Provide a model system for the analysis of urban green space and water Shiraz Municipality

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Abstract
Reducing the country's water reserves is a problem that has its effects in various areas, such as climate, agriculture, vegetation, and so on, and an analysis of this dilemma is also an issue that needs to be analyzed in different ways. In this paper, using a systematic approach to the dynamics of the system, the dynamic relationship between municipal water and urban green space in Shiraz will be considered as one of the major cities of Iran. The system model of this study was simulated and analyzed using the above-mentioned approach and with DSS Vensim software. The analytical results of the research indicate that, if the water consumption is continued in accordance with the current situation, in the near future we will see the completion of municipal water. In this regard, the sensitivity analysis and the presentation of different scenarios of this problem were examined. The results of simulation and modeling indicate that thermal islands and construction are one of the most important factors affecting the increase of water. Also, the most important factors affecting water loss, type and rate of water use in the Shiraz municipality are vegetation cover. In this regard, the quantitative results of the model show that if water consumption per square meter can be reduced by 40 percent, 242 million cubic meters of total water will be saved in the 30-year period of simulation.

Keywords: green space, water, reduce consumption, water storage, temperature
1. Introduction

In sustainable urban development, one of the main sustainability factors of a city is its environmental issues. Cities are formed in most areas, regardless of land use planning and environmental considerations, which causes a lot of problems (Eftekhari et al., 2014). In order to achieve this, we must use efficient land management techniques to assess the land use capability and evaluate the effects of development on urban development. Sustainable urban development has emerged as a pseudo-paradigm dominant in urban development strategies in response to socioeconomic disadvantages from the ecological point of view. On the other hand, the first areas in urban sustainable development are related to urban development policies, green space and clean water, prevention of air pollution, and reduced waste production at the local level (ATM). There is a close link between sustainable development and the power category, to the point where some, like Elkin et al. (1991), believe that social justice and environmental equilibrium are necessary and mutually exclusive, and that realization of one without another is impossible.

In the context of sustainable urban development, different Iranian cities have started a different range of activities. Shiraz is one of the great cities of Iran in the center of Fars province.

In the last four decades, systems analysis techniques have been researched by water resource engineering researchers in resource planning and management. One of the types of patterns used in such issues is simulation patterns. The analysis of systems has an important place in water resources management and simulation is an essential tool for decision making in the process of water management (Momeni & al., 2006). In this regard, the dynamics of a system or dynamical system is a targeted, feedback based approach that is simple and effective compared to other
systems analysis methods (Forester, 1968) and can be used as an efficient method in modeling Water resource management systems are used. The system dynamics method helps managers better understand the real world conditions for the causes of resource depletion and provide a knowledgeable tool for executives (Jackson, 1991).

According to the articles in the previous sections, the researcher is to answer the key question "Does the decrease of water resources of Shiraz municipality affect the increase of the urban environmental crisis?" To express For this reason, the present study, entitled "Impact of Shiraz Water Reduction Impact on Increasing Urban Environmental Crisis Using Systemic Dynamic Approach", aims to identify the role of the central management component in environmental protection. This is because a sustainable city must be a city in harmony with nature and the environment.

The concept of system dynamics was first introduced by Forester and has grown rapidly over the past fifty years. This science is an approach to discovering the nonlinear dynamical behavior and studying how structures and system parameters influence the behavioral models of the system. The output of the discrete simulation system, with the dynamics of the system approach, is to design effective performance policies to achieve high performance levels. A fundamental theory derived from the system dynamics approach is that the structure of each system affects its dynamic behavior. In other words, in this approach, an image of the system is created based on existing feedback and delays so that the dynamic behavior of the complex physical, biological and social systems can be better understood. [2]

The components of the models created by the methodology of the dynamics of the system are: cause-effect charts, causal rings and flow diagrams. Cause-and-effect graphs are a tool for illustrating the causal relationships between the set of variables (or agents) within a system. On the other hand, the presence of feedback in cause and effect relationships creates causal rings. Ali have different behavioral models that divide into a general divisor 2 and equilibrium loops 1 into amplifier loops. Boost loops are equivalent to positive feedback and equilibrium loops equivalent to negative feedback. Investigating the behavior of the system over time requires the simulation of relationships and variables that in simulation, flow diagrams will be equivalent to causal loops. [3]

Stroman’s modeling process to implement the dynamics of the system is in accordance with the form of a feedback mode. This process indicates that it is important that the results of each step lead to awareness that can be revised in the previous steps (in the form of this, the connection is made by the center of the graph). [2]
Background research

1. Dashti et al. (2010). Assessing the ecological capability of the land as the core of environmental studies is similar to the prevention and even the treatment of environmental crises. Therefore, before the implementation of the development, it is necessary to determine the ecological potential of the land for different uses. Zakherd watershed with an area of 82.23 km² is located in the northwest of Shiraz and east of Kazeroun city in Fars province. This basin is in the process of population growth and it is essential that any environmental development studies be made prior to any development load. In the assessment of the Zakhkhrd basin, the McHarg method, the ecological model of urban development of Makhdoom in 2001 and the GIS tool have been used. In the process of this process, the sources of the region (ecological and socio-economic) were first identified. Then, with the integration and collation of information layers in the Arcview system, a map of the ecological units of the region along with a unit charts table was created and compared to the assessment of the capacity of the area and the areas prone to urban development.

2 Aqa Bali Taheri & Vakili (2012). The purpose of this study is to provide a water resource planning model for assessing the allocation of water resources and, consequently, to investigate deficiencies within the catchment area of the Hajilar Chay River. Accordingly, due to the complexity of water resource systems, the dynamics of the simulation system has been used. Results of the research showed that since the behavior of variables in the first scenario was consistent with their behavior in the second scenario, the results of the model were introduced in the second scenario. Reservoir behavior in the second scenario was investigated based on the total volume of 46.66 million cubic meters and dead volume of 25.85 million cubic meters. Results of the simulation indicated that the problem is expressed and the boundary between the dynamic hypothesis model and the problem-statement formulation Formulating policy and evaluating it. By changing the design of the water harvesting site from the reservoir or watershed at the top, sediment control can be used to increase the useful volume of the reservoir.

Zhang & Al. (2008) introduced a complex dynamic system for the planning and management of water resources in the city of Tianjin, China. The model includes information feeds that direct the interactions in the system, and can combine the knowledge of the components into the simulation of the system's overall behavior, thus expressing the predictive outcomes for politicians regarding the allocation and management of resources. Water is in Tianjin, interactions between 96 variables and 12 consecutive years have been studied and four options have been selected including: 1. Preservation of existing patterns of human activities in the future. 2. Balancing economic goals and sustainable use of water resources. 3. Focus on rapid economic growth that causes tensions on water supply. 4. Emphasizes the improvement of water resource management, such as controlling water pollution, adjusting local water policy and allocating water resources. Finally, optimal options are presented based on different scenarios after comparing simulation results.
Wang et al. (2011) argue that water security is an integral part of China's economic and social development. However, due to the growing population, heavy irrigation, the effects of climate change and short-term policies, water resources are under intense pressure. Traditional management approaches focus exclusively on increasing supply and reducing demand, regardless of complex interactions and feedback loops that manage the management of water use behavior. While these methods may provide quick solutions, they often lead to unexpected, sometimes catastrophic and delayed results in the negative effects of decisions. Therefore, water management requires a comprehensive approach that, by seeing the input and output flow of water in the form of a cycle, and, on the other hand, the factors affecting it, urban management decisions are to be moderated. In this paper, we use a system dynamical modeling approach to explore the future of water security in Yilin. After designing a conceptual model in the field of water supply and demand, the authors have reviewed the water resource dynamics over time. On the other hand, in this paper, three scenarios have been designed and reviewed, which indicate that the current management model cannot effectively meet future demand for water. While water purchases provide short-term benefits, it cannot fit into the growing population.

Research Methodology

In this regard, with the aim of providing solutions for managing and improving the status of the system under study, the tools used for modeling are the dynamics of the system, which seems to be based on a brilliant record this approach to modeling similar systems can model the dynamics of the real world in a useful and practical way.

In this regard, the use of this method in this research has been specifically aimed at a systematic and holistic view of key feedback and facilitating the understanding of complex interactions between different sectors.
Dynamic hypothesis

In this section, we have tried to step by step to express the structure that explains the behavior (total water loss).

The model of this study has two main positive rings and two main negative rings. The two main positive loops that are conceptually similar in shape are visible.
Loops 1 and 2 in shape. It is important to note that with increasing rain, the total water is increased and with this we will have more green space. Eventually, increasing green space will also increase rain.

Two loops 3 and 4 in shape? Indicates the use of water in low-consumption and high-consumption spaces (negative polarity references are displayed in red).

Finally, by adding the effects of construction in two ways, increasing the thermal islands and reducing the penetration of rainwater to the lower levels, the causal model of this study is in accordance with Fig. Complete.

Considering the complete chart in the form and considering the issue of reducing the total water (Fig. 1), we can conclude this:
The water from the rain, which ultimately forms the entire water, is used in the greenery. Due to the increase of thermal islands and the increase in the construction of buildings and roads, rainfall and penetration of water from the rain into the lower layers has decreased. As a result, water is not recycled to this water cycle and has seen a drop in total water during these years.

Considering the theoretical foundations and the research background and the factors influencing the analysis, as well as the dynamics model of the system, the relevant variables are used in the model of this study. The variables of this model are distinguished by the variables of state, flow, auxiliary, intra-6, and exogenous in the table.

Construction in Shiraz has led to an increase in urban area. This will have two effects:

1. Construction will change the city's gender. That is, the land that was formerly empty has become a building and a road. This will increase the level of the thermal islands, which directly affects the rise in temperature and rain reduction.

2. On the other hand, the conversion of land to the building and the road will reduce the penetration of surface water to the lower levels, leading to an increase in the evaporation of surface water. This
increase in evaporation will also not be raining because the temperature is not favorable due to the increase of the thermal islands for precipitation (effect No. 1).

These two effects in the model state and flow, on the left side? It can be seen with the impact on precipitation and the rate of municipal water increase. The total annual rainfall is considered as a state variable, which increases with increasing the green space and increasing the moisture resulting from it, and decreases with increasing thermal islands. The increase in the amount of annual precipitation is determined by the effect of a node function, the input of which is the ratio of total green space this year to total green space in the past year.

The municipal water increase rate is affected by rain and building effects. Thus, if the rainfall is higher than the average rainfall, then a coefficient greater than one (through the function of the locale f4) in the initial estimation parameter is multiplied by the water's rate, and if the rainfall is less than the mean rainfall, then a coefficient smaller than one through the above function In the parameter, the initial estimate will be multiplied. The construction effect will also have a similar effect on the rate of municipal water increase through the F3 locale function.

In the central part of the model, the total water state variable is located. Output rates of this variable are dependent on the area of green space, which is low consumption and high consumption, meaning that by multiplying the area of green space in the amount of water consumed per square meter, the amount of water consumed is obtained. The amount of water consumed per square meter of low-consumption and high-consumption green space has been extracted from data from previous years. The increase in the area of green space is affected by the total amount of water. That is, if the total amount of current water is less than one percent of the perceived level of it (the previous mentality of the policymakers of the total water), the effect of water on the green space will be reduced, according to the current situation. Of course, this effect is slower for more green space. These two effects on green space will be affected by two floating point functions f5 and f6 on two levels of forest and green space creation.

### Table of key study variables

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<td>4</td>
<td>The rate of forest and green space is low</td>
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<tr>
<td>5</td>
<td>The rate of creating a conservatory green forest</td>
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<tr>
<td>6</td>
<td>Forests and green space</td>
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</table>
Simulation and Validation

In order to ensure the accuracy of the model's performance, several tests have been carried out in this regard, which are referred to below:

- Repeat Test

The purpose of this test is to compare the simulation results with actual data to ensure that the model behaves correctly. As in figure 1 it can be seen that the actual information and simulation results of four variables of the model over the fourteen periods (from 82 to 95) indicate that the behavior of the variables examined is reasonably simulated by the model.
The simulation results are also related to the total green space variable with the shape. Further, due to the importance of this variable in municipal policies, the error rate test is presented with respect to the real and simulated values of this variable.

Minor Mine Error (RMSPE)

Based on this indicator, the greater the difference between actual and simulated data, the more simulation results can be trusted. The error rate in this method is calculated based on formula 1.
\[ \text{RMSPE} = \sqrt{\frac{1}{\theta} \sum_{i=0}^{n} \left( \frac{y_{T+i}^s - y_{T+i}^a}{y_{T+i}^a} \right)^2} \times 100 \]

\[ \text{UT} = \sqrt{\frac{1}{\theta} \sum_{i=0}^{n} (y_{T+i}^s - y_{T+i}^a)^2} \left( \frac{1}{\theta} (y_{T+i}^s)^2 + \frac{1}{\theta} (y_{T+i}^a)^2 \right) \]

The value of UT will always be between zero and one, the closer this value to zero, the simulated values and the actual deviation are less than each other.

5.3 Extreme Trial Examination

Most knowledge about real systems is related to the results of the extreme conditions. If knowledge of extreme conditions is included in the model, then an improved model will often be obtained in the normal areas (non-extreme). This test is effective for two reasons: the first reason is the discovery of defects in the structure of the model. Because many of the proposed formulas seem to be logical before considering the conditions. The second reason for using this test is to improve the applicability of the model to analyze policies that may lead a system to operate outside of the domains of its previous behavior [4]
In this study, a 10-year increase in this model will be simulated. According to the shape of the whole water from about 31 to zero. With this, the effect of water on low-energy and high-consumption green space will be in accordance with the shape.

![Figure 6: Total water loss over a 40-year simulation period](image)

![Effect of water on high green space](image)

![Effect of water on low water consumption](image)
Figure 7: Effect of water on high green space

Figure 8: Effect of water on low water consumption

Figure 9: Forests and green space Low water consumption

Figure 10: Forests and green space High consumption water
Sensitivity analysis

In this section, by changing some of the fixed values of the model, they will analyze their effect on the values of other variables. In this regard, we first examine the effect of the change in construction rates on the rate of water increase.

With the change in the increase parameter in construction in the range of 100 to 400 with a randomized distribution, changes in the rate of increase of water in accordance with the figure will be. This chart shows the extreme sensitivity of this rate to this parameter. Of course, this is conceptually not too distant, as changes in construction lead to changes in the amount of thermal islands that will have a significant impact on rainfall. The amount of precipitation also directly affects the rate of water rise.

In the next step, in sensitivity analysis, the effect of the change in the two parameters of water consumption per square meter of low-consumption and high-consumption green space on the total water is studied. In this regard, the coefficients of water consumption per square meter of low-consumption and consuming green space have changed to 50 percent, so that their effect on total water is observed.

According to Fig. 2, the effect of the two above parameters on this variable is also very significant and can have a great impact in the long run in preventing water loss. It is worth noting that it is possible to use the newest methods of irrigation to make possible passible changes.

According to the two previous forms, the effect of changes in model parameters on the rate of water increase and total water is significant and significant. This can be used as a basis for applying some corrective policies. Hence, in the next section, these changes will be considered.

5-5 suggested scenarios

In this section, we try to examine the outputs of the model in terms of changes in the main variables. According to the views of irrigation experts, using up to 50% of water use can be used to save water. In the first scenario, the effect of this issue is on the model.

\ Discussions, results and study suggestions

The suggestions of this model in the form of analyzes and scenarios can solve short-run, medium-term and long-term shortage of water scarcity in Shiraz municipality. For example, the use of modern irrigation systems in different types of green spaces using the graduates of this field in all three horizons will have a great deal. The analysis of the kind and type of green space used by the municipality is also related to the consumption and maintenance cost of another issue that can affect the medium and long horizons. It is also possible to see rising rainfall in the mid-
term and long-term horizons, by examining the world's most successful experiments in reducing the urban thermal islands.

The proposed model has a variety of capabilities for development. For example, in creating and collecting water, more profound loops can be further developed by analyzing deeper factors affecting rainfall. Also, in the water use section, we can examine the mechanisms of household wastewater treatment and the entry of this water into the municipal water.

One of the main constraints of this study is the lack of a comprehensive and precise database, since improving any problem at a level requires a thorough understanding of it, and a thorough understanding of the multifaceted and complementary data. Also, because of future changes in the real world structure that could suppress the model's assumptions, the analysis and prediction of the proposed model may be changed and criticized.
Reference


