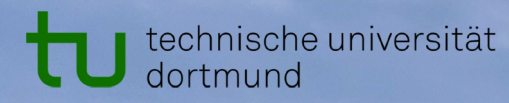




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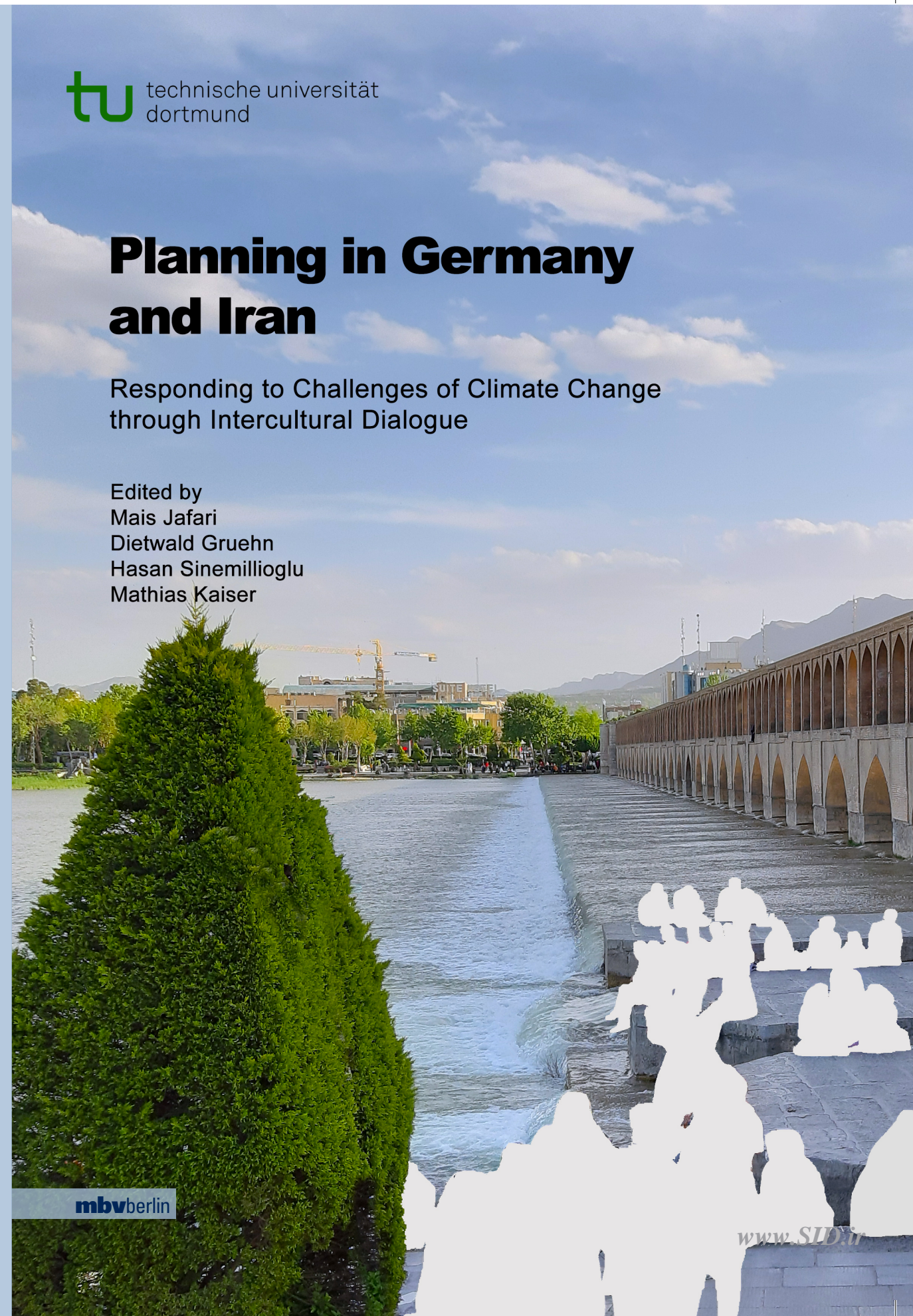
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Planning in Germany and Iran

Responding to Challenges of Climate Change through Intercultural Dialogue

Edited by
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Mathias Kaiser



عنوان :

تاب آوری اجتماعی در برابر تغییرات اقلیمی بر رودخانه های شهری (مطالعه موردی رودخانه زاینده رود، اصفهان)

Social Resilience to Climate Changes effects on Urban Rivers (Case study Zayandehrud River, Isfahan)

گروه تخصصی: فنی مهندسی

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12.**Social Resilience to Climate Changes effects on Urban Rivers: Case of Zayandehrud River, Esfahan**

Najime Riahi, Maryam Taefnia, Ghazal Farjami, Safoura Mokhtarzadeh, Mais Jafari

Abstract

One of the main global problems that human beings are facing is climate change, and it is consequences of which are widespread, such as droughts, floods, storms, and so on. Natural ecosystems including urban rivers are greatly affected by climate change. This phenomenon not only causes physical deformation but also affects the performance of spaces along rivers. Since the banks of urban rivers are considered as vital urban spaces and provide a platform for social activities and interactions, any change in their characteristics and function can affect people's social activities and interactions. One of the major challenges of these changes is the adaptability of activities and interactions in these spaces. Resilience is a concept that is applied to adapt systems to changes without losing their function. Accordingly, this paper aims to investigate the social impact of climate change that lead to drought in urban rivers in the Zayandehrud River in Esfahan. The research has been done using a descriptive-analytical method with the aim of identifying the factors affecting the increase of social productivity along urban rivers and its evaluation in the vicinity of Zayandehrud River. These factors are considered in the form of a theoretical study framework.

Keywords: Climate change, Social resilience, Urban rivers, Zayandehrud, Social space

1. Introduction

Dealing with the dangers of climate change is one of the main challenges for most countries (Cutter et al., 2016), which not only causes death and economic damage, but also harms society and behavioral patterns. In this regard, what seems very important is the ability to adapt and revitalize urban systems and return to normal state after change. Resilience has brought various social, economic, physical, and managerial orientations to urban and regional studies (Pizzo, 2015). In fact, a resilient system can absorb temporary or permanent risks and adapt to rapidly changing conditions without losing its function (Ghiasvand & Abdolshah, 2015). Meanwhile, explaining the relationship of resilience to climate change is in fact how social, economic, institutional, political and executive capacities of societies influence the increase of resilience and recognition of the resilience dimensions (Rezaei, 2013).

Today, natural ecosystems such as the banks of urban rivers have been largely influenced by human activities. Not only has their physical form changed significantly, but there have also been major changes in the performance of these spaces (Ghasemzadeh, 2013). Rivers, both seasonal and permanent, as public realms, influence the formation and identification of the contexts surrounding them. Urban rivers and streams have always been one of the main elements in locating, forming and expanding cities (Zandieh & Jaferman, 2010). Because these areas provide goods and services to people that are important for their well-being and comfort, any change in the nature and function of these spaces can have a reciprocal impact on people's lives (Parsi 2002). The Zayandehrud River in the center of Esfahan with its surrounding marginal park is about 15 km and 100 to 300 meters wide and attracts tourists as a natural environmental element and causes economic and cultural development of Esfahan (Mohammad Moradi et al., 2012). The river is also a place for leisure time and social interactions of Esfahan citizens and travelers (Karimian 2011; Golkar, 2008). It seems that the drying of the river has a significant impact on its social function and the level of social resilience of this urban area.

Drought is one of the effects of climate change. Dry rivers and their inefficiency affect the various dimensions of space content, including the social dimension. Given the role of urban rivers and public spaces around them in promoting social cohesion, it is therefore important to examine its performance at different levels of communication. As a living system, the city begins to adapt in different layers to the effects of the drought phenomenon. Much research has been done so far on the causes and consequences of declining or dry river, but the vast majority

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of these studies have paid more attention to this phenomenon from an environmental and economic point of view (Montazeri 2008; Ramesht et al., 1999), and its social and cultural effects have almost been neglected. This study describes the role of urban rivers and surrounding public spaces in increasing social resilience and determining the effect of river drought as one of the results of climate change affecting social interactions. For the research, the Zayandehrud River in Esfahan has been studied.

2. Climate Change

The planet's climate has constantly been changing throughout history, but with the onset of the Industrial Revolution, the role of humans in climate change has increased. This is mainly due to increased fossil fuel consumption, urbanization, deforestation and desertification (Cutforth et al., 1999). Climate change is potentially the greatest challenge facing the global society in the 21st century (Karimi Kakhki & Sepehri, 2011). The main and most obvious consequence of climate change around the world is an increase in temperature and changes in precipitation patterns. The consequences of global warming and climate change in Middle Eastern countries are very worrying due to the lack of water resources (Noroozi & Khosravi, 2010).

Table 12-1 Climate and Weather Incidents, Classification of Natural Disasters
(Sauerborn & Ebi, 2012)

Natural Disaster			
Biological	Geophysical	Hydrological	Metrological
Infectious diseases Insect infestation	Earthquake Volcano	Flood	Storm
			Climatology
			Excessive temperature Drought Extensive fire

Table 12-1 shows the classification of natural disasters and highlights severe events that may be fundamentally affected by climate change. Meteorological and climatic events are shown in the table in the two right columns. As shown in the table, drought is one of the effects of climate and extreme temperatures can cause rivers to dry up. Therefore, understanding the role of rivers in the physical-social structure of the city and how people use their spaces is very important in examining the extent and manner of urban resilience and its consequence in social resilience.

3. Urban Rivers

In most cities with rivers, the texture of the city is formed around these rivers and divides the city into two parts; therefore, the need to pay attention to river-related spaces is very important. Rivers, both seasonal and permanent, as public areas, influence the formation and identification of their surroundings. In fact, rivers have been the lifeblood of nature and a perceptible landscape of cities and human settlements. That is why urban rivers and streams have always been considered as one of the main elements in locating, shaping, and expanding cities (Zandieh & Jaferman, 2010). In high rainfall areas, rivers are usually of the permanent type, and in low-rainfall areas, they are often dry throughout the year. Rivers are thus divided into two general categories, seasonal and permanent. Rivers can be divided into three categories (Figure 12-1) depending on their location and role in shaping the main structure of cities: rivers with a defensive role on one side of the city, dry and seasonal rivers among the main structure of the city and rivers as one of the urban elements without a fundamental role in shaping the city structure (Pourjafar, 2013).

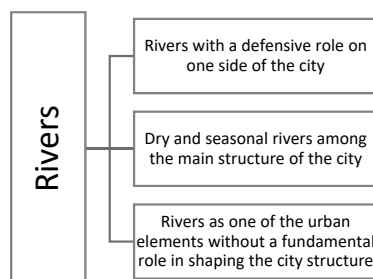


Figure 12-1 Rivers Categories based on their role in city (Authors)

Consciously managing the impacts of climate change, including the dryness of rivers, especially those that play a key role in the urban fabric, can effectively improve the quality of public urban spaces and the impacts of urban and social resilience. So the question is, what is the social connection of people with urban rivers?

3.1 Social Connectivity of Urban Rivers

The social connectivity of urban rivers refers to the communication and activity of people, goods, ideas and culture throughout the rivers in longitudinal, lateral and vertical ways. Figure 12-2 shows the different types of connectivity to, along, and across an urban stretch of river. Lateral connectivity is presented by blue arrows, vertical connectivity in orange and longitudinal connectivity in red adapted from (Piégay & Schumm, 2003).

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Historically, the most important function of the longitudinal connectivity of rivers has been their role as the main routes of transportation. However, the transformation of rivers with complex, irregular banks and beds into straight, uniform shipping channels has led to the loss of lateral and vertical connections, especially in fishing, laundry, water supply, swimming and other activities.

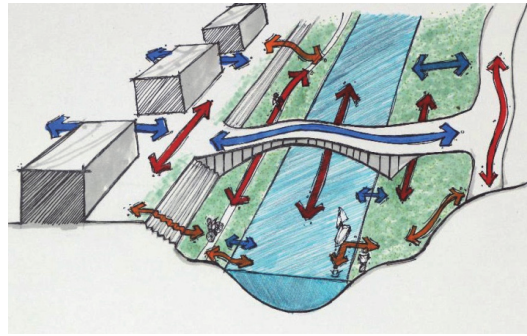


Figure 12-2 Different types of connectivity to, along, and across an urban river (Piégay & Schumm, 2003)

Many activities in lateral and vertical connection require direct access to water. Along natural banks, access is usually possible because the banks step down to the river, or informal access routes are easily developed down the banks. Indian rivers have long responded to such informal needs as important religious targets like ritual ablutions of pilgrims and bathing platforms (Boissière, 2005; Balmer et al., 2005; Santos & Peña-Corvillon, 2014).

When thinking about how rivers are used, a wide range of human activities can be defined in relation to elevation. Many uses occur on the top of the bank, such as walking, or cycling along a riverside, while others depend on contact with the water, such as wading, diving, and canoeing (Kondolf & Pinto, 2017). Water quality Improving water quality and re-access to the river strengthen connectivities. These concepts of connection can be used as an organizational framework for understanding river river-city interactions, improving relationships between cities and their rivers, and being aware of the growing efforts to revitalize urban rivers.

Some urban activities require a combination of lateral, vertical, and longitudinal connectivities. A single activity, such as running along a river, may require all three levels of connections. Integrating rotating networks, and especially those available to pedestrians or cyclists, is a starting point for re-establishing the city- river connection, in order to increase the lateral connection between the urban fabric and the waterfront. Bridges that are accessible to pedestrians and cyclists can ensure good lateral connections between banks. Finally, all access points should be connected by longitudinal routes, sidewalks, or riverside parks (ideally) (Mauch & Zeller, 2008; Castonguay & Evenden, 2012). Stepped banks or ramps are a compromise that allows for free movement down to the river and strengthen the vertical connections.

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The scale of the river itself, and its scale relative to the scale of the city, greatly influences the social role of the river within the city and the extent of its impact on the form of the city. The social role of a river evolves over time in response to various influences, such as changes in livelihoods, political decisions, and economic trends. Relationships between the width of the river and the distance to the other bank, the ease of crossing the river, the impact of the river on the city streets pattern and the type of waterfront uses affect the social role of the river. In narrow streams, the distance to the opposite shore may be such that people can still communicate along the river. In crowded urban environments, this sense of intimacy often creates vibrant public spaces that cover both banks (Kondolf & Pinto, 2017).

As the width increases, the nature of social interaction between people on opposite banks changes: while up to 15 m (depending on the eyesight), a person may be able to recognize a person walking on the other side (Loftus & Harley, 2005). The wider the rivers, the more limited the social interaction ranges. In rivers 50 to 200 meters wide, people are undetectable but are still clearly visible, creating a "lively" atmosphere on the banks of rivers. At more than 200 meters, people disappear, but moving vehicles and tree branches shaking in the wind can still create dynamic views. With wide rivers, the city on the opposite bank is seen as a skyline, which often becomes a signature and symbol of regional identity (ibid).

As mentioned earlier, changes and influences on rivers can affect river-related activities. To protect these activities, the system must be adapted to the new changes. Therefore, the issue of resilience arises. In this context, first, the concept of resilience and then its dimensions become important, which are discussed below.

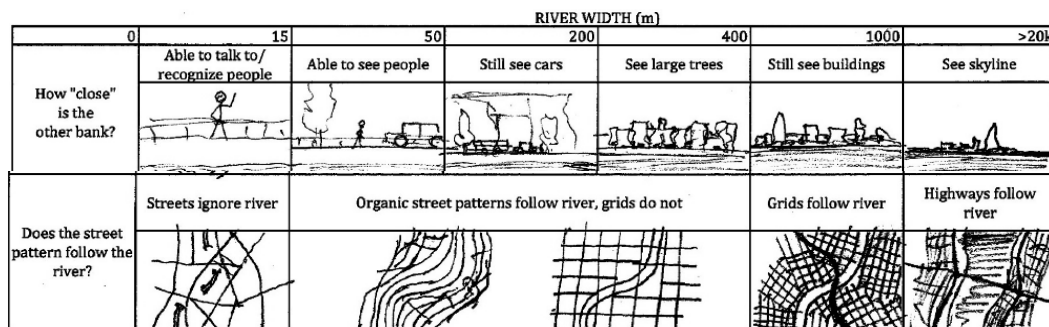


Figure 12-3 The influence of river width on two-coastal interactions and city form (Kondolf & Pinto, 2017)

4. Resilience and Urban Resilience

Resilience thinking is defined in a variety of ways, but according to Alberti et al., whose definition of resilience in scientific research is highly referenced, resilience is "the degree to which the system is able to absorb risks and reorganize itself." Based on this, resilience is a combination of "absorption of disorders and achieving equilibrium", "re-self-organization" and "increasing learning and adaptability capacity"(Alberti, et al., 2003). What is common to the resilience thinking in all definitions is the capacity to absorb disorder and risk, the ability to adapt to change and improvement, as well as to maintain the inherent characteristics and structures of the system, and that resilience is seen as an ability or flow rather than a result (Gharaei et al., 2018). The most recent definition of urban resilience in recent research refers to the ability of an urban system and its constructive ecological-social and technical-social networks in temporal and spatial scales to maintain optimal performance in the face of disruption quickly (Meerow & Stults, 2016). Urban resilience is discussed in social, economic, environmental/urban infrastructure, organizational and institutional dimensions (Gharaei et al., 2018).

Table 12-2 Dimensions of Urban Resilience (Gharaei et al., 2018)

Dimensions of Urban Resilience	Social	Godschalk 2003; Walker & Salt 2006; Santos Cruz et al. 2012; Hassler & Kohler 2014; Gómez-Baggethun et al. 2016
	Economic	(Eraydin & Tasan-Kok 2012; Ernstson et al. 2010)
	Environmental / Urban Infrastructure	Godschalk 2003; Alberti & Marzluff 2004; Walker & Salt 2006; Chelliri & Colding 2007; Olazabal, 2012; Eraydin & Tasan-Kok 2012; The Rockefeller Foundation 2014; Feliciotti et al. 2016; Sharifi & Yamagata 2016
	Organizational and Institutional	(Ernstson et al. 2010; Barthel et al., 2013; Suárez et al. 2016)

4.1 Social Resilience

All definitions of social resilience relate people, organizations, or communities, and their abilities or capacities to tolerate, absorb, cope, and regulate a variety of environmental and social threats. As Brist et al. (2010) noted, the point of entering the experimental study of social resilience is the question: "What is resilience?" What are the threats or dangers?" Threats are usually assumed to be of external origin (e.g., the impact of rising prices on household spending), but may be due to internal dynamics (e.g., the impact of disease on family income) or the interaction between the two (Gallo Pín 2006: 295). Turner et al. (2003) emphasize that

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social events and dynamics, as well as the environment, can be considered as threats, and social units are often exposed to stressors (see also Leichenko & O'Brien, 2008).

Researchers of complex adaptive systems describe social resilience as the adaptive and learning capacity of individuals, groups and institutions to self-organize in a way that keeps system function in the face of change or in response to a disturbance (Westley et al., 2002). Adger (2000) established a link between social and ecological resilience, especially where social groups or communities depend on ecosystems and environmental resources due to their livelihoods. However, humans in this Social-Ecological Systems (SES) are able to create new approaches that can change the future of the system (Gunderson & Holling, 2002).

Researchers argue that awareness of social resilience attributes can help managers and resource users develop strategies that minimize the impact on people and maximize the sustainability of goods and services derived from the ecosystem (Adger, 2000). Examples of social properties identified by researchers of complex adaptive systems for resilience to social ecosystems include vision, leadership, and trust, the ability to monitor and respond to environmental feedback (Folke, 2006); and development of social networks (Folke 2006; Lebel et al., 2006), the sharing various sources of information and knowledge through these networks (Folke 2006; Berkes & Turner, 2006); governance, including participation, representation, counseling, accountability, empowerment, social justice (Lebel et al., 2006) and areas of participatory and social learning (Pahl-Wostl et al., 2007).

Researchers describe social resilience as the capacity of groups and social communities to recover or respond positively to a crisis. Therefore, the social resilience of individuals, communities, and the wider society are closely related to their adaptive capacity (Manyena, 2006). Analysis of case studies has identified six characteristics of social resilience that are strongly seen in all case studies: knowledge, skills and learning; Community networks; People-place communications; community infrastructure; diverse and innovative economy; and the committed government (Cuthill et al., 2008).

4.2 Indicators of Social Resilience

In a study of 50 Spanish cities, Suarez et al. (2016) identified the most important factors in enhancing urban resilience, including diversity, modular system, strong feedback, social cohesion, and innovation (Suárez et al., 2016). Diversity refers to Variety of urban system components. Functional and response diversity increase resilience (Folke, 2006). Modularity is the way that system's components are linked together. The systems with subgroup of

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components (modules) and strong internal connections but weak relations with other subgroups have more capacity to self-organize after shock (Walker & Salt, 2006). Ecosystems are controlled by feedbacks. With complicated ecosystem, when something happens, it is difficult to find the cause and to respond appropriately. Consequently, several authors suggest that resilience depends on increasing the tightness of feedbacks, which requires increasing the self-sufficiency of the urban system (Walker et al., 2004). Resilience in social-ecological systems is highly related to the capacity of people to respond collectively to a disturbance (Gómez-Baggethun et al., 2013). Social cohesion or social capital is an important factor for the capacity of the response of communities (Carpenter et al., 2001; Walker & Salt 2006; Adger, 2003). Therefore, in order to strengthen social cohesion, linking structures are needed, which can be done by promoting the participation of citizens and their organizations (Adger, 2003). Platforms for citizen participation allow communication and information transfer. This promotes collective learning and a better understanding of problems, which in turn leads to experimentation and innovation (Ernstson et al., 2010).

Table 12-3 Main factors of urban resilience (Suárez et al., 2016)

	Main Factors of Urban Resilience	Definition
1.	Diversity	Variety of urban system components
2.	Modular System	The way that the system's components are linked with one another. A modular system is composed of subgroups of components (modules) with strong internal connections, but weak relationships with other subgroups
3.	Strong Feedback	Mechanisms that control ecosystems. Tightness of feedbacks is necessary to respond quickly and appropriately to shocks.
4.	Social Cohesion	Trust, social networks and leadership. It increases the capacity of people to respond collectively to a disturbance.
5.	Innovation	Collective learning and experimentation. It allows creating new ways to respond to changes.

Among these, the indicators of social resilience are: social trust, social networks, leadership, organized diversity, citizenship groups and suitable infrastructure for citizen participation (Suárez et al., 2016). In study of some other researchers, the indicators of social resilience are as follows: adaptability or adaptability capacity, communication or connection index, vulnerability, social health, cultural services, reduction of violence and insecurity and urban crime, learning capacity and knowledge, diversity of social classes, creativity and innovation,

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human resource capability, timely response speed and social capital (Hassler & Kohler, 2014; Godschalk, 2003; Walker & Salt, 2006).

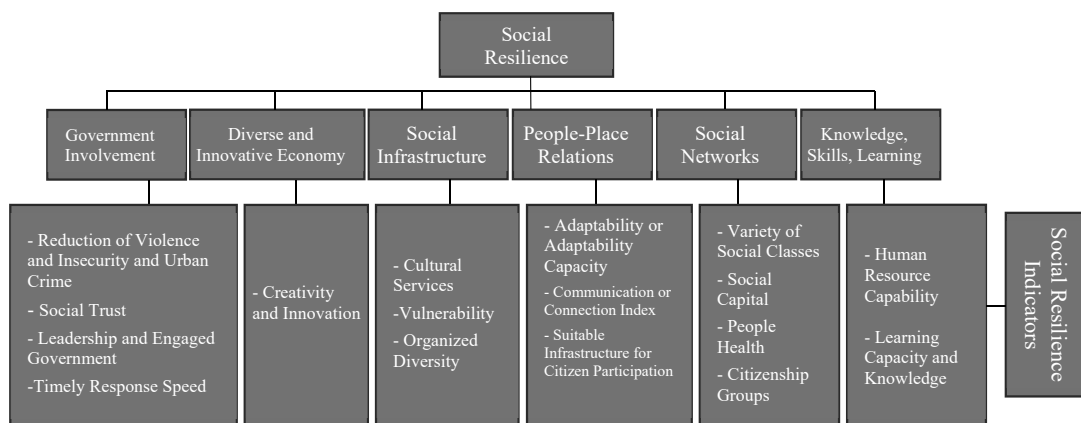


Figure 12-4 Relation of Social Resilience Characteristics and Social Resilience Indicators (Authors)

Summarizing the concepts of social resilience, it can be seen as people's ability in formal and informal social groups to cope with a crisis in an emergency situation and during reconstruction by using individual and collective resources. Social resilience reflects a paradigm shift in people's minds about their problems, understanding other people and, as thus, the need for a new perspective. (Ebadullahzadeh Maleki, et al., 2018).

5. Zayandehrud River

Zayandehrud or Zanderud, which means the river of life, is the largest river in the central plateau of Iran, which rises in the mountains of central Zagros and finally flows into Gavkhoni swamp. This river is located in the center of Esfahan city and perpendicular to the central axis of the city, which is the basis of the historical structure of Esfahan city (Atlas of Esfahan metropolis, 2016). Since the urban spaces of the Zayandehrud River provide important goods and services to the public, any change in the nature and function of such spaces can have a reciprocal effect on people's lives. Zayandehrud bank as a public arena has always played an important role in people relation and social interactions (Ghasemzadeh et al., 2014). On the other hand, the river as a vital vessel plays a fundamental role in the leisure of residents and vitality of urban space and citizens (Mohammadi & Heydaribakhsh, 2013).



Figure 12-5 Location of Esfahan Providence in Iran

The structure of the city consists of two main axes, Chaharbagh Street as the main North-East axis and Zayandehrud River as the East-West axis. The river as the natural element passing through the city and Chaharbagh as the man-made route have created different kinds of social life through their path. Existence of green spaces on both sides of Zayandehrud River, makes the city vibrant.

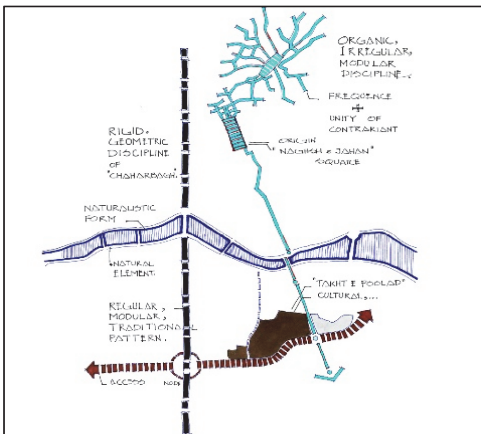


Figure 12-6 Esfahan City structure consists of 2 main axes of Chaharbagh and Zayandehrud River (Authors)

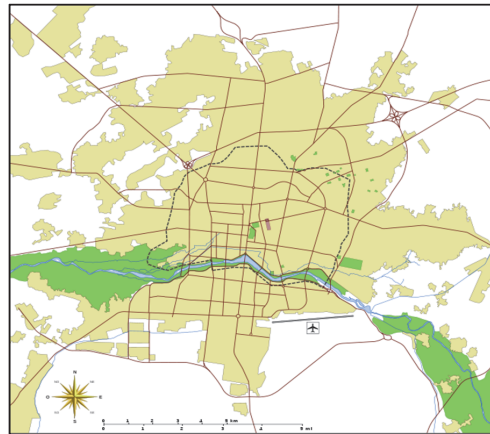


Figure 12-7 City of Esfahan with Zayandehrud River passing through (Skyscrapercity, 2011)

Zayandehrud has lost its permanent flow throughout the route since 2007 and its drying up in Esfahan has affected tourism and the cultural view of the city. The main reasons for the drying up of the Zayandehrud River are the decades of drought in the Zagros Mountains. However, inefficient management approaches such as establishing main industries with high water

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consumption along the river, increasing cultivated areas, inefficient water resources management, and lack of a systematic approach to Zayandehrud are some of the factors exacerbating the dry periods of Zayandehrud (Maleki & Ahmadpour, 2016).

Zayandehrud River, in the center of Esfahan, with marginal parks around with a length of approximately 15 km, is one of the environmental complexes of the city; (Mohammadi and Heydari Bakhsh, 2013). As a natural environmental element, it plays an important role in attracting tourists and economic and cultural development of Esfahan (Mohammad Moradi



Figure 12-8 The vendor selling food to people (Asirian, 2020)



Figure 12-9 Boating in the Zayandehrud River and picnic in the park (Bartarinha, 2020)

et al., 2012), as well as a place for Leisure and social interactions of Esfahan citizens (Karimian 2011; Golkar, 2008) and travelers, it seems that with rivers drought social function of this urban area has decreased. So far, many studies have been done on the causes and consequences of river water reduction and drought in Zayandehrud River, but the vast majority of these studies concerns about environmental and economic aspects (Montazeri, 2008); while its social and cultural effects have been almost neglected. At the same time, the banks of the Zayandehrud River, as a public arena, have always played an important role in the social connection and interaction of people (Honarfar, 1997) and have caused vitality and comfort for them.

The Zayandehrud River plays the most important role in the image of the city in the minds of citizens compared to other landmarks, but the presence of symbolic features such as historical bridges of Si-o-se Pol and Khajoo strengthens this role (Mokhtabad et al., 2010).

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Figure 12-10 Camping in the parks along Zayandehrud River (Iranbehtar, 2020)



Figure 12-11 Social life through the traditional bridges passing over Zayandehrud River (Authors)

There are different activities take place along the river, especially during holidays and weekends. Also, historical bridges passing through the river not only create a kind of sense of belonging but cause more attachment between people and the river. Gathering together in the form of picnics, public art and music, cycling and plenty of other activities have formed through this lively route of the city.



Figure 12-12 River Drought and lack of social life (Authors)



Figure 12-13 Environmental impact of river drought (Tabnak, 2020)

Since two third of Iran consists of deserts and researches show that this area has been increasing through recent years, Esfahan has also been affected by these changes. The level of underground water has dropped and the city is facing a drought crisis. During recent years, the river has been gradually dried up. In addition to all the effects on the city and agricultural, social life has also changed tremendously along the path. People existence in this area has decreased which resulted to a decrease in security, increase in antisocial activities, and so many other circumstances.

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But when sometimes the water level increased and the dam is opened, people rush into this area and social activities take place even more than before. The whole city revives during these periods. People welcome the water and vitality is felt in the city.

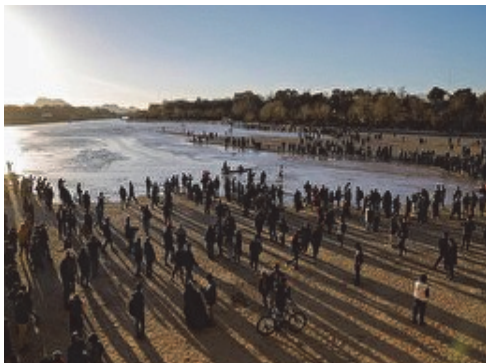


Figure 12-14 people welcoming the water back to the river (Payameiran, 2020)



Figure 12-15 social activities while water is back in the river (Bartarinha, 2020)

6. Conclusion

Undoubtedly, rivers were the center of ancient cities and connected with people's everyday life. Urban rivers mostly act as beating hearts of the cities, determining various activities according to their characteristics. If the river width and depth are sufficient, they were used for various activities. In Esfahan, Zayandehrud River is used for a wide range of individual and collective social activities such as fishing, boating, camping, picnics, and cycling. The areas alongside the river are also used for walking and vending activities.

However, the Zayandehrud natural features have been affected by climate change, which also has significant impact on people's social life in Esfahan. As drought affects people, they are trying to be resilient to this very important change in their lives. People in Esfahan cross the river and use the watershed without water to make a shortcut to the other side of the river. Thus is also in an attempt to inhabit the new space where the water flows in wet times and make new uses of these spaces. While doing so, they remain unhappy because of the absence of the water flow. Activities alongside the river such as picnics and cycling are also decreased significantly in dry times. It is also observed, that people mostly change and shift their social activities to other places in Esfahan when the river is dry. As a result, the Zayandehrud river

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axis loses its viability and importance without people's existence alongside which does not seem to be a good resilient solution.

Moreover, the Zayandehrud River changes the cityscape when water no longer flows in it. Instead of the refreshing flow of water, which creates a pleasant sight, in the dry season there is a wide gravel area running through the city, with which sad feelings are associated. Therefore, it is necessary to use this area during the dryness of the river, not only to change this image of the city in people's minds, but also to define new social activities to revive this main axis of the city. Nevertheless, there are potentials in such areas to redefine adaptive social activities according to the river situation.

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