Developing Criteria for Urban River Restoration based on Biophilic and water sensitive approaches*

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Abstract | Today, the challenge of environmental issues including water crisis has received particular attention in scientific circles and among political decision makers. However, rivers as one of the major environmental elements have remained neglected in Iranian cities leading to a decline in the quality of their adjacent urban spaces and contexts. Thus, urban professionals seek to provide solutions to address understatement of rivers and restore and link them to their context. Biophilic and water sensitive urban design have been introduced as two new approaches in an attempt to link cities and nature by considering issues related to water. In this study, descriptive and secondary data analysis methods were used to develop design standards for urban rivers' edges based on Biophilic and water sensitive approaches.

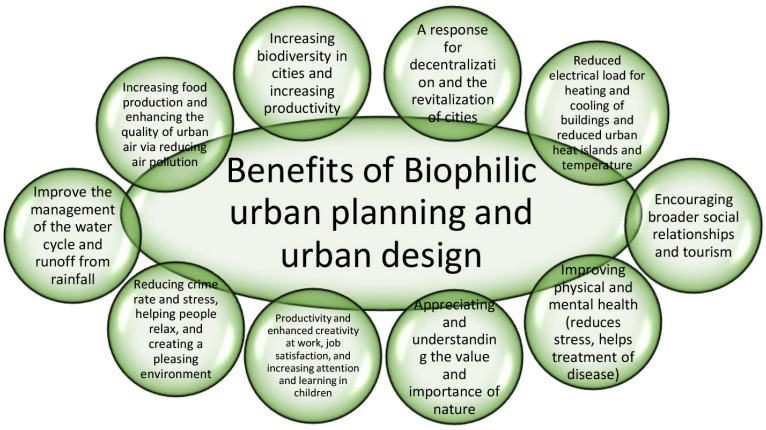
Keywords | Biophilic, Urban rivers, Water sensitive urban design.

Introduction | In the past, rivers acted as a contributing factor in cities and their environments, but gradually, they have lost their role and sometimes have become forgotten. In recent decades, the world has paid special attention to the rivers within urban areas and successful projects have been defined to organize and revive them. Investigating the related issues, we are faced with the question regarding appropriate criteria for designing the edges of urban rivers and their surrounding context acording to new concepts such as Biophilic or water sensitive urban design. In this study, the researchers invoke the documents and literature on urban river edge design and the international best practices in this area to develop criteria for the design of the rivers that cross the urban fabric based on Biophilic and water sensitive approaches. The Biophilic concept was selected because humans, especially in Iran, need a closer connection with nature and require development of cities that are more sensitive to natural systems. Therefore, it is better to use approaches like Biophilic in the design of the edge of rivers that are in the vicinity of urban fabric, so that their nature is preserved or upgraded. A focus on water sensitive design is also necessary given the nature of the river, which is closely related to and its life depends on water. This way, recommendations and best practices from water sensitive urban design can be investigated and considered in organizing urban riversides.

Theoretical foundations

Biophilic urban design and attention to riversides

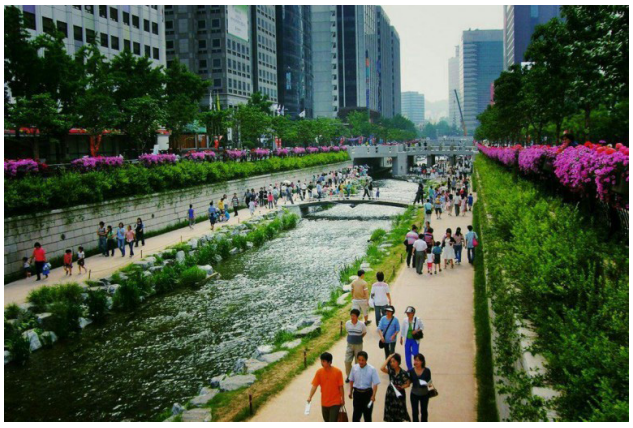
Today, paying attention to environmental needs and challenges has become an integral part of urban design, to the extent that many theories of urban design have been criticized due to lack of attention to environmental issues. The word Biophilia is composed of two components: Bio and Philia. Bio is used at the beginning of nouns, adjectives, and adverbs related to living things or life. Philia refers to fondness and positive emotions that people have towards habits and activities and all things in the nature around them. As a result, Biophilia refers to positive feelings of people towards living beings. This term was first used by Erich Fromm in 1964 to describe the psychological orientation of being attracted to all things that are alive and vital. This word is a noun that entered Webster's dictionary in 1979 and refers to the human tendency to interact or be closely associated with other forms of life in nature. The word Biophilia is literally defined as the love of life and living organisms or systems. The concept of Biophilia was also introduced by natural scientists and experts at Harvard University. Biophilia theory (city in the garden) was introduced for the first time by E. O. Wilson in 1993 (Sharifi and Azar Pira, 2014). Biophilic planning represents a creative combination of green urban design with the participation of outside life, and protection and recovery of green infrastructure in neighborhoods, living areas, or higher levels (Ziyari et al., 2015: 33). Biophilic urban design also means that cities should move away from a focus only on the beautification of cities in favor of capitalizing on direct and indirect benefits of using nature as a functional and conceptual design parameter, which can be brought in the daily life of urban residents. Shape1 demonstrates the benefits of Biophilic urban planning.



Shape 1. Benefits of Biophilic urban planning and urban design.
Source: Ziyari et al., 2015: 41

Lehman (2010, 2005 and 2009) suggested 15 guiding principles for Biophilic urban planning as follows:
1: climate and context; 2: renewable energy for zero co2 emissions; 3: zero-waste city; 4: water; 5: landscape, gardens and urban biodiversity; 6: sustainable transport and good public space: compact and poly-centric cities; local and sustainable materials with less embodied energy; 8: density and retrofitting of existing districts; 9: green buildings and districts, using passive design principles; 10: livability, healthy communities and mixed-use programs; 11: local food and short supply chains; 12: cultural heritages, identity and sense of place; 13: urban governance, leadership and best practice; 14: education, research and knowledge; and 15: strategies for cities in developing countries.
Biophilic urban design is applied at different scales ranging from a single building to blocks and neighborhoods, or a whole city and suggests various shapes, forms, and implementation offers that suit every scale. Examples of the application of Biophilic concepts to urban rivers, which are sub-scales of neighborhood and city, include closing or opening some or all day-lighted streams, streams, and water flow drainage that ultimately improve water quality, create favorable conditions for river fish and connect urban green paths for pedestrians and cyclists. A number of cities such as Zurich, Germany and Seattle, the US have done such projects. In one example in Seattle, part of Ravenna Creek was returned to the city creating a very beautiful and majestic natural environment with the restoration of native vegetation along the residential area. In this project, Ravenna Creek, which had passed through underground ducts in the early 1990s, was returned to the city by private companies (Pinkham, 2000). At the city scale, the role of green infrastructure has recently received emphasis and many cities have started attempts to improve ecology and hydrology systems at regional and environmental levels. Most

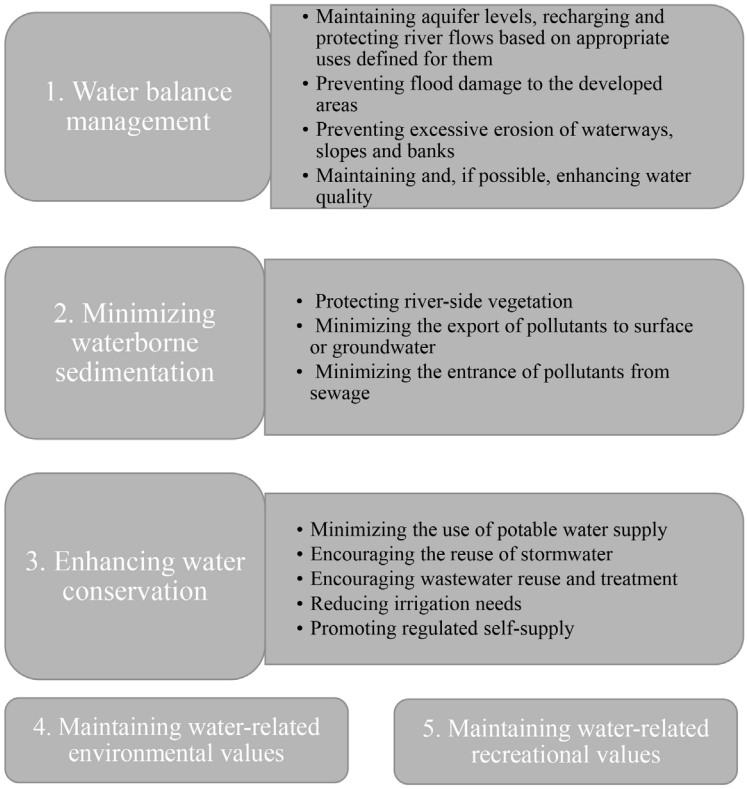
of these cities have started restoring and protecting rivers with the hope to create a physical connection with rivers (Beatley, 2005: 120-127). For example, new efforts are underway to revitalize the Los Angeles River, which is now more like a water duct than a natural river. It passes through almost all areas of the city and has a real potential to improve the quality of life of thousands of residents around the river through 239 green space projects (Anderson, 2007). Many plans based on Biophilic urban planning have provided exciting opportunities for the design of communities and cities around the world and increased the number of policy makers who have been able to gain public support for the programs aiming at improving nature in cities (Beatley et al, 2009: 19). For example, in Cheonggyecheon river revitalization project in Seoul, South Korea, an important measure was taken to eliminate eight square kilometers of an elevated highway, which passed over the river, and open the re-landscaped stream in the city (Pic. 1& 2). This project was sponsored by the Mayor of Seoul Lee Myung-bak, who later became the seventeenth president of South Korea. This indicates that projects carried out to support and develop the Biophilic foundations of cities have political interests as well. The Cheonggyecheon project had economic and cultural interests in addition to environmental ones (Revkin, 2009).



Pics 1 & 2: Cheonggyecheon River, Seoul, South Korea, during and after revitalization.
Source: URL2.

Water sensitive urban design

Water sensitive urban design and similar concepts used in other countries refer to the integration of land use and water management, especially the urban water cycle management. These include rainwater and wastewater treatment and harvesting to collect the water required by cities-especially for non- potable purposes (Beecham, 2003). Over the past decades, the concept of water sensitive urban design in some countries, including Australia, has been applied to various sites, including parks, green spaces adjacent streets, playgrounds, the edge of rivers etc. As a sustainable solution in urban development, the concept has been promising in resolving many problems associated with traditional methods of water cycle management, including increased hard surfaces and reduced urban green space (Kazemi, 2013). CSIRO (2006) provides a brief description of the objectives of the concept as follows (Shape. 2).



Shape 2. Water sensitive urban design objectives;
Source: adapted from Kazemi (2013)

Urban riversides

Revitalization of water edges has been an attractive phenomenon in urban revitalization process since 1980 (Fig. 1). Aspects of water edge developments include: pollution mitigation, remediation, storm water management, stream and wetland restoration, and habitat protection (Pourjafar. 2013).

After about 30 years of efforts to restore urban riversides a comparison of different projects such as Zhangjiagang Town River in China (Pic2), Singapore River project (Pic3), Trinity River project (Dallas, Texas) (Pic4), Barcelona River restoration in Spain and other environmental projects

based on Biophilic and water sensitive approaches in different countries and cities such as Berlin, Australia, Portland, Chicago, etc. can illuminate key environmental, economic, and social factors affecting the success of such projects including: using public-private partnerships, taking advantage of the residents in various areas, paying attention to the local context, planning for water treatment and reuse, generating energy from renewable sources, considering public transport and fuel consumption, mixing appropriate uses, increasing the economic potential of the area using commercial uses, and strengthening the recreational role by embedding environmental and recreational uses such as parks.

Pic3. Sculptures along the Singapore River.
Source : wisgoon. com

As can be seen in shape.3, the cognitive approach is a comprehensive approach, which somehow integrates the ideas of landscape ecologists and environmental and urban designers regarding connectivity in riverfronts. It involves a holistic view that relies not only on ecological and human factors but also on integration of the two approaches to provide a new look to the missing breathing link in modern cities.

The development of urban design standards for urban rivers based on water sensitive and Biophilic approaches

According to the literature, this section first provides a model of Biophilic and water sensitive criteria for riversides as shown in Fig.1 It mergers these three areas taking into account the urban design requirements to provide the final criteria for organizing and restoring urban riversides (Table 1).

Pic4. Trinity River Project (Dallas. Texas).
Source: manzaronline. com

Table 1: Design suggestions in the form of criteria and sub-criteria necessary for urban riversides based on water sensitive and Biophilic concepts

Ecosystem	Vegetation	Natural	Using natural vegetation to control runoff; Strengthening urban agriculture and preserving fruit trees within the city; Combating the loss of biodiversity
		Artificial	Using rain garden in landscaping of riverfronts; Using green roofs, walls and facades; Using .shapes and natural forms in design elements in riverfronts, such as pavements, handrails, etc
	Water	Natural	Removing contaminants from urban runoff; preventing sewage discharge into the urban river
		Artificial	Recycling greywater; Using water tanks as a source of non-potable water; Creating puddles in the right places in order to prevent overflow of river water; Revising local water recharge (systems (use of water recharge supplies
	Addressing riverfront topography and including it in restoration; and putting restrictions on the harvest of the riverfront ;soil to prevent soil erosion		
Policy making	Choosing people with high political and public acceptance for large environmentally sensitive projects; Providing government support for the projects that are in line with geographical, climatic, and cultural conditions of cities; Providing financial incentives and subsidies for the realization of environmentally friendly projects; Developing executive regulations to preserve, restore and improve riverfronts; Encouraging participation of people, residents and visitors in restoring and design process; Issuing green certification for rivers complying with Biophilic and water-sensitive criteria in their designs; .Stopping projects without standard environmental certificates		
Education, research, awareness raising, and improvement of public attitude and lifestyle	Increasing awareness by distributing brochures and installing signs associated with maintaining certain animal species in the region; Encouraging the formation of groups and NGOs for protecting the environment and urban rivers; Using the potentials and importance of institutions, from aquarium stores to Natural History Museums to promote education and ;awareness of nature		
Uses and activities	Using flood-prone areas as public open spaces; Establishing small recreational and business uses; Proper mixing of uses on 24-hour basis; Increasing environmental organizations and clubs		
Physical aspects	Maintaining continuity between the two sides of the river through designing beautiful bridges; Maintaining a riparian zone on both sides of the river when issuing construction permits; Encouraging step-up construction to provide maximum terrace and aesthetics; Using natural and domestic materials; Including adequate and attractive urban furniture and equipment; Providing night lights at the riverfront		
Transportation and access	Creating separate paths for bicycles, pedestrians, disables, skaters, etc. in the riverfront with a priority for pedestrians; .Reducing drivers' direct access to the riverfront; Providing trapezoidal access to the river		

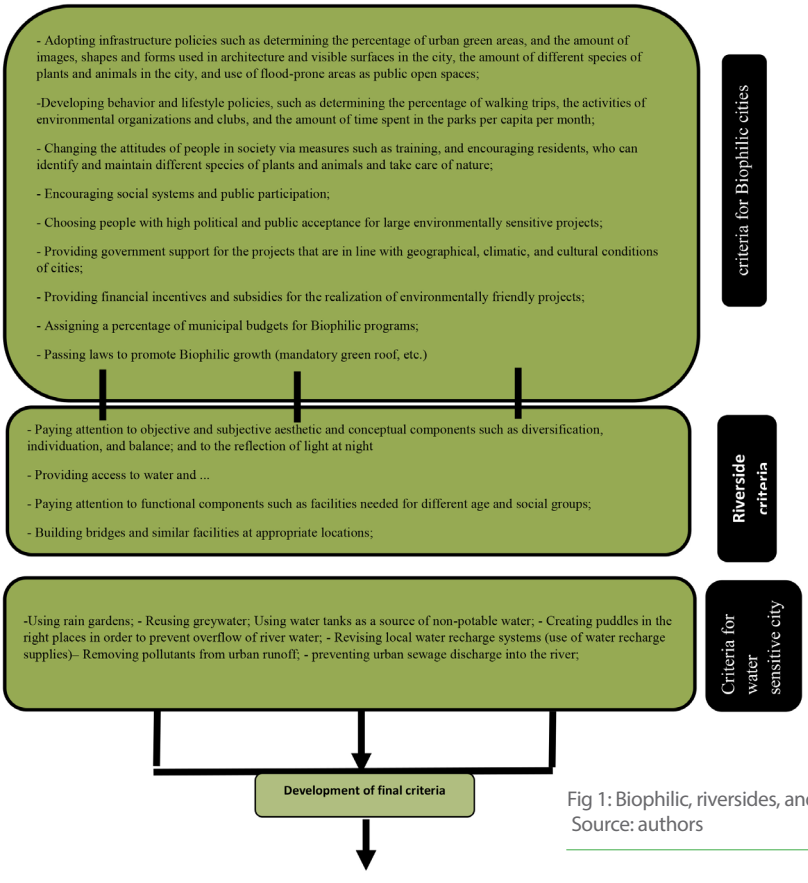


Fig 1: Biophilic, riversides, and water sensitive criteria. Source: authors

Fig.1 refines and classifies the design suggestions and criteria stated in table 1 based on Biophilic, water sensitive, and riverside design aspects. In developing Fig.1, despite some overlap in the formulation of criteria, in order to avoid duplication attempts were made to group criteria consistent with each of the three criteria. Common criteria were avoided.

The suggestions contained in Table 1 are distinct from those provided in the literature in that they highlight the role of ecology standards, policies, education, research, awareness raising, and changes in the public attitude and lifestyle. Previous studies have primarily focused on physical, operational and access criteria overlooking the role of the public and related policies and strategies, while even the fulfilment of ecosystems criteria depends on the more important criteria of policies and public awareness. This is because policies and public participation play an essential role in the success or failure of various projects, especially those of urban river restoration. Finally, an important aspect in relation to these criteria as a coherent whole is that although it is possible that one or more criteria may be more important compared with others, the project will be carried out efficiently and effectively if all solutions related to different criteria are implemented with an integrated approach in connection with the big picture.

Pic5. A river in Jiangsu, China.
Source: www.archdaily.com

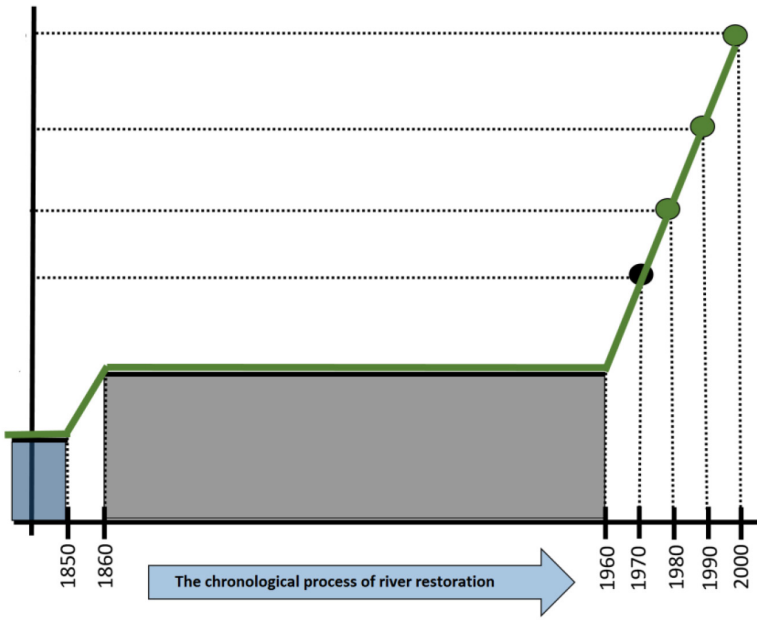


Diagram 1. The chronological process of river restoration and its different approaches.
Source: authors

Numerous books and articles have been published on the riverside issues proposing various design recommendations in various formats such criteria, goals, strategies, policies, principles, components, subject-case expectations, etc. Pourjafar's book on riverside environmental urban design, Pakzad's guidelines for urban space design, and articles such "a sustainable approach in landscape of permanent rivers" are a few examples. The focus of this part of the present article is on urban rivers. Because of their proximity to the surrounding urban context, it's important to find a connectivity between these rivers and their context. Therefore, in the following sections, different types of such connectivity are discussed via three approaches, i.e. biophysical, cultural and design, and cognitive, as presented in Fig 2.

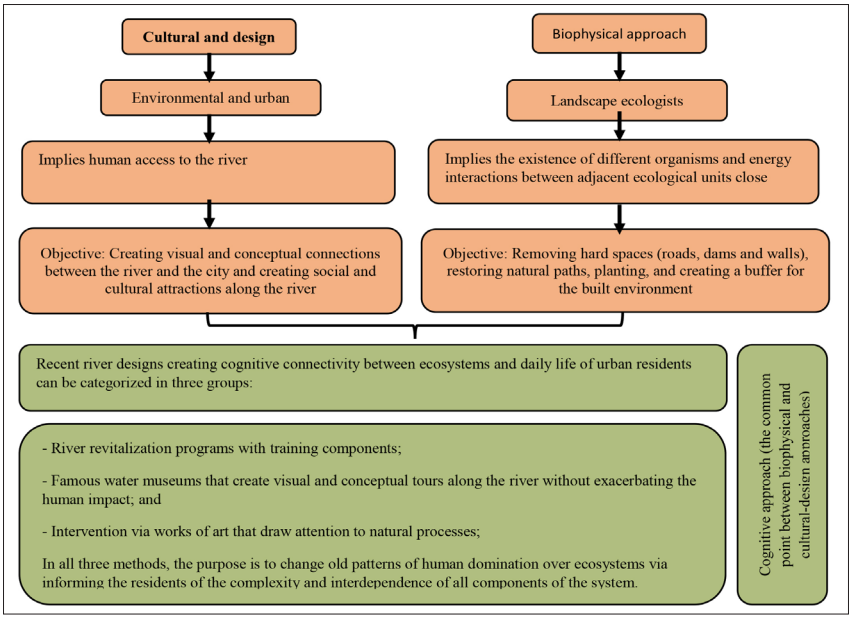


Fig 2. Connectivity and its three approaches.
Source: adapted from Spaid (28 :2002) and Ward (15 :1999)

Conclusion

This study was an attempt to use the authentic resources available to provide a relatively complete definition of the concept of water sensitive and Biophilic urban planning and discuss these two approaches in relation to urban rivers. Some cases were used to help illustrate the issue and finally criteria suggest recommendations for the design of urban rivers adjacent to urban fabric (Table 2). It should be noted that the framework proposed in this study for riverside design can be used to change the attitude towards the design of urban rivers and watercourses in Iran and bring about the awareness that they can be local natural opportunities in urban design rather than a place for accumulation of garbage. These riversides can provide clean, safe, and fun environments with good economic returns.

Reference List

- Anderson, T. (2007), "Waterway Going from Eyesore to City Jewel Transform: Tujunga Wash Project Opening Floodgates to Change", *DAILY NEWS*, Dec. 8, 2007.
- Beatley, T. (2004), "*native to now here: Sustaining home and community in a global age*", p. 32125.
- Beatley, T., Newman, P., and Boyer, H. (2009), "*Resilient Cities: Responding to peak Oil and Climate Change*", Island Press, Washington DC.
- Beecham, S. (2003), "Water sensitive urban design: a technological assessment", *Waterfall*, Journal of the Storm Water Industry Association, Vol. 17, pp. 513.
- CSIRO, (2006), "Urban storm water best practice environmental management guidelines", *Victoria*, CSIRO Publishing.
- Kazemi. F. (2013). The use of water sensitive urban design for urban water management. *Journal of Water and Sustainable Development* (Persian). 1(1) 2934.
- Lehmann, S. (2009), "*Back to the city*", Hatje Cantz Publisher, Berlin, Stuttgart.
- Lehmann, S. (2010), "The Principles of Green Urbanism: Transforming the city for Sustainability", *Earth scan*, London.
- Lehmann. S, (2005), Towards a Sustainable City Centre. Integrating Ecologically Sustainable Development Principle into Urban Renewal; in: Journal of *Green Building*, Vol. 1, No. 3, College Publishing, Virginia, USA.
- Pakzad. J. (2009). *Urban Design Guidelines*. Tehran: Shahidi Publications.
- Pinkham, R. (2000), "Day lighting: New life for Buried Streams". Rocky Mountain Institute, available at< http://www. rmi. org/images/other/Water/Woo32_Daylighting. pdf.
- Pourjafar. M.R. (2013). *Urban design of waterfronts*. Tehran: Tarbiat Modarres University Publications.
- Revkin, Andrew C. (2009). "Peeling Back Pavement to Expose Watery Heavens. " *The New York Times*, July 16.
- Simsek, Gul. (2012), "Urban river rehabilitation as an integrative part of sustainable urban water systems", 48 th International society of city and regional planners congress, Perm, Russia.
- Spaid, S. (۲۰۰۲), "Ecovention: Current Art to Transform Ecologies". Cincinnati: Cincinnati Contemporary Art Center.
- Sharifi. A. and Azarpira, M. (2014). Benchmarking study of the natural environment in urban architecture and biofilic theory (bagh dar shahr) and comparison with Isfahan School of Planning Approach. International Congress of Sustainability in Architecture and Urbanism. Masdar City. Dubai.
- URL1:http://www.archdaily.com/563128/zhangjiagangtownriverre-constructionbotaolandscape
- URL2: http://www. artishar. com/?p=565
- URL3: http://www. manzaronline. com/thetrinityriverprojectdallastexas. html
- URL4: http://wisgoon. com/pin/8141767
- Ward, JV., Tockner, K., and Schiemer, F. (1999), "*Biodiversity of Floodplain River Ecosystems: Ecotones and Connectivity*", Regul RiversRes Manage.
- Zand, M. and Jaferman, M. (2010). A sustainable approach in landscape of permanent rivers. *Baghe Nazar Journal*. 15, 1526.
- Ziari, K., Zarghamfard, M. and Khademi, A. (2015). *Urban planning with a Biophilic approach (naturebased city)*. Tehran: Arad Ketab.