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## Original Research Article

### “New Zayanderood”

## Investigation Within the Zayandehrood Stream Recognition and Examination it as a Socio-Ecological System

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### Abstract

**Problem statement:** The Zayandehrood River as the most important ecological factor in Isfahan plain, is the main factor in maintaining habitat and regulating of the region's ecosystem. In recent years, due to different reasons, the Zayandehrood has faced some issues include climate change, drought, traditional view on dam construction, population increase, using the age-old farming method, water-based industries, excessive water withdrawal, integrated management segregation and unprofessional and illegal resolutions, dehydration and dried-up crisis. These issues have caused intermittent interruption of river water flow in the Isfahan city, and consequently, deficiencies in the cultural, social, economic and tourism dimensions of the city.

**Research objective:** The research is based on the theoretical origin of landscape architecture discipline and adopts a systematic view of natural phenomena, considers the most important issue regarding the Zayandehrood River crisis in Isfahan in the separation of its constituent components as a result of the lack of a systematic and holistic view in its analysis and management. Therefore, the main strategy to solve this issue is the overview of the river as an integrated system, continuous understanding of ecological issues, and analyze the impact of society on the perception of an urban river.

**Research method:** This is a case study based on library resources, field observations, visual documents, and the adaptation of “understanding and analysis of the urban river as an integrated social-ecological system” theory as research method deals with understanding the subsystems, discovering its internal relations, conditions, pressure and flow rate of water in accordance with the situation of the Zayandehrood river.

**Conclusion:** The result of this study shows that the inconsistency between pressure and internal flows in ecological and social subsystems in this structure unbalance this complex, and its adaptability and self-organization properties have been disrupted. The issue should be noticed by recovering the neglected relationships between key social components (values, people, and government) and the lost relationships between ecosystem conditions and processes and the role of social infrastructure in massive decisions, also by implementing multilevel programs, timely and strategically return this balance to the system.

**Keywords:** *The Zayandehrood, Isfahan, urban river, Holistic view, Socio-ecological system.*

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## Introduction

The evolutionary history of the Zayandehrood river and studying the process of changing its role from a natural-ecological complication to a source for drinking water, agriculture, and animal husbandry, as well as the continuation of this route to affect the formation of human habitation and the city construction around the river is below the concept of "urban rivers." Due to this semantic and functional development, the components of the Zayandehrood River, as a historical urban river, expand in terms of quantity and quality. This issue is more complex and difficult in times of river crises, including drought, floods, pollution, diversion, etc., and requires reflection in understanding and providing solutions. In this regard, this study describes the status of the phenomenon as an entry point, examines the complexity of the river crises:

### A. An introduction to the Zayandehrood

"The Zayandehrood river originates from Zardkooh Bakhtiari and Haftanan and their tributaries in Shurab Tangazi, the region of Chaharmahal and Bakhtiari province. Having absorbed from some parts of Fereydan and Fereydoun-shahr areas of Isfahan province towards Isfahan city, the running waters flow from Gavkhouni swamp from southwest to east along a route, approximately 360 km. About one-third of the length of this route is the catchment, and two-thirds of it is the river watershed" (Hosseini Abri, 2001, 106).

By reading the document related to the distribution of water of the Zayandehrood River - known as Sheikh Baha'i scroll - related to the year 923 AH, it is concluded that out of 275 shares, the share of Isfahan is distributed through 9 main streams (Maadi) and their branches throughout the city. With the development of this network in the Safavid era, Isfahan has become a garden city and one of the most prominent urban settlements in the Middle East (Shafaghi, 2002, 69).

"Despite the abundance of water shares and the influence of climatic factors on the amount of water in the Zayandehrood River, the share of Isfahan and Jay Block, located in the eastern suburbs of the city, has always been 18% of the total river water (Sami'ei, 1928, 12).

"In other words, whether during the dry seasons or in the rainy years, the river flow was not selectively cut off on the city. The Zayandehrood River can be considered as one of the rivers of civilizations, the existence of ancient hills and the formation of the Zoroastrian-Sassanid core of Isfahan in its vicinity; also, these have made the Zayandehrood one of the cradles of Iranian civilization. On the other hand, by examining the historical maps of Isfahan, it is clear that nearly until the Safavid era, this river played the role of a moat and a southern fence for the city, and with the construction of Safavid gardens and bridges, the river has turned from a natural-defensive border into an urban river (Fig.1).

### B. Urban river as an objective-subjective phenomenon

The presence of the Zayandehrood River in this settlement has always played an essential role in people's perception of their living environment and has practically gone beyond a natural structure also as an identifying element that has caused a sense of belonging to a social and ecological phenomenon. As the famous French sociologist Emile Durkheim points out: "The sense of identity and belonging is influenced by human structures, values, culture, and interactions and is considered a socio-cultural category" (Durkheim, 2004).

The transfer of the concept of the Zayandehrood River from an objective phenomenon to the people's mindset and the formation of the concept of the Zayandehrood River as an Subjective-Objective phenomenon can be understood from studying the works of intellectuals about the Zayandehrood River in literary texts, poems, travelogues and historical documents: One can see the references to the name of the Zayandehrood in the poetry of great Iranian poets like Hafez, Saeb Tabrizi, Abdolteif Khojandi and Khaghani Shervani to lesser known poets and historians such as Ibn Hawqal, Yaqut al-Hamavi, Hamdollah Mostofi and later in the literary collections of Isfahan and the works of contemporary novelists historical evidence about the role of this river in the Seljuk period is the references of Mafrukhi in "The Mahasen of Isfahan" (5th Century); he refers to some features of the Zayandehrood water as well as the effects of its presence in Isfahan, which is more related

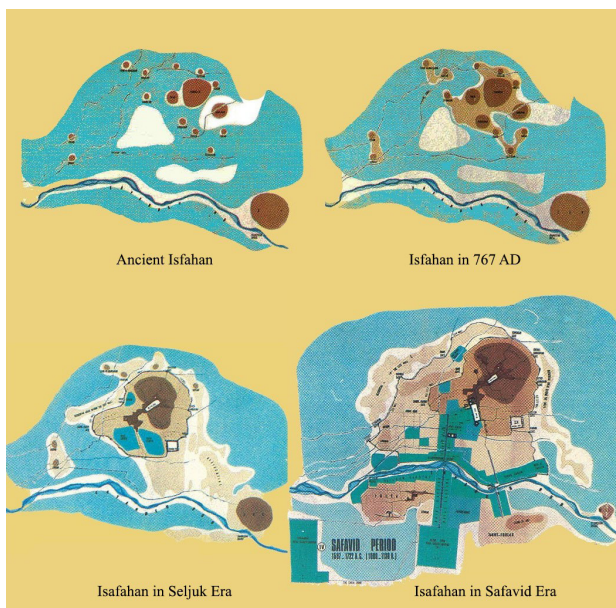


Fig. 1. The development of the Isfahan city and the location of the Zayandehrood River compared to the beginning of antiquity until the end of the Safavid Era. Source: Naqsh-e-jahan pars, 2009.

to “human connection of people with this nature” (OmraniPour & Mohammad Moradi, 2011, 173).

In the contemporary era and with the formation of the concept of citizenship and national identity, the attention increased. From the story of “Gavkhouni” by Jafar Modarres Sadeghi, “Az Sir ta Piaz” by Mohammad Ebrahim Bastani Parizi, and the story collection of “Isfahan: Half of the World” by Sadegh Hedayat to the story collection of “Yahyaei Zayandehrood” by Kayhan Khanjani; the authors have been writing more about the river and the whole concept of Isfahan. In one of the most prominent examples, Ahmad Mir Alaei, a famous Isfahani translator and author had written: “Nearly thirty years ago, when I was leaving Isfahan to see the world or maybe capture the world, I did not think I would return to this city again. Who was I and what was I doing in the west? Little by little, I became an Isfahani, and my speech became accented, I subconsciously insisted on this identity, if I walked next to a river, that river would become the Zayandehrood” (Mir’ala’i, 1993, 36).

Based on this evidence, the Zayandehrood can be considered as a very important factor in the historical understanding of the people and elites of society from the concept of Isfahan; an issue that, according to Durkheim, defines it as a very high sociocultural

phenomenon. That is why this river can be seen not only as a natural phenomenon in the structure of the city but also as a socio-ecological phenomenon (Fig. 2).

A phenomenon that has become the main element of the urban landscape of Isfahan, meaning “the result of the interaction of memories (intangible-subjective) and body (tangible-objective)” (Atashinbar, 2009).

## Research Background

The researches that have previously dealt with the issue of the Zayandehrood drought crisis and its solutions can be divided into three groups: ecological pathological researches, social pathological researches, and river watershed management researches. The first group has mainly studied the damages caused by river drought in various fields, such as: “the Zayandehrood water shortage crisis, consequences and solutions” by Seyed Ramin Amininejad, (Samadi & Rahmati, 2015). When they studied the historical hydrological landscape of the Zayandehrood, the status of water resources and the extraction indicated the need to model integrated water resources management and attention to the other economic, social and cultural aspects of the river. In this research group, “Environmental Impacts of the Zayandehrood Dam Lake” (Eslamifar, 2009) also investigates the ecological and environmental effects of river drought.

The second group of these researches was focused on crisis and social protests caused by the Zayandehrood drought crisis; examines the effects of the Zayandehrood crisis among social groups and the instabilities that occur between them.

In this category, researches such as “Semantic Context of Cultural Consequences of Drought and Zayandehrood Drought (with an Emphasis on the Cultural Identity of Isfahan Citizens)” (Faeghi & Navabakhsh, 2016), and “Impact of the Zayandehrud drought on social interactions and populated spaces in Isfahan city” by (Ghasemzadeh, Pazhuhan, Hataminejad & Sajjadzadeh, 2014), have dealt with the impact of water shortage and drought crisis on the transmutation of the cultural role of the river and reduce its impact on social interactions. (Golkarami & Morad Kaviani Rad,



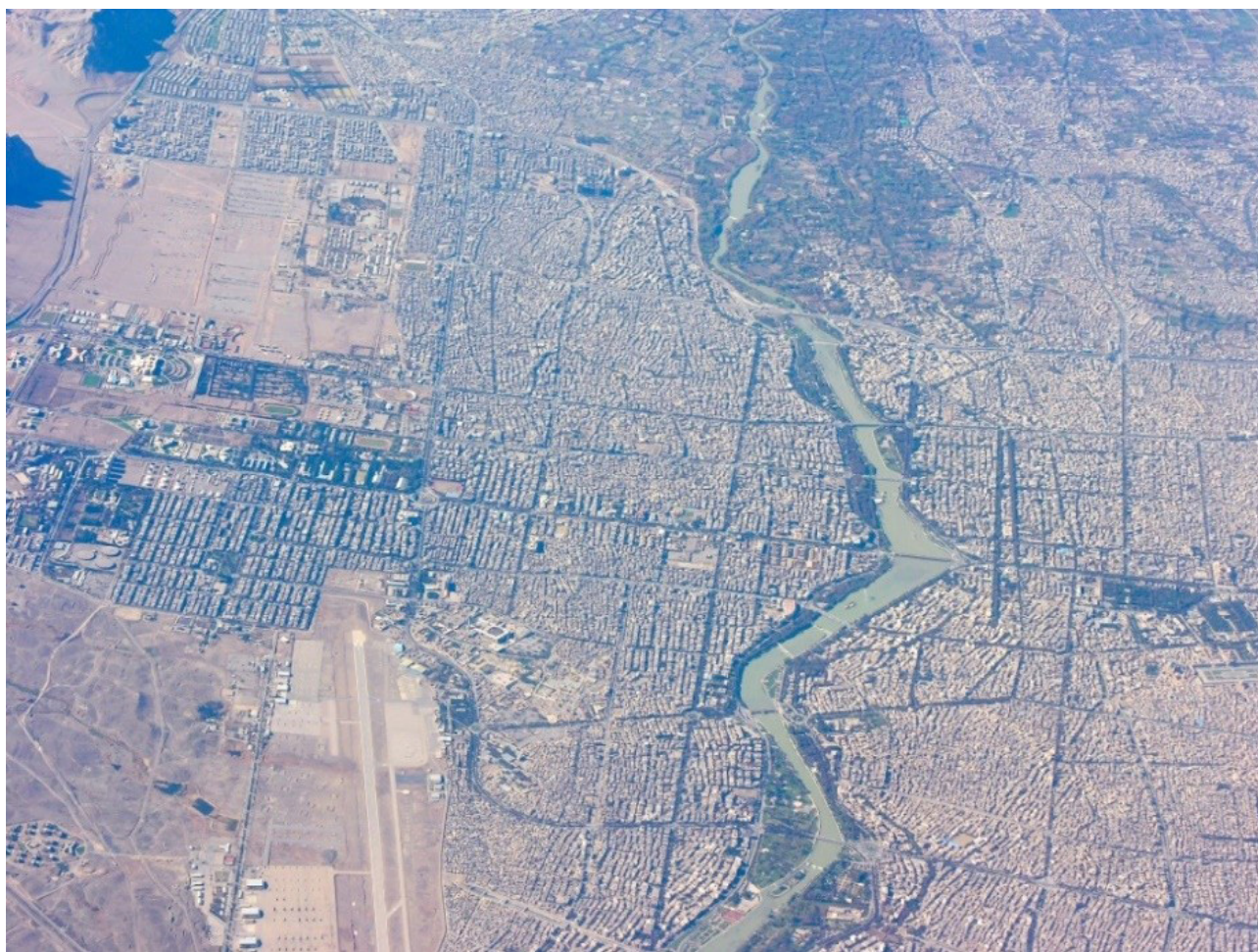


Fig. 2. Aerial photo of Zayandehrood River at the geographical border of Isfahan. Source: Krapf, 2006.

2015), with their study “The Effect of Limited Water Resources on Hydropolitic Tensions (Case Study: Iran’s Central Catchment with Emphasis on Zayandehrood Basin)” analyzes the social tensions resulting from the Zayandehrood drought crisis and the social, political, economic and environmental risks of this crisis from a political, geographical perspective.

The third category is mainly researches that emphasize the need for a holistic view on the management of the Zayandehrood River, such as the “Report on the Integrated Water Resources Management Document Zayandehrood-iwrm” in 2017, (Ministry of Education and Research of the Federal Government of Germany, 2017), and Isfahan Regional Water Company, which deals with the need for integrated management of water resources and consumption in the fields of agriculture, industry and urban water supply. Also, the “Zayandehrood (Gavkhouni) watershed rehabilitation

program” from the Presidential Center for Strategic Studies in 2018, while proposing a practical reform of the water governance system, speaks of the need to use public participation and reducing central government intervention in managing the Zayandehrood basin. In the same category, researches such as “Solution to the Water Crisis in the Zayandehrood River Basin Area” by (Safavi & Rastghalam, 2016) pay attention to the current management of the river in the basins mentioned above and provide solutions to improve it.

In this regard, in a group of researchers, with a close social pathological view on the issue of comprehensive river management, they have dealt with pathology and sometimes provided solutions in this field.

“Sociology of a Crisis: The Social Pathology of the Water Crisis in the Zayandeh-Rood River Basin” written (Talebi Somesarayee, Zokaie, Fazeli & Jomehpoor 2019), while paying attention to the

social and political issues of the Zayandehrood crisis, by studying the laws and attracting the attention of experts, tried to adopt a comprehensive view of governance ruptures and weaknesses in river resource management as the main generators of the current situation. Also, the research “Water Supply Crisis in Zayandehrud Watershed; Social Issues and Solutions to Manage it (Demonstrations of 2011 to 2014)” written (Esmaeili, 2020) with a field of study about crisis and social protests and their causes provides solutions solving the water supply in the Zayandehrood basin area and reducing social harms, including land use planning and managing the river unit.

In comparison, the difference between the selected view in the face of the Zayandehrood crisis in this study with previous papers and documents in recognizing the pathological and holistic managerial view - mentioned above – is in syncing those views, and also achieving a holistic view in recognizing and managing the Zayandehrood Riverscape.

In fact, the innovation claimed in the research is not in the sum of that three views but is based on the understanding of the Zayandehrood River and its problems in the unified, self-organizing, and adaptable way with all its absolute inseparable complex ecological and social aspects.

### The problem statement

The formation of the objective-subjective phenomenon of the Zayandehrood mixing with natural structure, people’s perception of the city with historical and social background, the impact of this phenomenon on the ecosystem, livelihood, and climate of its watershed has led to other areas; in case of any change, the other relevant areas also benefit or suffer from it. The Zayandehrood River, as the only permanent river in the center of the Persian Plateau, has been the vital artery of Isfahan throughout history. Today, however, the city is facing issues in water supply in the drinking, agricultural and environmental sectors due to water shortages.

Other consequences of the Zayandehrood drying are decreasing in air humidity, increasing in local dust

and air pollution, decreasing in groundwater from aquifers, gradual drying of vegetation and pastures, decreasing in agricultural and horticultural activities, and finally increasing in unemployment and social poverty, especially for the people living around the river (Kavehzadeh, 2018, 1).

On the other hand, the weakening of the basic factor in the formation of the public concept of Isfahan is one of the most important damages to the public perception of the urban landscape of Isfahan, which has occurred in the last two decades due to the drying of the Zayandehrood River for this city.

For centuries, the Zayandehrood River, as the backbone of the city, has played a special role in building the identity of a city with the historical richness of Isfahan, and it can be said: “Based on the life experience of Isfahani citizens, water shortage and drought in the Zayandehrood have led to an identity (cultural) crisis for the citizens of Isfahan” (Faeghi & Navabakhsh, 2016, 55).

On the one hand, the presence of various factors in the emergence of the unfavorable situation of the Zayandehrood River and the multiplicity and variety of subsequent crises; on the other hand, the process of understanding and stating the issue of the Zayandehrood River crisis leads to the point that:

As a problem that has arisen from several non-cumulative factors, the drying of the Zayandehrood must be separated into constructive factors in the process of describing the causal status, and it should be analyzed as the pillars of a multifaceted crisis. Factors have emerged due to interdependence and the direct result of partial managerial decisions:

#### A. Drought issue

According to the scientific definition, drought is a lack of rainfall in long periods that causes a lack of moisture in the soil and reduces water resources and thus disrupts human activities and normal plant and animal life. (Barry & Chorley, 1992). In addition, it is necessary to mention that the change in the quality of water resources is an issue that is attributed to the occurrence of urbanization and expansion of cities in parallel with the change in the quantity of water (House et al., 1993).



The oldest source in the history of Iranian water is stated in the book "Surat Al-Ard": "The Zayandehrood River never dried up; that's why it was called the Zayandehrood meaning living river. Throwing an arrow from the thumb of the armor, the water of the Zayandehrood River has always been flowing" (Ibn Hawqal, 1988).

"Fluctuations in the water of the Zayandehrood, famines, droughts and reduced rainfall and the consequent periodic decrease in the amount of water in Iranian rivers, especially the Zayandehrood, are not specific to recent years; because climate instability and uncertainty about the continuation of annual rainfall, are the characteristics of this region of the world" (Kaviani, 2001, 79).

By searching historical sources, accurate and systematic statistics of the drought trend (drought period) of the Zayandehrood in different periods cannot be found, and the assumption of seasonality and temporality of this river can be rejected.

But historians in the past more or less point to the outbreak of famine and sometimes drought in Isfahan, indicating that this has always happened throughout history (Hosseini Abri, 2003).

Some of the most reliable reports in historical sources mentioned droughts in different periods like the 4th and 5th centuries A.H., also after the Afghan invasion of Isfahan, and during the rule of Karim Khan, in 1917 and 1968<sup>1</sup> (Fig. 3).

With the development of meteorology in the contemporary era and research conducted in recent decades according to the formulas for calculating drought periods, it can be said that Isfahan's rainfall on average is like this: once every 3.5 years, low rainfall (70% of average annual rainfall), will experience moderate low rainfall (60% of average annual rainfall) once every six years and severe low rainfall (60% of average annual rainfall) once every 24 years (Ghayour, 2003, 11-13).

In addition to declining rainfall, increasing urban population and increasing demand for drinking water and growing demand for heavy industries located in this area (e.g. Isfahan Steel Company

and Mobarakeh Steel Company), significant mismanagement in recent years is applied to the only water source in this large area (Faeghi & Navabakhsh, 2016, 54).

## B. Partial and Non-systematic Management

Land use and urban-related hydrological changes affect sedimentation regime and river morphology (Taylor & Owens, 2009), and this makes urban river management doubly important. The situation of the division of the Zayandehrood water into drinking water and agriculture, along with the water share system which was trusted for several hundred years, changed with the increase of population and the entry of the central government into water supply in Iran. Later, with the arrival of water-based industries such as steel and thermal power factories in the Zayandehrood basin, the load on this river increased. This was intensified by the transfer of the water to other neighboring areas and the non-implementation of water transfer plans from other areas to this.

Despite the necessity of integrated river management by the Ministry of Energy in the laws "Water and how to nationalize it" approved in 1968 (Soltani & Jafari, 2010,11), the law of equitable distribution of water approved in 1989 (ibid., 23), and the executive regulations for the law of equitable distribution of water approved in 2000 (ibid., 7), in the Council of Ministers and organizational hierarchy of rivers, integrated management of the Zayandehrood water was gradually transferred to the provinces of Isfahan and Chaharmahal and Bakhtiari (General Directorate of Water of each Province). Practically, in the second half of the 1980s, this management was separated by the decision of the central government, without the intervention of the urban management regarding the river area within the cities. These factors, along with the frequent water withdrawals without predicting the resources in different parts (Alimohammadi, 2014, 4-5), indicate the unbridled management of water in this area.

The current water consumption in the Zayandehrood watershed is done in three main sectors: agricultural, urban, and industrial; after consumption, some of them in the form of drainage from agricultural lands adjacent



Fig. 3. Drought in Isfahan during the Naseri era. Source: <https://www.Fararu.com>.

to the river or urban and industrial effluents and eventually returns to the underground water sources or the Zayandehrood River (Safavi & Rastghalam, 2017, 13).

“Until a few decades ago, perhaps the most important concern of water resources managers was the provision and supply of water from different remote or deeper regions, but today, consumption management is also a priority in planning and comprehensive management of water resources” (ibid.). This issue has remained a slogan due to the lack of planning to meet the water needs of different regions and the lack of holistic management.

Contrary to unsuccessful partial management approaches, integrated water resources management represents a successful example of moving towards integrated yet comprehensive thinking; In this regard, the report of the Integrated Water Resources Management Document of Zayandehrood IWRM in 2017 states: “In this management, water bodies and related ecosystems, water beneficiaries and different levels of governance must be integrated into the decision-making process, also ecological, economic and social goals combined to achieve sustainable achievements” (IWRM, 2017, 2).

### C. The Zayandehrood Dam

The Zayandehrood Dam - named after Shah Abbas Kabir Dam - was put into operation in 1970. In the last three decades, Iran was one of the countries where the construction of the dam became a huge movement. Many environmental experts impute the right or wrong construction of water dams to the unique features of

each dam; however, there are those who consider dams to be the main cause of water tensions in Iran.

The negative effects and pressure of environmental groups in some countries of the world, such as the United States, caused some dams to be destroyed; the removal of the last dam on the Elwha River in 2014 in Washington is an example of this destruction. This movement was not limited to the United States, and today China has closed its large dam construction projects, too (Madani, 2016). In the study of the Zayandehrood dam in 2009 Safdar Islamifar mentioned the positive and negative effect of the construction of this dam, the most important damages mentioned as follows:

Decreased the quality of surface waters due to sedimentation, stratification, temperature changes in the reservoir and the addition of agricultural and industrial effluents along the way.

Negative effect on downstream agriculture due to significant reduction of sediments and water nutrients and force using of chemical fertilizers.

Salinity of groundwater aquifers by increasing the area under cultivation and the use of surface water.

Climate change in downstream areas in case of current absence of water flow in the riverbed over long periods (Eslamifar, 2009, 25-28).

Generally, with the full operation of the dams, the most important effect of the dam on the quantity of water is to reduce the flow of the river downstream and change the hydraulic regime of the river downstream. Downstream water will be limit to meet minimum environmental needs (Deputy of planning and research at Isfahan municipality, 2018, 97).

### D. Water consumption in watershed

One of the important factors intensifying the pressure on the Zayandehrood has been the excessive water from catchment area without practical compensation for these resources, and it unbalances the catchment during the last 40 years.

The largest population share of the river basin belongs to Isfahan province, with the majority of urban population. During the past years, the amount of available water in the Zayandehrood Dam has not been liable for the

water needs and water rights. Therefore, the agricultural sector in particular and the environment have faced problems due to water shortages. Since the water supply was reduced, farmers have not been able to make full use of their water withdrawal rights (according to the confirmation report of the 13th session of the Supreme Water Council and the 4th session of the Zayandehrood watershed dated 2nd September 2014, also Gavkhouni wetland has received little and the aquifers around the river have also been affected by its negative effects (IWRM, 2017, 12); (Table 1).

In this regard, according to the Presidential Center for Strategic Studies: From the beginning of the 50s until now, despite various water transfer projects from the adjacent basin (Koohrang 1 tunnel, Koohrang 2 tunnel, Cheshmeh Langan dam, and tunnel), river water management and control (through Zayandehrood Reservoir Dam and 30 times extraction of groundwater resources in the noughties and 20 times in the twenties compared to the 50s), not only the long-standing problem of water shortage in this basin has not been solved but also with the increasing gap between water resources and its uses, water scarcity has become a water crisis and has created environmental, social,

economic and political-security crises that can greatly reduce the sustainability of this basin, and due to its important role in the whole country of Iran.

In the current situation, this basin has become so vulnerable that if the water resources are reduced by 10%, the basin will suffer from severe water tension (Presidential Center for Strategic Studies, 2018, 4).

In summarizing the knowledge of the Zayandehrood crisis and understanding the factors that make up the problem - as the main factors of the Zayandehrood river crisis - taking into account the existence of other issues such as: the requirement of "Law on Fair Distribution of Water" - approved by the Islamic Consultative Assembly in 1983 - in integrated management of rivers (from source to wetland) and removal of urban management from integrated river management, (Soltani & Jafari, 2010, 23) other managerial steps such as: removing the natural landscape of the river as a result of widening the riverbed and building marginal parks, relying on agriculture with traditional irrigation methods and cultivating crops that uses a lot of water, regardless of the ratio of resources and population in each region, the ethnic and local view to the national issue and the lack of attention to huge

Table 1. Access and withdrawal of water in the Zayandehrood watershed in the statistical period from 1971 to 2013. Source: IWRM, 2017.

Water access and withdrawal	
Average rainfall	265 mm per year
Average entrance to the Zayandehrood dam (including water transfer)	1402 million cubic meters per year
Drinking water for Isfahan province	334 million cubic meters per year
Water withdrawals for Isfahan' industries	152 million cubic meters per year
Water withdrawals for Chaharmahal and Bakhtiari province (total)	227 million cubic meters per year
Drinking water for Yazd province	65 million cubic meters per year
Agricultural water harvesting (water right)	419 million cubic meters per year (Under investigation)
Agricultural water harvesting (water share)	655 million cubic meters per year (Under investigation)
Environmental water supply system (Gavkhouni)	176 million cubic meters per year



data by considering the scale of the problem, has led to the reduction and cessation of the Zayandehrood water flow and ultimately to the weakening and elimination of the most important factor generating the concept of Isfahan in the people's mindset (Fig. 4).

## Research Questions

By understanding the multiplicity, diversity, and dispersion of river crisis construction factors and their structural dependence in this urban-natural phenomenon, recovering the role of the Zayandehrood River in the city's spatial organization and reviving social, environmental, ecological, and the important plans by defining the Urban Landscape of Isfahan, how it can be interpreted in such a way that all components, issues and internal and external connections of this phenomenon - in proportion to their structural weight – be considered and based on this analysis, can the right structure be achieved for the sustainable management of this river?

## Hypothesis

To solve the problem of the Zayandehrood river permanently by determining the role of the components of this objective-subjective phenomenon, it should be examined as an integrated socio-ecological system, and by adapting the optimal state of the system to its current challenges, the state of balance and self-organization of the system identified and determined the role of different factors in its realization.

## Research method

In this study, the qualitative research method has been used a case study based on library resources, field observations, and visual documents in 4 steps: describing the current state of the phenomenon - collecting information in the area of the current situation - examining hypotheses and adapting the phenomenon to them - and making suggestions for its future.

Also, the historical-analytical and content analysis methods have been used to describe the current situation, causing the problem under the first and second stages of the case study method.

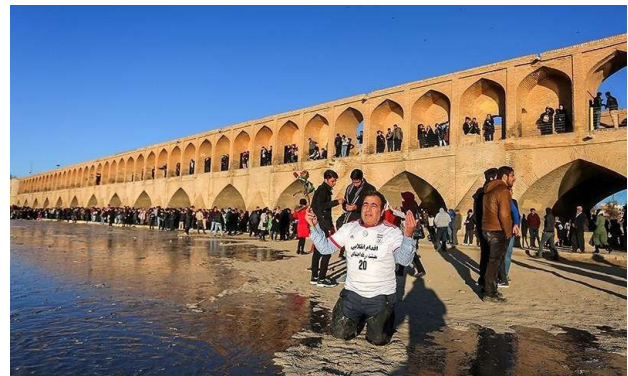


Fig. 4. People welcome the reopening of the Zayandehrood River. Source: Tasnim News Agency, Morteza Salehi, 2018.

## Examining hypotheses and adapting to the phenomenon

• **Solution:** Landscape Architecture Understanding, Holistic View, System Management

The Zayandehrood, as an urban river with vast impact, needs to see it as an integrated approach include economic, ecological, and social and intervene in proportion to the impact and role of this phenomenon in the city. In the intervention phase of this approach, while understanding this integrity (totality), we should translate it into an applicable way, which is the very rule of systems thinking, based on interconnected subsystems in the city as a super system.

Simply, a system is a set of independent and semi-independent components that define a single goal, and each component assumes a specific role for that goal. So, if the city is seen as a single system, intervention in this whole system requires a holistic view that is appropriate to understanding the role of each of its components and understanding the perspectives that provide the three goals of these aspects (aesthetics, identity, and function) (Mansouri, 2017).

Urban rivers have different roles, such as providing a connection between the landscapes and the community. Also, the rivers bring people together around the idea of a stable and creative environment. Therefore, people from all social classes, both public and private, should be a part of the Urban River Management Development Program (Cengiz, 2013, 550 - 551); (Figs 5 & 6).

### A. Urban river as an integrated socio-ecological system

The presence of natural phenomena in cities and the passing of time changes their physical characteristics and coordinates and, consequently, the way humans interact with them also changes the whole perception of them. A group of researchers considers studying, analyzing, and confronting with the urban rivers - Socio-Ecological System - while seeing the impossibility of separating social components from their ecological nature due to their natural and integrated structure, systemic perspective as the only way to sustain these natural phenomena in time:

#### - Social sciences' approach

The relationship between the social sciences and anthropology with the environment has a long history: In 1903, Durkheim and Habermas believed that the relationship between nature (Macrocosm) and culture (Microcosm) was a basic foundation for both human cognition and social organization. Cultural ecologists later added an ecological dimension to this view and formed the concept of socio-ecological systems. A concept that implicitly suggests that the relationship between them is more complex than the simple exploitation of land resources (Lansing & Vet, 2018, 4). In fact, it can be said that there is no social system without nature, and conversely, there are few ecosystems, such as large desert areas without human presence (Petrosillo Aretano & Zurlini, 2015, 1).

#### - Ecological approach

Considering urban rivers as social-ecological systems includes recognizing the complexity of these phenomena and recognizing their constituent components as subsystems of this integrated system: the view to urban rivers as a socio-ecological system is a view that arises from the revision of ecologists in the study of these rivers. In this view, coordination, and convergence in the analysis of communities and water resources have led to the construction of complex socio-ecological systems in which humans have shaped the rivers (Ashmore, 2015).

In fact, based on the analysis of ecologists: A

correct understanding of the river landscape is not necessarily better achieved with ecological science, but the analysis of human behaviors, sociology, basic components, economic motivations, etc., can give better understandings. It is clear that just focusing on ecological processes and biodiversity won't produce a perspective of river's functions and how to manage them effectively (Dunham et al., 2018, 2).

In explaining the Zayandehrood river as an objective-subjective phenomenon (landscapes), due to the role of this river in the development of Isfahan; historical change of the role of this phenomenon from an ecological phenomenon to a moat and later an urban river and the formation of literary, cultural, economic and social concepts related to it; its identity and nature are inseparably integrated. Analysis of social behaviors, sociology and protesters such as the attack on Yazd Water transmission facilities in 2012, the protest against the Beheshtabad Water transfer Project to the Central Plateau of Iran, the protest of Chaharmahal and Bakhtiari officials against the construction of Golab tunnel to transfer water and to endanger the lives of large economic and industrial institutions (Esmaeili, 2020, 578, 579), are among of the strong reasons for the combination of social dimensions with this natural phenomenon and the necessity to include social sciences in its interdisciplinary study.

#### - The impact of human factors on urban rivers

Considering the impact of human behaviors in different paradigms on the urban rivers phenomenon from a sociological and ecological point of view, rivers are considered as an integrated totality. A socio-ecological phenomenon and the impact of human factors on them are examined.

Human factors in the form of systemic thinking as direct components affecting urban rivers are divided into three categories: values, government, and people.

Values are important because of their impact on behavior and decisions at the individual and organizational levels. People value the rivers as a result of the interactions between all social



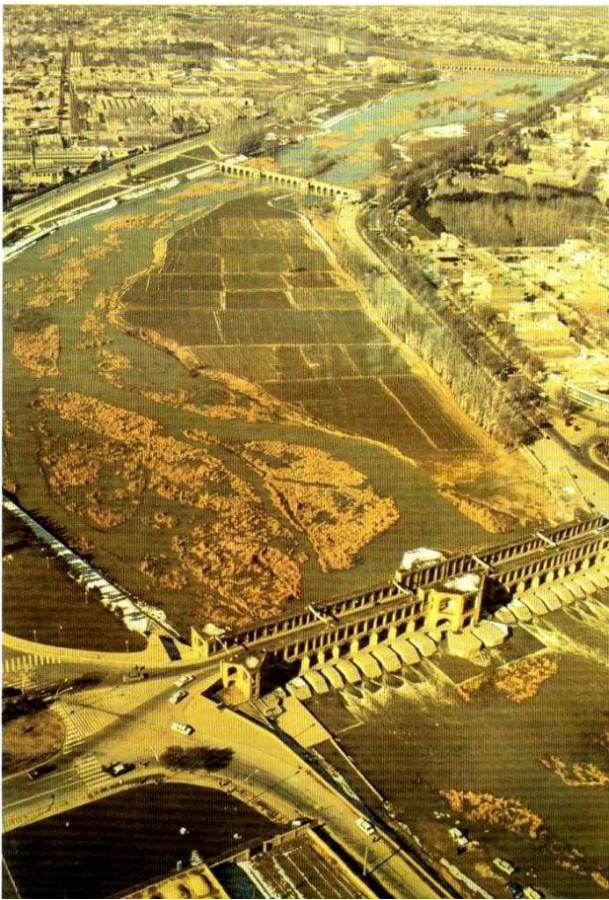


Fig. 5. Natural view of the zayandehrood river in the 70s before widening the bed and building parks around. Source: Sajjadi, 2011.

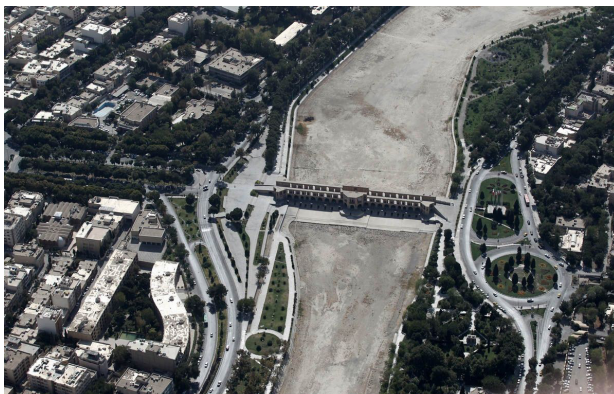


Fig. 6. Drought, widening, and building parks around the river. Source: First Vice President News Base, 2014.

subsystems, and according to this: what matters is the sense of collective belonging to the phenomenon, opinions about that value, and moral principles (Dunham et al., 2018, 2).

These values are often considered at three levels: individual, family, and social values that shape attitudes

and decisions about how to act in the world (Hitlin & Piliavin, 2004, 362). On the other hand, shared values are typically seen as one of the core aspects of culture: These values and social norms shape the actions of individuals in those societies and are often reflected in social laws and policies.

In addition to values, governments are an important aspect of dynamic social systems that shape the human variables of riverscapes. Understanding and analyzing river management and studying the actions of governments point to the political, social, economic, and administrative interactions or regulations that affect water resources (Dunham et al., 2018, 5).

In this discussion, people are considered as the main beneficiaries of riverscapes.

By the people (individuals and organizations) that are heavily influenced by natural resources can affect or be affected. It is the understanding and participation of these stakeholders that improves social legitimacy (ibid., 5,6).

In connection with the human factors discussed above and the issue of the Zayandehrood River; it can be interpreted that weak communication between the government (Ministry of Energy, Agricultural Jihad and Urban Management) and the people (through guilds and organizations) and lack of continuous communication and dialogue between these parties has led to the loss of social participation, in the research "Sociology of a Crisis: The Social Pathology of the Water Crisis in the Zayandehrood River Basin" (2019) and it is directly and implicitly mentioned in the "Integrated Water Resources Management Document of Zayandehrood" (2017) and the "Zayandehrood River watershed Rehabilitation Headquarters Program" (2018). An issue that, by deepening the gap in water governance, instability of resources, as well as social problems, cause ambiguity in the definition of common values and overshadow all components of the impact of the human factor and the natural phenomenon of the Zayandehrood River.

#### - System organization based on mutual interactions of subsystems

In this structure, the system is affected by two groups of conditions:

1. Social conditions include values, governments, and



subsystems resulting from human relationships (e.g., society, economy, culture, and politics).

2. Ecosystem conditions include physical processes (climate, radiation, temperature, humidity, etc.) and environmental processes (drought, raining, ecosystem changes, etc.) that make up the river landscape conditions (in living organs, soil morphology, quantity, and quality of water).

The interrelationship between the social system and ecological systems is established due to the pressures of social conditions on the ecosystem and the flow of facilities and services of the ecosystem to social conditions, and an integrated socio-ecological system is formed. Interaction and mutual influence is the vital point of this system (Fig. 7). It should be noted that this interrelationship makes socio-ecological systems complex. It also makes their dynamics adaptable to non-linear and abrupt changes. These changes can be unpredictable, posing an inevitable challenge to our system's sustainability of ecosystem services (Saras institute, 2019). Also, the bed and basin around a river can provide services to humans; humans may also change the structure and function of this collection (Parsons, Thoms, Flotemersch & Reid, 2016).

Socio-ecological systems are self-organizing systems that are organized based on a network of feedbacks and mutual interactions. Among these mutual feedbacks and relationships, identifying two neglected categories plays an important role in reviving the system:

1. Lost communications and feedbacks (whatever it should be)
2. Unrecognized, anonymous, and ignored communications and feedbacks (whatever it must be considered).

In this view, the main influential interactions are cross-scale and mostly social feedback (Walker, 2013).

The problems that have been ignored in the Zayandehrood's issue is the relationship between human factors (values, government and people) and the relationship loss between social infrastructure with macro decisions and ecosystem threats, due to these factors make the whole system-critical and out of balance. In this structure, according to Walker, the

system, more than before, in addition to relationships (making internal connections), is affected by two categories of conditions (meaning external effects of internal relations and factors outside the system) (Fig. 8).

## B. Retrieval of the Zayandehrood River as a socio-ecological system

Understanding peripheral natural phenomena as a social-ecological system, which some see as a new ontological approach to science, in addition to extending it to urban rivers, may require new methodological and non-reductionist approaches (including new computational methods, modeling, or artificial intelligence) for phenomenological perception (Schoon & Sander, 2015, 172).

The approach that was found in the discipline of landscape architecture, and under landscape and sensory perception as a preliminary factor, the meanings in the process of interpretation can be traced by us (Ebrahimi Asl, Panahi & Foroutan, 2017, 68). The first step in the retrieval of the Zayandehrood riverscape is to understand the river as an integrated system and facilitate the way for revitalization, regeneration, and adaptation to new environmental and social conditions. From a sociological point of view, the capacity to accept this retrieval can be identified in the social history of Isfahan:

"What has made Isfahan one of the eternal cities in the world and has guaranteed its immortality; it has undoubtedly been its old and new coexistence. The old-new confrontation has led to the formation of the dynamic necessary for its growth, expansion, and enrichment. The favorable geographical location of Isfahan on the Persian Plateau, especially during the period of political and cultural movements, has put it in the center of attention and has led to its construction instead of destruction" (Ayatollahzadeh shirazi, 2007, 307).

In the process of restoring the relationship between the ecological structure of the Zayandehrood with its social structure, it is necessary to note that: In this structure, the water shortage becomes more and the competition for water intensifies; river management - beyond

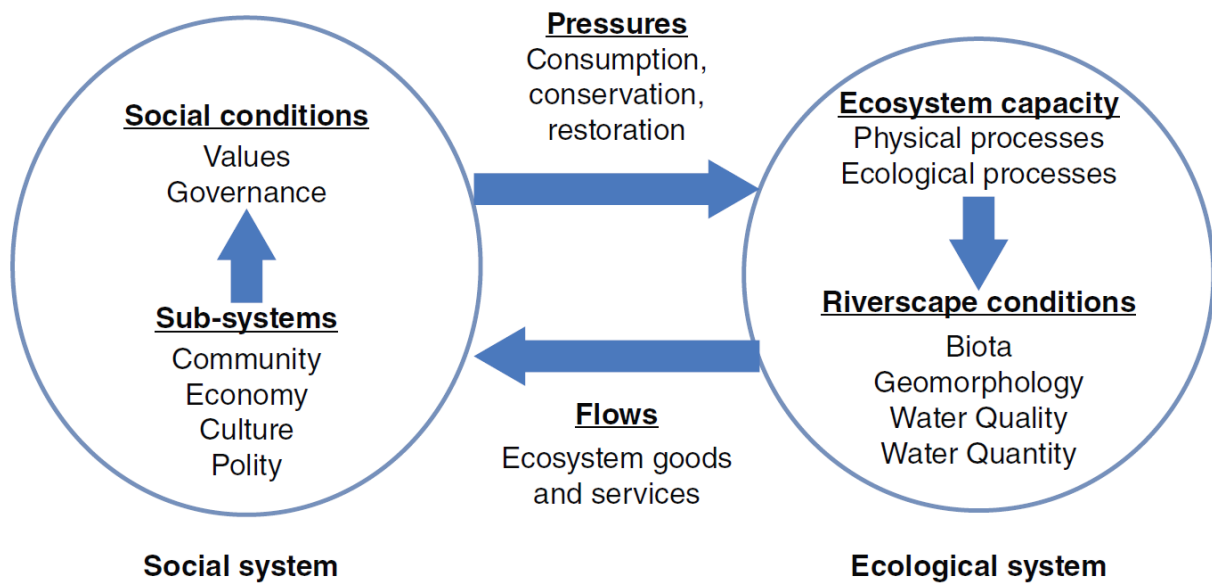


Fig. 7. Socio-ecological system in the river landscape, from right: The ecological system has the ability to provide conditions in the river that deliver biota and services or trends to the community. The availability of these streams can affect the social system through four interactive subsystems. Subsystems then create social conditions that stimulate human demands for ecosystem facilities and services, leading to various pressures to consume, protect, or restore ecosystem capacity. Source: Dunham et al., 2018, 2.

the boundaries of an area - will become a challenge. Using the holistic approach, better alignment of social and environmental structures, internal and external changes of the system can ultimately lead to successful restoration and management of destructive river ecosystems. The management of this type of communal river requires the establishment of direct horizontal social relations between the beneficiaries (Wang et al., 2019). A major part of the efforts to revitalize urban rivers is due to these social benefits and the provision of biodiversity, landscape attractiveness, leisure, and educational facilities, tourism, and contributing to urban renewal (Everard & Moggridge, 2012, 296).

Based on the definition of conditions and subsystems in the socio-ecological system (see Fig. 7) and considering the Zayandehrood River such a system with management challenges, resource consumption, and climate change, how systematic the management structure of this river and conducting is, it can be expected to behave in accordance with an adaptable and dynamic system.

In this context, changes appear as a result of the adaptation and interaction of various components of this system in the form of new behavior from the whole

socio-ecological system of the Zayandehrood, and the whole system is constantly changing in adaptation to new conditions because this set is a complex adaptive system (see Fig. 8).

The important point is that not only the social benefits of this ecosystem should be revived in the existing urban infrastructure, also be centrally considered in future development planning (ibid., 2012, 309).

### Comparison of the research with previous researches

The tendency and view of comparison in comparison of this research with the latest related researches, we can mention two groups of fundamental and analytical differences in the view of the Zayandehrood river problem:

The difference in looking at the problem-solving process in choosing a holistic view instead of a comprehensive view is the most important difference between this study and other solution-oriented studies in this field: Considering the Zayandehrood river phenomenon as an integrated system and recognizing and analyzing its constituent components by understanding their role and impact holistically in this study against recognizing

## The Zayandeh Rood River; The socio-ecological system under challenge

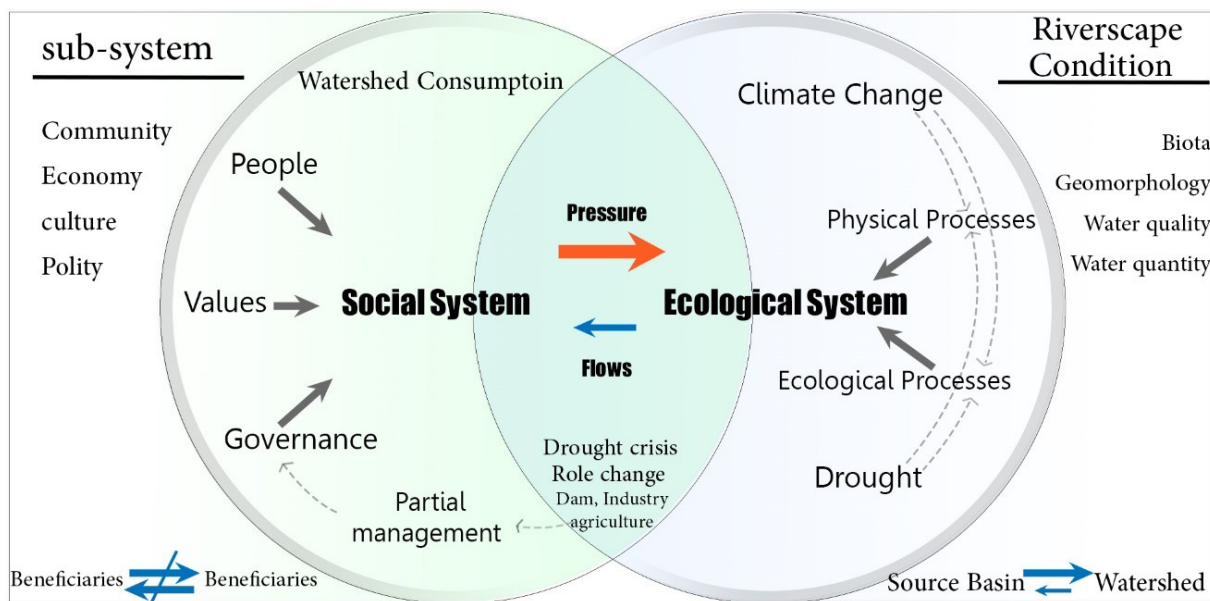


Fig. 8. The Zayandehrood; Socio-ecological system under challenge in conditions of systemic imbalance and deficiency of internal relations. Source: Authors.

the phenomenon by summing critical factors and mentioning the corresponding solutions in the solution stage. The issue is considered in a comprehensive manner in researches such as: “the Zayandehrood River Integrated Water Resources Management Document (IWRM)”, “Zayandehrood (Gavkhouni) watershed rehabilitation program” and other researches based on recognizing the important factors in this crisis and without considering the basic components, internal and mutual relations of the constructive factors of the Zayandehrood river to provide appropriate solutions to the crises, has been used.

By choosing systemic thinking in the analysis of the Zayandehrood river, each internal factor and each external condition related to the structure of the system is determined (Fig. 9) The impact of all ecological and social factors is always examined in an interconnected process and “within the system.” This method is opposed to a significant part of researches with a socio-pathological approach; in this type of research, most social conflicts are analyzed as the result of ecological disturbance and mismanagement, and the continuous, reciprocal, and systemic effects of

social and ecological components under the influence of beneficiaries, influential, social infrastructure and river conditions are ignored. Even in the study “Water Supply Crisis in the Zayandehrood Watershed, Social Issues and Solutions to Manage it (Demonstrations of 2010 to 2013)” by Mohammad Mehdi Esmaili, despite providing solutions that include both ecological and social aspects in the analysis phase; the usual path of social research has been used, and the ecological aspect has been analyzed as the main forces outside the urban river structure.

### Step 4: Conclusion and Recommendation

Inexact structure adaptation of an urban river as a social-ecological system (see Fig. 7) with the Zayandehrood River (see Fig. 8), one can consider the ecological subsystem of the Zayandehrood River because of the conflict with environmental and physical processes of drought and climate change, a system under internal pressure conflict with many challenges is still able to establish the initial flow to the social system. But in the social subsystem, due to the neglect of the existing relations between values, government, and people, and also the loss of the connection of social infrastructure



with the macro-management of the river, these challenges intensify, and more pressure is returned to the ecological system and even the river conditions (riverscape). As a result, in a mutual process, the whole system is in crisis, and even its survival is in jeopardy.

By studying the historical-natural process of formation of Zayandehrood river and the process of turning it into a subjective-objective phenomenon, it can be said that what led to the stability of the Zayandehrood river (despite natural stresses) in the pre-crisis period was the balance of pressures with that currents had been emitted to the surrounding environment, especially in the watershed. Also, with the formation of social belonging and the historical mental image of this river in the eyes of citizens, the most important factor of its protection has been formed in the procedure of social processes.

To summarize, having systematically scanned the Zayandehrood river, we can see the crisis and drought of the Zayandehrood river in the pressures on the system in the form of drought, partial management, the Zayandehrood Dam and the consumption of the watershed, which are among the facilities and services of this system, (in most environmental, ecological, water quantity and quality) has been surpassed. In this case, the internal balance of the system should be restored to this system based on strengthening its inherent self-organization and with the aim of turning the river into an adaptable and dynamic system.

In this regard, the solution of revitalizing of Zayandehrood in Isfahan and its effect on people's perception of the city – "urban landscape" – can be confirmed with the structure of this system (Fig. 9) in a design in which:

1. In order to restore the relations and internal interactions of the system, while paying attention to the social subsystem, at first, it is necessary to support the ignored relations in the relationship among values, people, and the role of macro and systemic government decisions (whether central or local government).
2. In parallel with supporting the neglected relations of the system; it is necessary to restore the lost relations, including the relations between social infrastructures (economy, culture, politics, society) with the

management of the river in the social subsystem and the protection of river conditions (morphology, living organs, water quantity, and quality) in the ecological subsystem.

3. In order to establish balance in the Zayandehrood river system, the pressures and trends of this system under the effect of the beneficiaries of the river basin and watershed must reach a relative balance. This is something that should be considered most at the macro and strategic policy level, during which it should redefine the pressures and trends on this system:

In this regard, we need to study the Zayandehrood Basin Rehabilitation Headquarters program as a participatory program with the governance reform approach and report the Zayandehrood River Integrated Water Resources Management Document (IWRM) as the water resources management strategy in various areas. Also, the general framework of the strategic plan can be the Zayandehrood River revival, and its watershed on crisis analysis, definitions, horizontal and vertical interactions of variables were summarized as follows:

- Upstream decisions and actions to mitigate pressures on the system:

1. Return to the integrated water management system of the Zayandehrood, taking into account the communications, benefits, and necessity of watershed.
2. Improving the pattern of agriculture and water resources management in the watershed.
3. Review of the Zayandehrood dam plan.
4. Efforts to reduce the dependence of the province's economy on water-based industries, self-sufficiency and recycling of water required by industries and long-term planning in the transfer of heavy industries to coastal areas of the country.

- Direct decisions and actions (Isfahan watershed) to balance the trends within the system:

1. Redesigning of the Zayandehrood riverbed with the aim of the permanent and minimal flow of water in the riverbed and creation of refined lakes in the area around the historic bridges using light recirculation systems.
2. Redesigning of the Zayandehrood riverscape and returning to the Lost and natural landscape of the Zayandehrood.

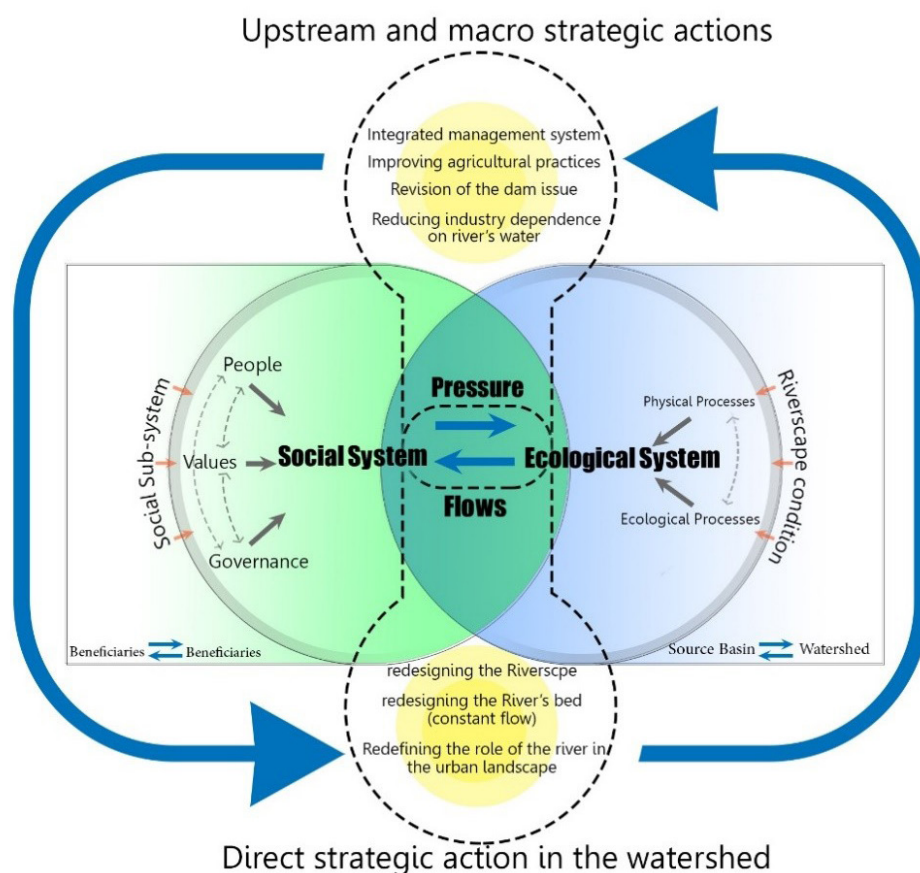


Fig. 9. Conclusion: Zayandehrood as a stable and balanced socio-ecological system; desirable system as: landscape (objective-subjective) phenomenon, self-organizing, complex and adaptable to the challenge of drought crisis, change of role in the city and the use of the field Various. Source: Authors.

3. Recovering the role of the Zayandehrood River in people's perception of Isfahan concept by redesigning the event-driven and opening the view of the Zayandehrood riverscape.

## Endnote

1. (Isfahan droughts mentioned by Hosseini Abri, 2003):
  - A. In 323 AH, a terrible famine and drought occurred in Isfahan. (Hamzeh Esfahani, 203, 1967).
  - B. In 423 AH, after the massacre of the people of Isfahan by the order of Sultan Massoud Ghaznavi, a terrible famine occurred in this city (Al-Hafiz Abu Naeem, 1998, 33).
  - C. About 21 years later (444 AH) before Nasir Khusraw arrived in Isfahan, there was a great famine in this city (Ghobadiani Morozi, 1955, 167).
  - D. There was a terrible famine in Isfahan when the Afghan invasion to Iran has occurred; as they said: people even ate dogs, cats, tree bark and even human flesh, which due to the seven-year period without snow, drought also caused (Krosinski, 1656-75 - quoted by Firooz Ishraqi, 1998, 345).
  - E. During the time of Karim Khan Zand, due to the lack of rain in winter and spring, a strange drought and famine occurred in Isfahan (Alkhajeh tajdar, 1984, 181).
  - F. In the year 1871, a terrible famine occurred in Isfahan (Chardin quoted by Jenab, 1997, 144).
  - G. Before that, there was a famine of 1832 to 1834, and before the history of the Armenians of Julfa, it lasted three years and the people ate the

grass of the desert. Before that, there was a famine of 1202 ... before that famine, it was 1182 (Jenab, 1997, 144).

H. "Every thirty or forty years a severe famine has occurred and the situation in Isfahan has deteriorated, e.g. the drought of 1918" (Jenab, 1997, 145).

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