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Planning and Design of Urban Sustainable Riparian Park
(Case Study: Kan River- Valley)

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ABSTRACT: One of the most important natural factors and critical facilities in Tehran is presence of Alborz Slopes River-Valleys which have been considered as natural tourist places for citizens since a long time ago, especially in hot summers and play effective role in creating a balance between manmade and natural spaces. Importance of these river-valleys as ecological pathways is enhanced with the increase in population and development of river-valley cities can become a vital element of urban life cycle. However unfortunately, their inappropriate use has only reduced the quality of life in their area. Design of riparian parks, establishing dynamic edges and creating lively urban space may give a new spirit into the lifeless body of these river-valleys. This paper has been written aiming at planning and design of sustainable resorts in the area of Kan River-Valley (The largest urban watercourse of Tehran) and attempted to answer this question that has Kan River ecological context and environmental characteristics to become a green urban corridor? Land use planning process has been used and strategic planning has been performed using analytical - descriptive method of artificial, natural and visual characteristics of the subject area, relying on the table Strengths, Weaknesses, Opportunities, and Threat (SWOT) and using present capabilities and removing barriers. The research results show that using sustainable ecologic landscape design and compatible with the environment, is an appropriate strategy for revitalizing the urban river-valleys.

Keywords: *Landscape ecology, Sustainable ecologic landscape design, Urban river-valleys, Riparian parks, Kan River-Valley.*

INTRODUCTION

Rivers and valleys are of important natural areas that always bring life to urban spaces in different parts of the world (Bemanian, 2008). River – Valleys are ecological and economic opportunities which have been used in developed countries for years. These river-valleys have been organized and used with a variety of goals, such as increased security, suitable ecological conditions, sustainable river basin, increase in resorts diversity, increase in sports areas, etc. (Behtash et al., 2010).

Unfortunately in Tehran, stream beds become tighter or even vanish by the day for reasons like high density of buildings and ever increasing shrink of gardens and gradually main function of rivers is going to be forgotten and they have become channels for disposal of wastewater and hazardous municipal wastes. Therefore the need to conserve and revitalize natural watercourse of the river within the city and prevention of irregular construction on their sides and ecological design with the least amount of human intervention in the riverbank is clearly revealed to us (Leghaei et al., 2009). This is because in the current situation not only these river-valleys have a constructive role in increasing the spatial qualities and improvement of citizens' quality of life, but also they have caused some problems and disorders for various reasons. In the meanwhile, efficient use of the natural gifts and linking urban green spaces to the existing natural spaces, while meeting human needs, guaranties durability and survival of the natural environment and will follow environmental sustainability (Bemanian, 2008). Restoration and improvement of river-valleys and urban streams, for their abundant environmental features, are effective steps towards creating urban sustainable natural landscapes (Bozorgi, 2004) which are far from international standards according to per capita statistics in Tehran (Sheibani, 1996). Recently authorities in the country have given attention to plan, protect and restore the river-valleys, these beautiful divine gifts, in the form of natural

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resorts (Bozorgi et al., 2005) and in Master Plan of Tehran, passed in 2006, the importance and necessity of preserving and development of Tehran river-valleys as the city lung airways have been further emphasized (Amani et al., 2012).

According to studies there are many researches done in this area in form of dissertations, books and articles. For example we can mention M.Sc. thesis of Ali Reza Bozorgi titled "Regional Echo Park Planning and Design (Case Study: Kan River-Valley)" at Tarbiat Modarres University (Bozorgi, 2004) and M.Sc. thesis of Ms. Fariba Mirzaei titled "Recreational Organization and Design of Kan Riverbank in order to Improve the Quality of Life in District 22 of Tehran " at Islamic Azad University, Tehran Science and Research Branch (Mirzaei, 2007). Also several projects like Nahjolbalagheh Park and Velenjak river-valley landscaping are implemented by Tehran Municipality or they are under progress towards revival of Tehran river-valleys. However the restructuring and revitalization of the river-valleys so far have been largely performed for recreational space development and their appropriate ecological conditions and environmental sustainability have been forgotten (Alinasab, 2012). Therefore this study set planning and design of sustainable resorts in the area of Kan River-Valley (The largest urban watercourse in Tehran) as its target and according to the research questions a hypothesis has been proposed as follows:

It seems that use of sustainable ecologic landscape design and compatible with the environment, is an appropriate strategy for revitalizing the urban river-valleys and compliance with safety and environmental requirements in the design of river-valleys can cause to achieve a sustainable plan for recreational operation.

MATERIALS AND METHODS

Accordingly, in the present study, which is kind of analytical – descriptive research, two methods of documentation and field study were used to gather information and their analysis and integration. In documentation stage, information were gathered from books, magazines, surveys, maps, aerial photographs and Internet websites and in the field studies, information were collected by field observation and then the study area has been reviewed and analyzed. Finally, by extraction of capabilities and opportunities, limitations and threats perceived from the region environmental capabilities and land use planning, proposals have been presented as strategies to exploit the opportunities and overcome the limitations and threats in the form of SWOT[1] tables and then, appropriate option has been proposed by Analytical Hierarchy Process (AHP). On this basis methodology of the present study is as follows:

The Research Literature:

In terms of literature this research is descriptive which has benefited from data collected from library studies through documentary approach.

Check out experiences and initiatives:

Analytical-Inferential method has been used in the case studies that examined cases in relation to the research literature in the previous stage.

Survey and identification of the study area:

Descriptive, Analytical and Inferential methods have been used in survey of the subject area in which direct observation and image methods were used in the context of field studies.

Intervention and selecting intervention strategies:

The results of identification of the study area and in fact, environmental surveying were analyzed by reasoning-deduction method based on SWOT technique and policies, solutions and related proposals were provided after development of strategy.

Sustainable Development and Urban Sustainable Landscape

Sustainable development is undoubtedly planning of an approach which is composed of the following three perspectives (Kohan, 1997):

First, economic perspective , i.e. to maximize human welfare, despite the present limitations;

Second, ecological perspective which stresses on preservation of all ecological sub-systems or micro-systems;

Third, sociological perspective based on which human beings are the main actors in sustainable development.

Fig.1 shows these three perspectives in relation to sustainable development. However concepts of content and procedural dimensions of urban planning are still ambiguous in professional area (Long, 2005), landscape is considered as one of its most known dimensions. Urban landscape is not limited to tangible data around us but it is a two-dimensional action which on one hand, considers tangible components (and mainly visual factors) of the space and on the other hand, it looks at subjective conditions including historical, memorial, identity dimensions and like that and provides for three independent and separate targets of aesthetics, identity, and function (Mansouri, 2010). It should follow principles and conditions in order to get sustainability. Fig.2 explains the way of achieving sustainable urban landscape.

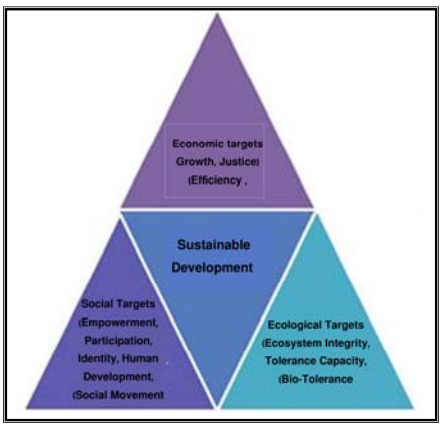

Fig.1 : Diagram of the sustainabl development targets
(Source: Based on Kohan, 1997)

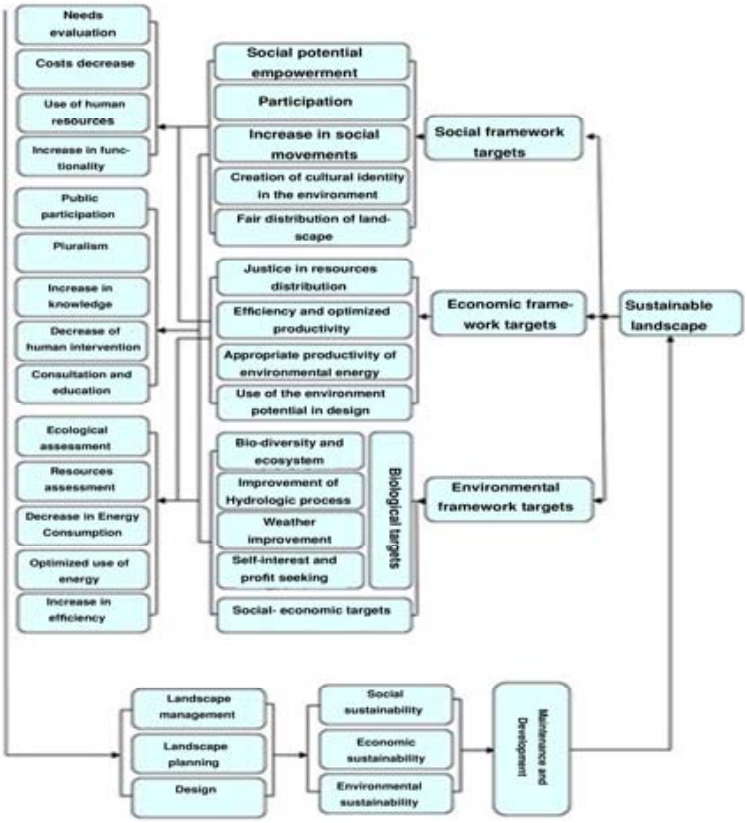

Fig.2 : The way of achieving sustainable urban landscape
(Source: Alinasab, 2012)

Ecological Design

Kon Yeang defines ecological design as follows: Ecological design as an approach is an introduction to impact of the earth ecosystem and resources in response to constraints and the site opportunities are used in planning landscape of a region (Yeang, 1995). Van der Ryn and Cowan in their definitions of ecological landscape design introduce it as a joint which inevitably connects the nature and culture through the exchange of substances and materials, energy flow and usable land selection process (Van der Ryn & Cowan, 1966, 8). Thus, ecological design is an approach that maintains manmade products in a healthy relationship with the natural environment in a manner that ecosystem faces the least damages or in other words, any design coincided with the environment using the existing opportunities and limitations for the connection between culture and nature of the region through the exchange of materials and energy in order to minimize destructive environmental impacts on the earth's ecosystem and the site resources and making attempt to improve quality of the region environment in three levels of management, planning and design. This approach is based and focused on indigenous and environmental characteristics.

Ecological Landscape Design Approaches

In recent years, many attempts have been made by experts and professionals to integrate ecological concepts into design which has a broad range of methods among which we can mention deep design approach, green design, green architecture, and ecological architecture. Despite the difference in name, any approach offers a common definition of ecological design. What is briefly addressed in this research is a comprehensive systemic approach in the field of ecological design presented by Makhzoumi and Pungetti in the book "Ecological Landscape Design and Planning" (Makhzoumi & Pungetti, 1999, 197). In this approach, with a holistic look at the ecological landscape design, landscape and environment design is introduced as a major factor linking the nature and local and indigenous culture. This approach is presented in the form of four items:
1) holistic approach to design[2], 2) fluid and dynamic design approach[3], 3) sensory and intuitive design approach[4], 4)responsive approach in design[5]. In Fig. 2, the way of achieving a sustainable ecological landscape design is presented according to the above mentioned approaches. In the meantime what is important is how to achieve appropriate models to design an environment and landscape using evaluation and precise recognition of the

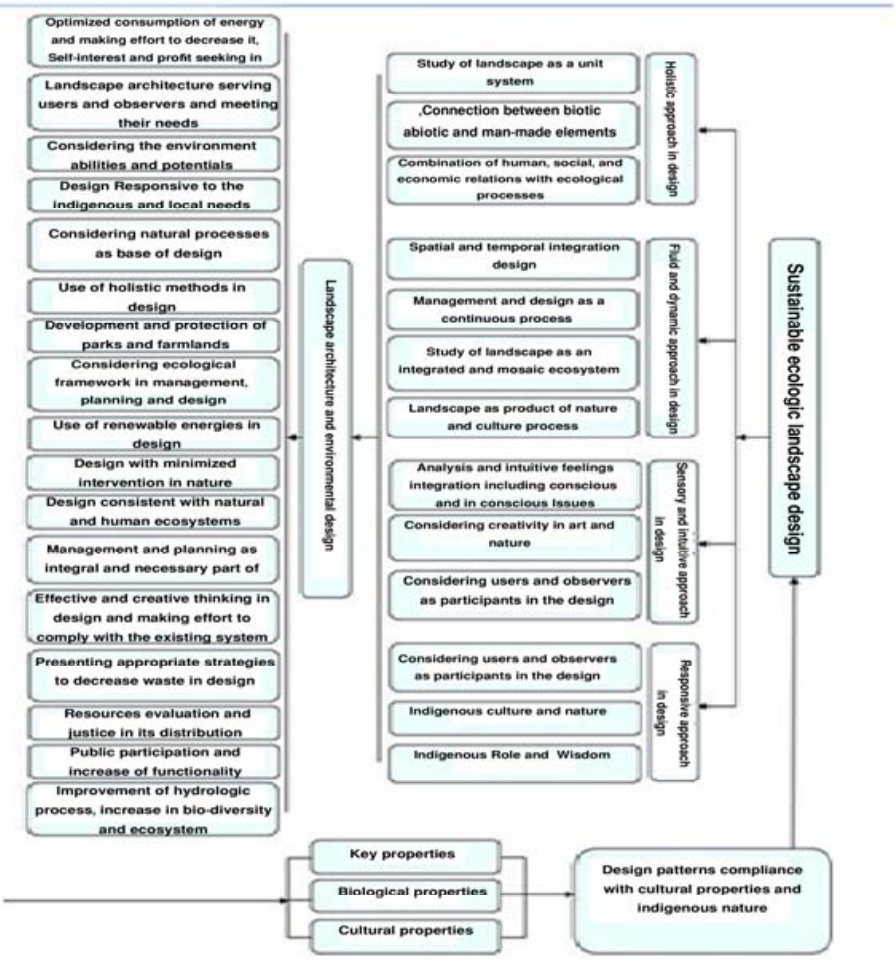

Fig.3 : Diagram of the sustainable Landscape Design,
(Source: Alinasab, 2012, 40)

place and identification of opportunities and constraints of the site and how to comply with the local culture and nature of the region. Fig. 3 describes sustainable landscape design with various approaches.

River-Valleys and their Importance in Urban Planning

Unrestrained urban development, population growth, lack of urban green spaces throughout major cities of the country (especially Tehran), inappropriate distribution of green spaces with regard to the city and other urban applications, lots of money spent on the maintenance and preservation of green spaces in cities made environmental and landscape designers and planners to review and revise design approaches which so far have only considered aesthetics regardless of environmental compliance and local and geographical features and pay more attention to environmental, geographical, social and economic characteristics of each region along with aesthetic aspects (Eisanazar Foumani, 2005).

Rivers and valleys are of the most important natural areas that have been always considered by municipal authorities in various cities around the world in order to create urban green spaces. The combination of natural elements of water, earth, rocks and plants of various species together by diverse artistic practices in different river-valleys, will remind virgin nature magnificence and gives certain tranquility to people (Salehi, 2007). The corridor of urban rivers may partially preserve decaying natural values of urban ecosystems. However, urban rivers restoration requires proper planning and design of rivers.

Riparian Park

Linear parks designed along the margins of rivers, lakes, seas,

and islands are called linear coastal parks and in cases where the linear park is designed along the river it is also called riparian park. In the proposed definitions, riparian parks are considered as one of the most important varieties of green ways and play an important role in increasing green space and physical organization of their surrounding area. Usually along these parks, places to sit and watch scenery, boating docks, restaurants, fishing platform, sports facilities for all ages, educational facilities for children and botanical gardens for public use will be considered (Mansouri & Sazandeh, 2009).

Checking out Experiences and Initiatives

Study of experiences and works done in this field helps more comprehensive understanding of the urban riparian parks design with sustainable approach. Looking at a few domestic and global examples and the pros and cons of each provides condition to provide models for the subject of research. Samples are selected such that they have relationship with the scope of this research in terms of urban design, landscape and environment and each considers at least one of the effective viewpoints and approaches of urban rivers planning. Table 1 and Fig.4 and 5 show a selection of studies carried out in this area.

Fig.4: Use of terrace and platform for sitting under the shade of trees, use of memorial elements of war soldiers as an element of identity and to create a healthy environment for children in the Guadalupe Park
(Source: Horii , 2007)

Fig.5 : A large area in Guadalupe River Park with visual access to the river used for picnic and fun activities
(Source: Confluence East, 2010)

Table 1: Subjects of Study regarding Linear Parks (Behtash et al., 2010)

Design Criteria of Rivers Margin	Subjects of Study
Maintaining and restoring natural habitats, development of flood control measures, energy consumption efficiency, special paths for biking, identity elements design, design of different spaces for children	Guadalupe riparian park in California
Paying attention to climate of subject of design, paying attention to the land, benefiting from sustainable development values , paying attention to identity and history, combining virgin natural areas with recreational and cultural spaces, taking into account the needs of people with different ages	Colorado riparian park in Texas
Selection of plants suitable for the climate, separation of pathways for driving and walking, avoiding contamination of the beach by organizing surrounding industry	Del Lito Ral Park of Barcelona
Creating green center, keeping river margin, creating a lively space, paying attention to climatic comfort	Chicago Riparian Park in Chicago
Creating green center, biological vitality, development of public spaces and recreational facilities, increase of safety and health, improvement of visual and sensory quality	Farahzad River Valley (Nahjolbalagheh Park)

Presentation of Patterns Derived from Experiences and Design Principles

Reviewing studies carried out on some samples of riparian parks, linear and coastal parks, together with studies and ecological design concepts and related theories of sustainable development, we can conclude with the results that can be presented in the form of below patterns in order to determine criteria of organization and design of riparian resorts. Seasonal flood control and management, giving identity and belonging to the set, grading the project area and surrounding land to regional, national, transnational use, natural preservation of the river and its natural functions and characteristics, fixing and protecting its edges (the best use of vegetation and flora), considering buffer (an area where development is restricted or prohibited) around the river, establishing relationship between natural and green spots, increasing green space while restoring the region habitats as natural resources heritage, improving environmental quality, eliminating visual pollution and increase in the level of security and safety, spatial arrangement of plants in planting design (heterogeneity in time, plant form and color).

Tehran River - Valleys

Because of its proximity to the slopes of Alborz and seven valleys as national-natural heritage, Tehran benefits from a special geographical and ecological location. Previously river-valleys, natural gifts, used to define identity of Tehran. Water and watercourses as natural element of the skeleton of Tehran have had special place in its formation, growth and expansion and they have been always main elements of development directions of the city and yet organizing and integration factor of its spatial- physical organization (Yazdgerd, 2011). Fig. 6 shows the position of north - south river valleys of Tehran Metropolis.

Fig. 6: River - Valley of North - South Axis of Tehran
(Source: Boomsazegan Consulting Engineers Company, 2007)

Reorganization Plan of Tehran River Valleys has been mentioned in Tehran Master Plan passed in 2008 in two sections: 1) including four river valleys of Darband, Darake, Darabad and Farahzad that have been considered in the section of “Organizing axes and urban centers" and 2) including

Table 2: The River Valleys position in Master Plan Organization programs.
(Source: Boomsazegan Consulting Engineers Company, 2007)

Some of strategies and policies	City center	Type of Program
Program of organization of urban axis and centers	Darband-Ray	- Planning and designing Darband axis as unified and integrated with the aim of consistency along the axis; - Organization of natural areas along the axis for expansion of public space; - Creating perfect urban perspectives, benefiting from northern landscapes of the city; - Organization of movement system according to the characteristics along the axis; - Improving the quality of urban bodies along the axis as coordinated and integrated.
	Darake	- Continuous improvement of space - movement along the axis benefiting from the existing capabilities in order to improve urban landscape of the axis; - The development of public spaces along the axis.
	Darabad-Bibishahrbanoo	- Creating integrity along the axis; - Development of public spaces in East of Tehran using the axis potentials; - Combining historical and natural tourist areas along the axis.
	Farahzad	- Organization of natural areas along the axis in order to develop public spaces; - Linking public areas of the axis and activity and educational spaces; - Improving and organization of residential spaces within the axis; - Organization of movement system according to the axis features.
Program of Organization of Recreation and Tourism Areas	Kan river valley	- Use of limits (watercourse - electrical) to create tourism - cultural axis; - Expansion of green areas in the form of linear parks on both sides of the river for tourism and to spend leisure time with a focus on conservation of natural resources; - Creating recreational spaces and related facilities such as trails, horseback riding, biking routes; - Preservation of surrounding applications like Kan gardens.

Kan river valley that has been considered in the section of "Organization of recreation and tourism areas" (Table 2).

Survey and Identification of the Studied Area:

Kan River - Valley parts of which are located between regions 5 and 22 of Tehran municipality with its natural green margins and potentials and also lands at a high altitude of 1400 m, has many features for guaranteed investment in relation to the per capita of services, recreation and tourism (Tehran municipality district 22, 2010). Kan watercourse as the largest urban watercourse in the West of Tehran may actually act in the form of regional echo park aimed at sustainable development. The study area includes some part of the watercourse between Hemmat Highway to Resalat Highway, 2.4 km in length and 30 hectares in area and it has been selected as a case study with its several applications as milestones. Fig.7 shows the location of the study area.

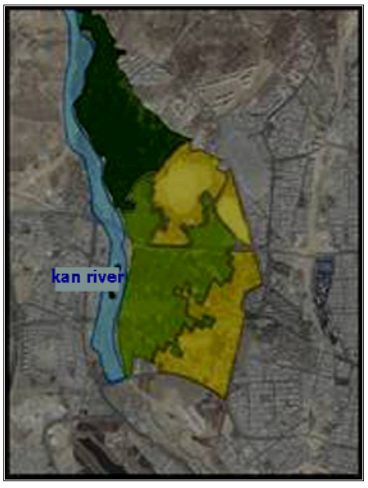

Fig.7 : Location of the study area
(Source: Tehran municipality district 22, 2010)

RESULTS AND DISCUSSION

After field ruling and recognition of the status quo (social, economic and ecological status) of the region aiming at assessment of the citizens needs in order to base the plan proposals on the economic and social returns frameworks (Because it is a prerequisite for achieving sustainable development and sustainable urban design), ecological potential of the region was analyzed in the context of Land use planning. This section addresses synthetic, visual and functional features like applications, the neighborhood, the way of communication, social and economic status, view and sights) in order for detailed understanding of the current situation and consistency of objective and research findings of the site and presenting final conclusion to provide facilities and limits of the area and presenting basic guidelines of the plan. Fig.8 shows study map of the area which is provided for evaluation and Fig. 9 shows the data analysis.

Later, the summary and conclusions derived from the site analysis are provided in the form of SWOT tables considering the strengths and weaknesses, environmental opportunities and threats in order to achieve initial proposals. Table 3 shows the conclusion.

In this study, the results of the analysis of the study area, patterns, and criteria derived from documentary and field studies have been extracted (like minimizing manipulation in the nature, harmony between man-made elements and natural space, maintaining open views , preservation of historical and cultural aspects, planning to use the utilities, reducing the non- expert construction , preservation of natural habitats of the region and identifying gardens, imitation of nature in the design, landscaping and fixing edges, maintaining and restoring natural landscape of the site, improving slope safety, seasonal flood control, setting the appropriate limit for the river, use of the river potential for recreation facilities, increased green space per capita and promotion of environmental quality, elimination of noise and air pollution) were considered in selection of the studied alternatives and between two desired options, the following option has been selected by Analytical Hierarchy Process (AHP) as the preferred option.

Table 3: SWOT Analysis

Threats	Opportunities	Weaknesses	Strengths
The risk of soil erosion due to lack of consolidation	Appropriate connection of the stream with regional and trans-regional streets	Invasion to River limit	Terraces and landscape and views along the river
Surrounding Constructions	Ability to create variety of routes and sequencing along the watercourse	Accumulation of garbage and sewage around the river	Fruit gardens and old trees in the area
The risk of pollution and outbreaks of infectious diseases due to wastewater disposal	Usability in regional and trans-regional level	Unstable slopes and probability of landslip and landslide	Relatively coarse graining of surrounding applications
Changes in gardens application and converting them to residential and commercial spaces	Usability of Kan river as a resuscitative factor in to restore the river-valley	Visual disturbances caused by the irresponsible construction	River with ecological value
The body landslip and landslide	Ability to use different slopes for diversification	Lack of proper flood plain along the watercourse	Presence of bio-diverse ecosystems
Destruction of flora on the margins of watercourse		Relative air pollution	

After determining the most appropriate options for designing, considering natural, artificial and visual features of the study area and considering zoning (division) of the study area into different slopes, its strategic plan was provided. (Fig.10)

The described approach in ecological landscape design including holistic approach, fluid and dynamic approach, sensory and intuitive approach, and responsive approach have been considered in this design. For this reason the area has been considered as a unified perspective and maintaining priority of habitats and making efforts to minimize interference with the nature, using creativity and environmental abilities, the set has been considered as an integrated system and finally, the final design has been prepared with facilities like Persian garden, library, auditorium, special walking path, special biking paths,

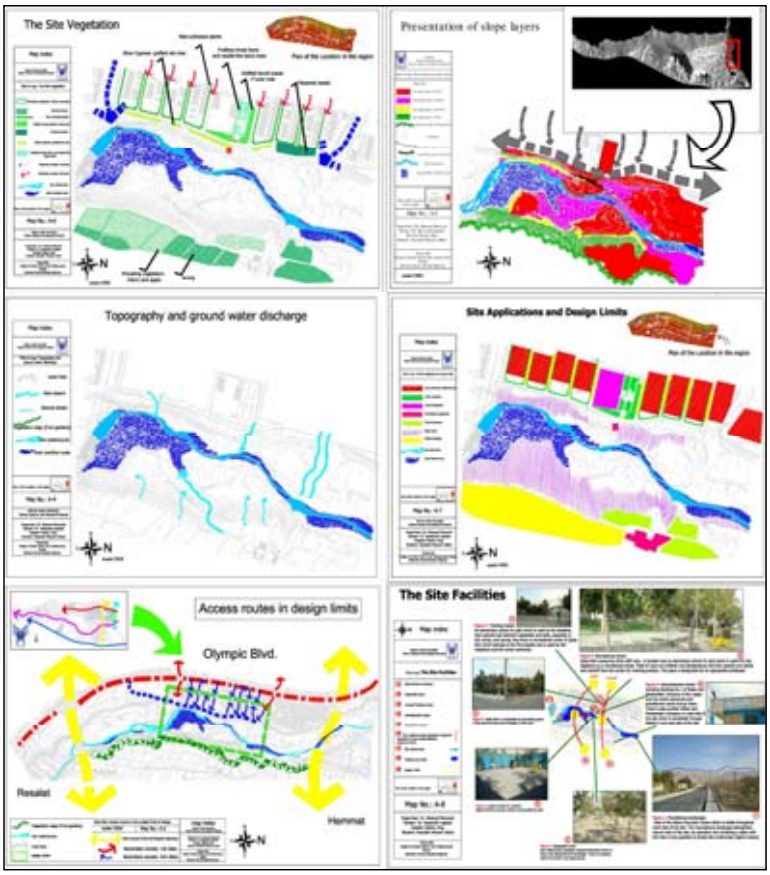

Fig. 8 : Study Map of the area

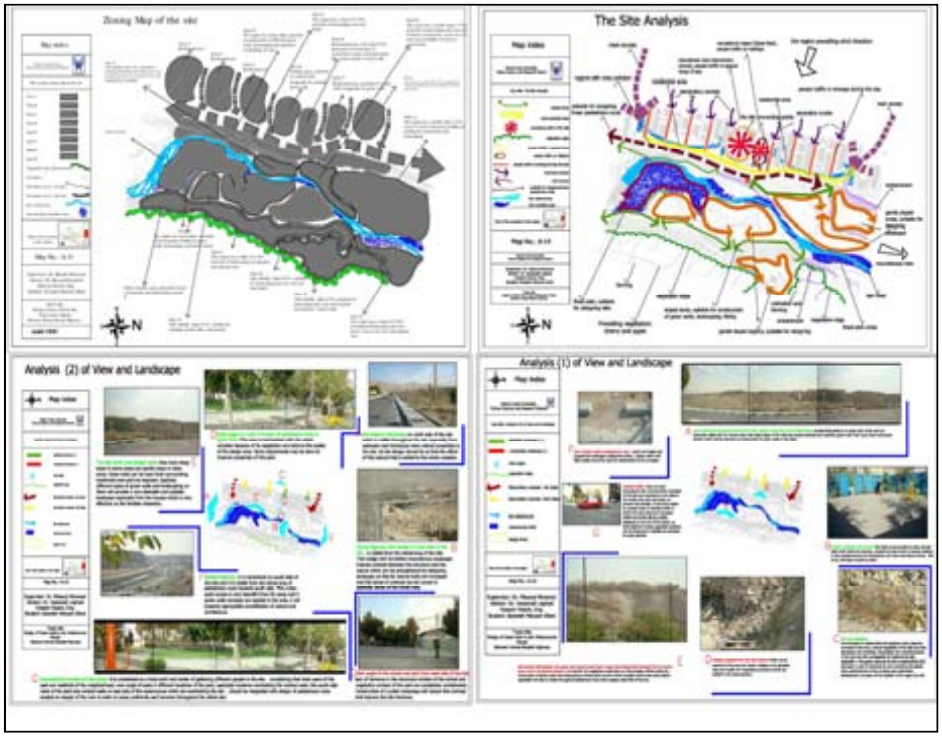

Fig. 9: Analysis Map of the area

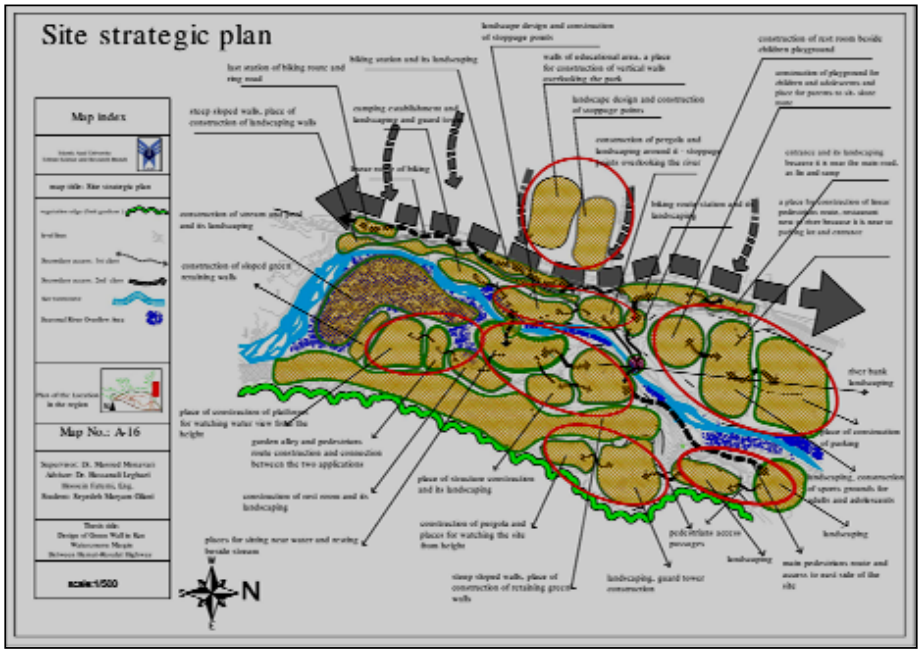

Fig.10: Strategic Plan of the study area

Fig.11: Final Plan of the Project

platforms to watch the height, place for planting flowers and plants, playground for children, market, parking and etc. Fig.11 shows the design elements and layout.

CONCLUSION

According to the results it seems that to design urban riparian parks with the approach of sustainability in urban river-valleys, formularized planning and design should be scheduled according to the region abilities and the implications of land use planning. The first step in achieving a sustainable design of landscape in urban river valleys is identifying the relevant elements of ecological sustainability especially elements that are more vulnerable to environmental risks. According to corridor role of the river valleys and their environmental and ecological functionality can act as critical elements in Tehran. Findings of this research indicate that seasonal flood control and management, identifying a set, restoring rivers, establishing relationship between the green and natural spots, increasing green space and linking human with nature are answered by ecological approaches and the dynamics of river valleys that act as heart of city should not be prevented by non-professional interventions. Use of ecological potential of land, while improving spatial quality of space, will be responsive to the issues of sustainability and puts nature and human in a mutual relationship. In this study, riparian park design with sustainability approach has been carefully studied and examined and the result indicates that use of sustainable ecological landscape design consistent with the environment is an appropriate strategy for revitalization of the urban river-valleys.

ACKNOWLEDGMENT

The author would like to thank Dr. Hassanali Laghai for finding this study.

ENDNOTES

1.Strengths, Weaknesses, Opportunities, and Threat

For more information see Adaptation of Analytical Technique SWOT in order to be used in urban planning, written by Kourosh Golkar, Sofe Scientific-Research Journal, No.41, 2006

2.Holistic

3.Doynamic

4.Intuitive

5.Responsive

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