked up a substantial amount of groundwater, so that be predicted the city in 1420 compared to 1392 in the six scenarios is defined respectively 231.85, 233.334, 233.335, 220.27, 239.26 and 239.25 million cubic meters be confronted with reservoir shortage. Therefore it is necessary that by adopting various policies in both sections of government and the consumer and applying the proper and efficient management techniques, to minimize annual groundwater decline in the city.

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