International Journal on
"Technical and Physical Problems of Engineering"
(IJTPE)
Published by International Organization of IOTPE

ISSN 2077-3528
IJTPE Journal
www.iotpe.com
ijtpe@iotpe.com

September 2012 | Issue 12 | Volume 4 | Number 3 | Pages 83-88

# THE NECESSITY OF DYNAMIC BASED MODEL FOR URBAN ECOLOGICAL LANDSCAPE PLANNING AND DESIGN

**B. Bahrami E. Salehi H. Jafari H. Irani Behbahani**

*Faculty of Environment, University of Tehran, Tehran, Iran*
*bbahrami@ut.ac.ir, tehranssaleh@ut.ac.ir, hjafari@ut.ac.ir, hirani@ut.ac.ir*

**Abstract-** The rapid urbanization of the human population raises concerns about the sustainability of cities then the influence of technology and industry has produced lots of changes in urban ecological landscape. Ecology in the city deals with ecological sciences; the core includes studies of flora, fauna and other biophysical environmental factors such as climate, hydrology and natural structures in urban areas and its surroundings. On the other hand, cities in short, are human ecosystems, with biotic, social, physical, and built components all interacting with each other. The study of urban systems must be considered integral to the study of landscapes, and urban processes must be studied in order to understand their influences and predict their impact on surrounding ecosystems. Ecological research targeting sustainable urban landscapes needs to include findings and methods from many lines of ecological research, such as the link between biodiversity and ecosystem function, the role of humans in ecosystems, landscape connectivity, and resilience. Landscape simulation models have been developed for several decades to replicate atmospheric, hydrological, and ecosystem dynamic processes and assess the effects of various natural and human-induced disturbances. The urban landscape model is necessary to simulate numerous types of human-induced environmental stressors and landscape characters. At last, urban landscape planning and design is a multifaceted undertaking that engages the landscape at many scales. It requires an understanding of numerous areas of knowledge, an extensive range of professional skills and a simulation dynamic model.

**Keywords:** Urbanization, Human Ecosystems, Landscape Simulation Models, Urban Ecological Landscape, Simulation Dynamic Model.

## I. INTRODUCTION

The rapid urbanization of the human population raises concerns about the sustainability of cities. The word urban has a number of meanings related to a variety of conditions, such as population density, land cover, or cultural practices, with most authors using their own definition, or none [19].

Still, urbanization is something tangible that influences the environment by altering ecological processes. Cities are interesting as they are dominated by one species, humans, and social and cultural factors are strongly involved in the shaping of system identity [10], [22] and [8].

Also ecology in the city deals with ecological sciences; the core includes studies of flora, fauna and other biophysical environmental factors such as climate, hydrology and natural structures in urban areas and its surroundings. However, ecology of the city, regards the city to be an ecosystem built by human activities and supported by natural and man-made functions and processes over time. The development of such an approach to ecology could be traced through the ecology of urban landscapes, where a city is defined as a complex set of biological and socio-cultural processes constructed on a specific natural matrix [5].

In terms of shape rather than processes, urbanization results in an environment that is compositionally more heterogeneous, geometrically more complex, and ecologically more fragmented and may represent the most complex mosaic of vegetative land cover and multiple land uses of any landscape [9].

Though urban ecological research reaches back to the early 20th century, it has only recently emerged into the ecological mainstream. An urban ecology theory has not been articulated, and consequently, much of the accumulated wisdom of the science, and its framework for advance and application, are not widely appreciated. Yet there exist individual principles and emerging generalizations about the structure and function of urban ecosystems [2].

There are five principles about cities. These principles are 1) cities or urban areas are ecosystems, 2) they are heterogeneous, 3) they are dynamic, 4) their human and biophysical components interact, and 5) biophysical processes remain important in them [6]. Cities are ecosystems by virtue of having interacting biological and physical complexes. The biotic complex in cities has complex social structure [13, 14 and 15] including institutions [24]. Cities in short, are human ecosystems, with biotic, social, physical, and built components all interacting with each other [18, 21, 11 and 3].

In the city, social structure results from population density, age structure, ethnic and racial composition, economic class, and life style. The physical complex of cities contains not only the native substrates and soils, and any remaining or newly emergent non managed vegetation and animal populations, but also highly modified or covered soils, maintained and introduced vegetation, buildings, roads, utility infrastructure, and various kinds of paved surfaces [6].

However, cities have not generally been treated as complex systems. The architects, planners, urban designers, and builders of settlements treated them as simple predictable systems to be ordered and reduced to their components in order to facilitate urban modeling and to tackle city problems.

Results of urban ecology studies indicate complex and sometimes surprising relationships between socio-cultural and environmental variables within urbanized ecosystems [1, 5].

Ecological research targeting sustainable urban landscapes needs to include findings and methods from many lines of ecological research, such as the link between biodiversity and ecosystem function, the role of humans in urban ecosystems, landscape connectivity, and resilience [6].

In urban planning and design, the rise of the science of complexity has engendered a shift between the old view that sees cities as simple, ordered, structured, expressible by smooth lines and shapes towards a view that cities are complex organisms, evolving from the bottom up according to their local rules and conditions, which manifest greater order across many scales and times. Sustainable development is a strategy by which communities seek economic development that relates to a strong economy, a clean environment, social equity and engagement of the community in he development processes.

This approach enables the creation of healthy communities that can sustain not only current generations but also generations to come. Within the context of the theme of a clean environment, ecological landscape is an important role of a sustainable city. Ecological landscape provides opportunities for ecology, environmental improvement, active and passive recreation, aesthetic appreciation and a community focus.

During the last few decades, in many parts of the world rapid growth due to industrialization has destroyed the balance of natural processes and consequently, the quality of natural and urban landscapes. In post-industrial Western Europe things have improved in the past 30 years.

Urbanized ecosystems and urban human populations are expanding around the world causing many negative environmental effects. A challenge for achieving sustainable urban social-ecological systems understands how urbanized landscapes can be designed and managed to minimize negative outcomes.

## II. THE ROLE OF ECOLOGICAL PROCESSES AND SOCIAL DRIVERS IN URBAN ECOLOGICAL LANDSCAPING

For the first time in history, more humans now live in urbanized than rural environments; the growth trends of urbanized areas and populations are expected to continue into the foreseeable future [23, 25 and 11]. Thus, the overall well-being of most people is, and will increasingly be, intimately linked to the environmental quality of urbanized environments.

Cities are subjected to a strong human influence, and management decisions have profound implications for ecosystem function. One of the central tenets in ecological landscaping is that processes can be inferred from geographical patterns, but it may not be that straightforward in urban landscapes where human activities both transcend habitat boundaries and differ between patches of the same habitat. Instead, urban landscapes may be conceived of as composites of many different types of influence, all expressed on a single surface plane.

Thus, a major challenge to ensuring the long-term sustainability of human societies is creating and maintaining urbanized ecosystems in which the ecosystem services and biodiversity that support human well-being are conserved and, where needed, restored [20].

In addition, sustainable environments are those that humans wish to maintain because they find them aesthetically pleasing, an important sociocultural dimension of sustainability [17, 16]. In ecological landscaping, all socioecological systems are exposed to two different selective forces at the same time, i.e., natural and cultural selection, the latter guided by human ideas and preferences. These two may work in concert, but they may also work in opposite directions.

To comprehend and manage cityscapes, processes and functions must be understood and linked to their spatial, ecological, and social origin [12]. The relation between ecological characteristics (e.g., the presence of different functional groups) and the ecosystems services people enjoy in cities is incompletely understood, and, because urban development is guided by human values, there is a need to inform people about the ecological requirements for the ecosystem services that increase human well-being [4].

Interaction of socio-economic and ecological aspects is needed to support environmental planning and management decisions for sustainable urban development. In this respect, the diversity in urban landscapes, with urban planners respective challenges and approaches to their management may be regarded as experiments for sustainable development. In this time, there is an urgent need to find suitable strategies to reduce land consumption from urbanization and promote more sustainable patterns of urban development. Landscape pattern and process analysis in cities concerns two specific issues:

(1) Describe the types and characteristics of natural, biological and cultural resources of a city for explaining present urban landscape characteristics.
(2) Analyze the process of natural, biological, cultural and visual processes of cities, and evaluate the processes above, based on the integrity and continuity of the overall pattern for finding kinds of existing problems of the present urban landscape characteristics.

Cities have been viewed by many specialists as social and engineering inventions, where ecological processes may be legitimately neglected. But the urban landscape, beyond just green spaces, can also provide ecological services. Concepts and approaches basic to ecological research can be applied to urban areas in an effort to understand how the city itself functions as an ecosystem [3].

Cadenasso et al., suggested five principles about an integrated conceptual structure for ecological understanding of urban ecosystems. In addition, they also indicate perspectives and approaches to landscape design and practice that can improve the ecological resilience and function of urban systems Table 1 [6].

On the other hands, cities could be described as highly dependent open systems which depend on their surroundings for the provision of natural resources, including energy, and for the disposal of waste. The use of an ecosystem approach to urban environment, emphasizing the city as a complex system, enables a greater understanding of human, biophysical and urban interactions.

This greater understanding of the urban processes and internal dynamics allows the derivation of a set of conditions and principles for urban sustainability, promoting sustainable production and consumption patterns, more informed decision-making concerning material use, waste production and pollution prevention and, in term, moving towards a circular metabolism or 'closed loop' system.

In the past, ecologists have typically ignored anthropogenic processes in their study of ecological systems. However, it has become clear that such processes can no longer be ignored, as there are no areas left in this world that are completely untouched by human influence. Urban growth affects ecological habitats when urban areas expand into the surrounding natural areas, diminishing them in size or resulting in habitat fragmentation, as well as generating damaging effects through such sources as pollution and human use.

Table 1. General implications of the five principles in urban ecology for ecologically motivated landscape design and management [6]

| Principle | Summary of Implication for Landscape Design |
|---|---|
| Cities are ecosystems | Design affects all four components of human ecosystems |
| Cities are heterogeneous | Design should enhance heterogeneity, and its ecological functions |
| Cities are dynamic | Design must accommodate internal and external changes projects can experience |
| Human and natural processes interact in cities | Design should recognize and plan for feedbacks between social and natural processes |
| Ecological processes remain important in cities | Remnant ecological processes yielding ecological services should be maintained or restored |

For identifying the characters of urban landscape and interaction between human settlements and context of cities, the use of different techniques and methodologies are necessary to understand complex real landscape problems. One of the focal points of the research projects on urban ecological landscape is, the definition of an integrated methodology, designed in order to ease urban management and planning, throughout the identification of how, where and when new urban actions should take place, linking the assessment of the flows to tangible policy options and to decouple economic growth and resources consumption.

## III. MODELLING URBAN LANDSCAPE DYNAMICS

In the past, ecologists have typically ignored anthropogenic processes in their study of urban ecological systems. One of the greatest challenges for natural and social scientists in the next decades is to understand how metropolitan areas evolve through the interactions between human behaviors and biophysical processes. The complexity of these interactions is extraordinary. A broad set of processes contribute to urban development and ecology and many theoretical perspectives have been developed to explain or predict them. Urban development evolves over time and space.

The study of urban systems must be considered integral to the study of landscapes, and urban processes must be studied in order to understand their influences and predict their impact on surrounding ecosystems Urban growth affects ecological habitats when urban areas expand into the surrounding natural areas, diminishing them in size or resulting in habitat fragmentation, as well as generating damaging effects through such sources as pollution and human use. The study of urban systems must be considered integral to the study of landscapes, and urban processes must be studied in order to understand their influences and predict their impact on surrounding ecosystems. Early modeling efforts tried to capture the totality of the system in a single model. The complexity of urban systems necessitated dividing the system into subsystems for ease of understanding and, as most models avoided dealing with the links between the subsystems, they were limited in their ability to model responses to changes within the system.

Although extensive urban landscape research has focused on the dynamics of urban systems and their ecology, these diverse urban processes have yet to be synthesized into one coherent modeling framework. Modeling efforts have proceeded separately and disciplinary approaches have not adequately addressed the processes and variables that couple human and natural systems. Scholars of both urban economics and ecology have begun to recognize the importance of explicitly representing human and ecological processes in modeling urban systems. Environmental simulation models have been developed for several decades to replicate atmospheric, hydrological, and ecosystem dynamic processes and assess the effects of various natural and

human-induced disturbances. It is only during the last few decades that increasing environmental impacts associated with rapid growth in human activities have generated an increased interest in modeling the interactions between human and ecological systems in an integrated way. Early efforts in understanding the interactions between urban development and environmental change led to the conceptual model of cities as urban ecosystems.

Advancement in the study of ecosystem dynamics and in computer processing has made it possible a more explicit treatment of the human systems in landscape ecological models. The development of Geographic Information Systems (GIS) has provided with the capability to integrate spatial processes. However current integrated assessment models are still too primitive in representing human behavior and the heterogeneity of urban land uses. The new urban ecological frameworks are designed to take into account the interactions between the ecological impacts and urban processes. These include feedback from the ecological changes on both households and business location choice, and land and resources availability. Although significant details remain unresolved, this framework appears to provide a solid foundation for integration of urban and ecological modeling approaches. Incorporating ecological processes has expanded the use of urban models to biologists and ecologists. Neural networks, fuzzy-logic, fractal geometry and ecological energetic theories may continue to have an impact on urban models.

The urban landscape model must simulate numerous types of human-induced environmental stressors and landscape characters. For example, the current urban and ecological simulation modeling efforts described above offer an important opportunity for developing an integrated urban-ecological landscape modeling framework at the metropolitan scale. In these models, the changes in land uses and physical development predicted by simulation models are among the required inputs for the landscape model to predict the changes in land cover and their ecological stresses.

Changes in land use in an urban region alter the biophysical structure and habitat and influence the flows of resources needed to support human activities. The consequences of urban growth will be very different depending on whether the land demand is satisfied by increasing urban density, converting agricultural land or by clearing forested land [2]. Much of the heterogeneity present in cities and urban landscape destruction is probably a result of a wide range of different management objectives and practices in cities [7, 12].

To comprehend and manage urban landscape, processes and functions must be understood and linked to their spatial, ecological, and social origin [12]. However, as shown in a review by researchers, It is not the form of landscape itself that is sustainable or not, but the processes that create and are in turn shaped by the form. The combination of ecological and social information in ecological landscape models should be able to capture important processes in the landscape and determine their origin and implications for sustainability.

## IV. CONCLUSIONS

Some of urban ecological simulation models can link terrestrial ecological, physical, and socioeconomic components of metropolitan areas in an ecological approach to landscape planning in urban environment. Protecting the integrity between structural elements, preserving the original pattern of ecological systems, will help to establish and enhance the ecological processes and flows in the urban and suburban environment.

"Urban Landscape" refers to the physical arrangement of human communities and helps to determine the nature along with public spaces, streets, parks, neighborhoods, towns, suburban and the rural landscapes. Among other things, the design of urban open spaces in a community influences how walk able it is, how well it interfaces with the natural environment, meets the needs of a variety of users, and enhances local culture, tradition, economic development, and sense of place.

Urban landscape planning and design is a multifaceted undertaking that engages the landscape at many scales. It requires an understanding of numerous areas of knowledge and an extensive range of professional skills. The common theme of urban landscape design along with other design is people. In the vast majority of situations, urban landscape design for people of the habitat with specific needs that does not harm the environment, can be accommodated through proper design. For a successful urban landscape design, it is required to make an attempt to suit appropriately the site and context that make urban functions safely, along with urban structure that looks attractive, and fulfills the needs of the people for whom it is designed at the present and future context. For doing this process, using urban landscape simulation models can clear the complexity of the urban system and display multilayer system for identifying and analyzing all necessary data's in urban landscape planning and design.

As a result, to make the urban landscape planning and design strategies versatile and efficiently fit into the varied urban fabric in different periods, it is required to follow the general planning and design prescriptions as follows:

- Proposals visually affecting historical sites require detailed scrutiny through urban design analysis, and should exhibit architectural excellence.
- New developments at historical locations should be of high quality and harmony with ancient urban design pattern and historical architecture. This will involve consideration of their context and provide them with appropriate settings.
- Clearly defined, and varied urban edges (including the boundaries between conservation areas) and urban divides with attractive green belt land, Regional Park at the city edge, green corridors that penetrate and interlock with the urban form.
- Major public parks, structural open spaces of landscape and urban landscape value; historic gardens and designed landscapes, significant Sites of Special Scientific Interest and areas of trees and woodland.

- All new development should integrate with its wider surroundings and harmonize with the general height of buildings prevailing in the area development should re-enforce and not detract from valued skyline and views.
- Consider open spaces as a means of integrating and linking development to provide structure and a shared community focus.
- Development should respect the general urban topography, ecological features and scenic landscape.
- Open spaces, natural vegetation cover and citywide green corridors are of particular interest should be assessed to establish under development proposals without having any threat that might make the existing or future urban fabric.
- New area development should reflect the history, conserve and provide a setting for natural and best ecological features and focus on the reuse of ancient buildings with respect to their character, especially when material of construction and other designs or owned by pure traditions.
- Create new open spaces and links to green and civic space networks.
- Strengthen and increase ecological links between existing and new developments of both cultural and natural landscapes.
- Extend the network of cycle ways and footpaths along the green corridors that in turn along axes of road ways or natural water coarse. Ensure new developments that do not jeopardize existing open spaces as well as being appropriately separated from natural and cultural heritage areas.
- Well designed and maintained open spaces, whether they are footpaths, streets, parks, squares, can be seen as places for people to meet. They also provide opportunities to improve integration between different places, spaces and buildings.
- Increase mix of green spaces and building forms appropriately by connecting existing good development and green ways structure that in turn offer links to future ecological development opportunities.
- Significant proposals at local scale should be accompanied by a Contextual Analysis.
- Identify needs/opportunities to improve the components of urban design, form, space, activities and relationships with the established fabrics of cultural and natural landscapes.
- Complement the surrounding urban landscape, the prevailing urban form, skyline features.
- In new area development, opportunities exist to create context by composing green spaces and sequences of buildings, access and arrival points and open spaces to increase the efficiency.

## REFERENCES

[1] F. Agha Ebrahimi Samani, E. Salehi, H. Irani Behbahani, H. Jafari, "Urban Landscape Planning and Design for the Interface Conflict between Urban Development and Landscape in Historic Cities - A Case Study: Isfahan City in Iran", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 11, Vol. 4, No. 2, pp. 122-127, June 2011.

[2] M. Alberti, P. Waddell, "Integration of an Urban Simulation Model and an Urban Ecosystems Model", International Conference on Modeling Geographical and Environmental Systems with Geographical Information Systems, University of Washington, 2010.

[3] M. Alberti, J.M. Marzluff, E. Shulenberger, G. Bradley, C. Ryan, C. Zumbrunnen, "Integrating Humans into Ecology: Opportunities and Challenges for Studying Urban Ecosystems", Bio Science, No. 53, pp. 1169-1179, 2003.

[4] E. Andersson, "Urban Landscapes and Sustainable Cities", Urban Landscapes and Sustainable Cities, Ecology and Society, No. 11, Vol. 1: 34, www.ecologyandsociety.org/vol11/iss1/art34/2006.

[5] B. Bahrami, E. Salehi, H. Jafari, H. Irani Behbahani, "Urban Ecological Landscape Planning and Design from the Garden City to Ward Modern City - A Case Study: Tehran City in Iran", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 11, Vol. 4, No. 2, pp. 128-134, June 2011.

[6] M.L. Cadenasso, S.T.A. Pickett, "Urban Principles for Ecological Landscape Design and Management: Scientific Fundamentals", CATE, No. 1, Vol. 2, Article 4, 2008.

[7] S. Clayton, "Domesticated Nature: Motivations for Gardening and Perceptions of Environmental Impact", Journal of Environmental Psychology, No. 27, pp. 215-224, 2007.

[8] T. Elmqvist, J. Colding, S. Barthel, S. Borgstrom, A. Duit, J. Lundberg, E. Andersson, K. Ahrne, H. Ernstson, C. Folke, J. Bengtsson, "The Dynamics of Social-Ecological Systems in Urban Landscapes - Stockholm and the National Urban Park, Sweden", Urban Biosphere and Society: Partnership of Cities, Annals of the New York Academy of Sciences, New York, USA, pp. 308-322, 2004.

[9] T.W. Foresman, S.T.A. Pickett, W.C. Zipperer, "Methods for Spatial and Temporal Land Use and Land Cover Assessment for Urban Ecosystems and Application in the Greater Baltimore - Chesapeake Region", Urban Ecosystems, No. 1, pp. 201-216, 1997.

[10] N.B. Grimm, J.M. Grove, S.T.A. Pickett, C.L. Redman, "Integrated Approaches to Long-Term Studies of Urban Ecological Systems", Bioscience, No. 50, pp. 571-584, 2000.

[11] N.B. Grimm, S.B. Faeth, N.E. Golubiewski, C.L. Redman, J. Wu, X. Bei, J.M. Briggs, "Global Change and the Ecology of Cities", Science, No. 319, pp. 756-760, 2008.

[12] N.B. Grimm, C.L. Redman, "Approaches to the Study of Urban Ecosystems: The Case of Central Arizona - Phoenix", Urban Ecosystems, No. 7, pp. 199-213, 2004.

[13] J.M. Grove, W.R. Burch, S.T.A. Pickett, "Social Mosaics and Urban Community Forestry in Baltimore", Maryland, pp. 249-273, R.G. Lee, D.R. Field (Eds.), Communities and Forests: Where People Meet the Land, Oregon State University Press, Corvallis, 2005.

[14] J.M. Grove, A.R. Troy, J.P.M. O'Neill-Dunne, W.R. Burch, M.L. Cadenasso, S.T.A. Pickett, "Characterization of Households and its Implications for the Vegetation of Urban Ecosystems", Ecosystems, No. 9, pp. 578-597, 2006a.
[15] J.M. Grove, M.L. Cadenasso, W.R. Burch, S.T.A. Pickett, K. Schwarz, J.P.M. O'Neill-Dunne, M.A. Wilson, A. Troy, C.G. Boone, "Data and Methods Comparing Social Structure and Vegetation Structure of Urban Neighborhoods in Baltimore", Maryland, Society & Natural Resources, No. 19, pp. 117-136, 2006b.
[16] J. Hitchmough, "New Approaches to Ecologically Based, Designed Urban Plant Communities in Britain: Do these Have any Relevance in the USA?", Cities and the Environment, No. 1, Vol. 2, Article 10, pp. 15, http://escholarship.bc.edu/cate/vol1/iss2/10, 2008.
[17] R. Kaplan, S. Kaplan, R.L. Ryan, "With People in Mind: Design and Management of Everyday Nature", Island Press, Washington DC, pp. 225, 1998.
[18] G.E. Machlis, J.E. Force, W.R. Burch, "The Human Ecosystem - The Human Ecosystem as an Organizing Concept in Ecosystem Management", Society & Natural Resources, No. 10, pp. 347-367, 1997.
[19] N.E. McIntyre, K. Knowles Yanez, D. Hope, "Urban Ecology as an Interdisciplinary Field: Differences in the Use of "Urban" between the Social and Natural Sciences", Urban Ecosystems, No. 4, pp. 5-24, 2000.
[20] Millennium Ecosystem Assessment, "Ecosystems and Human Well-Being: A Framework for Assessment", Island Press, Washington DC, pp. 137, 2003.
[21] S.T.A. Pickett, W. Burch, S. Dalton, T.W. Foresman, R. Rowntree, "A Conceptual Framework for the Study of Human Ecosystems in Urban Areas", Urban Ecosystems, No. 1, pp. 185-199, 1997.
[22] S.T.A. Pickett, M.L. Cadenasso, J.M. Grove, C.H. Nilon, R.V. Pouyat, W.C. Zipperer, R. Costanza, "Urban Ecological Systems: Linking Terrestrial Ecological, Physical, and Socioeconomic Components of Metropolitan Areas", Annual Review of Ecology and Systematics, No. 32, pp. 127-157, 2001.
[23] R.V. Pouyat, K. Belt, D. Pataki, P.M. Groffman, J. Hom, L. Band, "Effects of Urban Land-Use Change on Biogeochemical Cycles", Canadell, P.D. Pataki, L. Pitelka (Eds.), Terrestrial Ecosystems in a Changing World, Springer, Canberra, Australia, pp. 55-78, 2006.
[24] F.R. Steiner, "Human Ecology: Following Nature's Lead", Island Press, Washington DC, No. 237, 2002.
[25] United Nations, "Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat", World Urbanization Prospects, 2007 Revision Population Database, http://esa.un.org/unup, 2007.

## BIOGRAPHIES

**Behrang Bahrami** received the master degree in Environmental Engineering Design. Currently, he is the Ph.D. student and researcher in Environmental Planning and Designing at Faculty of Environment, University of Tehran, Tehran, Iran.

**Esmaeel Salehi** received the Ph.D. degree in Urban Planning from The University of Tehran, Tehran, Iran in 2003. He currently is the Associate Professor of Department of Environmental Planning and Disaster Management, University of Tehran, Tehran, Iran.

**Hamidreza Jafari** received the Ph.D. degree in Computer Science and Engineering from LSU in 1990. He currently is the Professor of Department of Environmental Planning, University of Tehran, Tehran, Iran.

**Homa Irani Behbahani** received the Ph.D. degree in Environmental Design from The University of Montreal in 1991. She currently is the Associate Professor of Department of Environmental Design, University of Tehran, Tehran, Iran.