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Environmental management for urban development around river valleys using a conceptual model

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ABSTRACT

BACKGROUND AND OBJECTIVES: Urban river valleys are so important with regard to their benefits and functions, including air temperate, microclimate creating, landscape, fresh water supplement. Urban development over considering environmental issues, population density, constructions, solid waste or effluent discharging, especially in quantitative and qualitative river boundaries and land taking of their beds, are significant reasons to decline cities functions and ecosystems degradation. So, natural ecosystems should be restored and a thorough strategic planning is necessary for their conservations.

METHODS: With regards to managerial aspects involving ecological, spatial, economic, socio-cultural, and managerial- executive dimensions integrated management model has been recommended for Farahzad River Valley in Tehran city as a case study via Urban River Survey and Geographic Information System. Finally, effective and efficient strategically management plan was suggested by implementing SWOT, QSPM and Analytical Hierarchy Process.

FINDINGS: Amongst 12 identified strategies regulation settings, “correlation between green space and the surrounding park”, and “preventing the increase of residential” and “the expansion of recreation” are prioritized as most significant strategies, scores have been calculated 5.616, 5.589, and 5.375 on QSPM matrix or 0.256, 0.192, and 0.133 by AHP method, respectively.

CONCLUSION: in overall, systemically, multi dimensional and holistic decision of river valleys environmental management is a magnificent example that provides essential tools to urban planners. Environmental and ecological approaches of the model are counted as a main key of succession to sustainable development achievement and its advantage to other past studies.

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INTRODUCTION

Primary civilizations encompassing from Egypt to India and afterward Helens, Romans, Byzantine, Asia Minor, and Islamic cultures had settled along the rivers, which had urbanized numerous progressive nations in which the water is a fundamental portion of their philosophy (simsek, 2012). Rivers are counted as important ecological elements in urbans, have been a vital part in the appearance of civilizations. Not only rivers characterize circumstance for development of settlements but those also affect the imaginative quality of municipal forms and the size of cities. Rivers are known as dynamic systems and have been in interface under altering the constituents of the cities over time (Abshirini and Koch, 2016). The landscape is changing faster than its natural potential urbanization and widespread land use are considered as main agents of the change (Bratley and Ghoneim, 2018). Declining biodiversity, vegetation and habitat indicate urban development, in addition to increasing the global effects of climate change, and a significant impact on the functioning of the land system (Dewan and Yamaguchi, 2009). The world's urban population is growing, so that urban populations almost doubled between 1950 (30%) and 2014 (54%) and it is predicted that by 2050 the world's urban population Reach 66% (Hurlimann and Elizabeth, 2018). River valleys are important elements of natural ecosystems in cities that start from the upstream, pass in the urban area and end to the lowest point of the basin such as wetlands, lakes or seas (Bemanian, 2008). In fact these are the most beautiful elements and valuable natural heritage of the city that play an important role in providing environmental resources to cities and the balance between nature and human (Harvey and Gooseff, 2015). Large amounts of water is transported downstream by urban rivers and feed groundwater reservoirs along the route which have a high function in the dynamics of the morphological process (Ostrowski and Falkowski, 2020). Regardless of the slope along the valley edges, the predominant hydrological flows are maximized throughout the year (MacGregor, 2009). Rivers are rapidly changing in response to changes in the hydrological regime and drainage in the basin (McDonald *et al*., 2019). In the lowlands, it is more affected by climate and human activity (Ostrowski and Falkowski, 2020). River valleys also have special natural and economic values, and the management of these areas requires to recognize their natural processes and limitations (Macklin and Lewin, 2015). Economically, river valleys are an important phenomenon for development in the city (Ostrowski and Falkowski, 2020). Urban river valleys create a natural landscape with morphological changes in depth, slope and width; these potentials attract investment in the areas and symbolize sustainable development in the city with environmental, economic and cultural effects as well as biodiversity potential on free spaces (Falkowski *et al*., 2017). Therefore, protection and restoration of river valleys are essential measures in the sustainable development of cities (Wang *et al*., 2020). Otherwise, the rehabilitation of the area is complex and requires consideration of all aspects, including environmental, socio-economic, land use for residential, industrial and recreational purposes, flood protection and environmental rehabilitation (Minh Vo *et al*., 2019). In recent decades, most countries have paid attention to urban river valley management and implemented many successful projects to rehabilitate it (Macklin and Lewin, 2015). According to past experiences, management criteria throughout the river valley depend on ecological characteristics (Harvey and Gooseff, 2015). Also, humans are interested in adjacent nature, so, in the cities, that managers are sensitive to the issue, so are distinguished more successful than others. In fact planners apply environmental management in their decisions and especially consider ecological properties to protect river valleys and design of surrounding lands (Mohammadian *et al*., 2018). In particular, environmental management is trying to improve ecological and hydrological systems in urban areas, and recently the restoration and protection of rivers is one of the main efforts of urban planning (Bernhardt *et al*., 2011). Other examples of these efforts are the rehabilitation and upgrading of the Los Angeles River, which is in the form of a canal, and includes 239 (Mohammadian *et al*., 2018). Green space projects are often carried out to improve the quality of life of residents in urban areas. These programs provide significant opportunities for urban management to benefit from public participation (Bernhardt *et al*., 2011). In Seoul, South Korea, they opened an 8-kilometer highway under the Chuang Chuan River, which had many environmental, economic, and cultural benefits (Wang *et al*., 2020). Restoration of riverside areas has been considered as an attractive phenomenon in pollution reduction, flood management and environmental protection since 1980 (Shafaghat *et al*., 2019). Regarding previous experiments in Iran and entire the world, such as the Zhangjiangsu Urban River in Jiangsu province of China (Yu *et al*., 2020), the Singapore River thematic formula (Savage *et al*., 2004), a Trinity River project in Dallas, Texas, USA (Kurwadkar *et al*., 2020), restoration of Alangdere Urban River spaces in Gorgan province of Iran (Lotfi and Mousazadeh, 2020), and the Barcelona city restoration project in Spain (Casellas, 2009), have shown environmental, social and economic issues are most important factors in river management and combined methods are more effective and sufficient. In fact, an integrated approach involves a combination of sustainable development approaches in each section with regard to recycling, local conditions, renewable resources, water treatment and recycling, public transport, and land use (Shafaghat *et al*., 2019). Consideration of ecological issues is important in development for management efficiency (Khandelwal *et al*., 2017). According to experience in Sperchios River (in Phthiotis in central Greece), the SWOT analysis method (Strengths, Weaknesses, Opportunities and Threats) is known as a useful tool for environmental decision-making and planning, that processes ecological, land use, socio-economic parameters in the river area and then suggests management programs corresponding to sustainable development proposes. Weaknesses should be minimized and threats should be turned into opportunities, and uses strengths and opportunities to optimize performance (Stathopoulos *et al*., 2013). SWOT has been conducted in south east of Anatolia, Turkey in the field of tourism development around the rivers leading to the Mediterranean Sea and also the surrounding area has been identified by using Geographic Information System (GIS) (Özüpekçe, 2019). The study of Gange River, in India and Bangladesh, has been carried out to analyze and report the river bank erosion hazard, soil stratification of river bank and morphometric parameters on the upstream of Farakka barrage using RS and GIS, in 1955, 1977, 1990, 2001, 2003, and 2005 from LANDSAT and IRS satellite images (Thakur *et al*., 2012). GIS and RS have been implemented as a sufficient tool for mapping (Boori *et al*., 2015*)*. Remote sensing considers trends and future directions of river valleys and finally determines management measures to improve ecosystem conditions (Thakur *et al*., 2012), for instance, the study of Bug river in Poland determined the improvement of remote sensing is necessary for prevention of rational flood in lowland of river valleys especially on those places with complex geological structures (Ostrowski and Falkowski, 2020). As well as, the experiences of Dhaka River in Bangladesh and urban rivers in Malaysia have been implemented via GIS and RS as a useful tool to determine the land use cover and changes around the rivers and to measure the major factors including traffic, industrialization, and building development (Dewan and Yamaguchi, 2009). As mentioned, in order to analyze and present managerial strategies SWOT method is known as a sufficient method. In most of previous studies, SWOT has been conducted with analytical hierarchy process (AHP) model to demonstrate an urban development framework and sustainable planning. To consider the land uses, flora, and other characters of urban river areas GIS has been used; studies of Delhi in India (Rajput *et al*., 2021), Trinity River Basin in USA (Kurwadkar *et al*., 2020), and Sinos River in Brazil (Orteg *et al,* 2018) are the explicit examples. AHP can contribute for choosing a better option of environmental management (Orteg *et al,* 2018). Ecological evaluation of Trinity River basin watershed has been done by using hybridized method of AHP-SWOT- GIS; in results, the ranking of scores determines the priority for restoration as main strategy (Kurwadkar *et al*., 2020). There are many experiments in field of river valleys which have been conducted by combined methods such as GIS-SWOT-AHP model (Wang *et al*., 2020). The GIS–SWOT-AHP model can hardly assures the urban development strategies and it is flexible method with considering all aspects of urban planning which can be used for integrated urban management and river basin restoration (Rajput *et al*., 2021). Since socio-cultural, economic, spatial and managerial indices of river basin are not enough indices, ecological or environmental aspects should be considered in an integrated management framework (Scott *et al*., 2012). The urban water corridors can significantly preserve the declining natural values of the urban ecosystem (Allam and Jones, 2018), consequently, restoration of urban river valleys requires an appropriate planning model which deliberates spatial, socio-cultural, economic, managerial and ecological dimensions (Lotfi and Mousazadeh, 2020), moreover ecological features and urban development changes, indeed a "revitalization" has different meanings in each area and it depends on all features in combination of together, so ecological indices are important factors in decision making process not formed base on this approach and also responsibilities of authorities are not certain separately (Karimi Moshaver, 2013); the river valleys were seen as deep valleys in the north of Tehran and then are shallow and old in the center of the city, in most sections converted to cement and covered canals (Laghai and Gilani, 2014). In Tehran, there are seven large valley rivers with a north-south trend (Karimi *et al.*, 2018), which are the only remaining natural heritages on the southern slopes of the Alborz mountain ranges, and forms the water sources of old Tehran, also those are the discharge routes of surface water and possible floods (Kamanroudi Kojuri *et al.*, 2020). The functions of river valleys of Tehran are dramatically substituted for sewerage. The urban and environmental management of the valleys should be done according to special principles and criteria (Barghjelveh and Sayad, 2011). Because of the features such as proximity to the northern mountainous areas of Tehran, water flows, and beautiful landscapes in the urban background (Karimi *et al.*, 2018) these are the best urban recreation areas (Kamanroudi Kojuri *et al.*, 2020). Creating temperate climate, micro-climate, nourishing groundwater resources and supplying fresh water are important functions of urban river valleys (Karimi Moshaver, 2013). Tehran is always facing a shortage of water for drinking, irrigation and other consumptions; therefore addressing this issue in urban management is counted as a key element. Farahzad River Valley, in the north west of Tehran, has undergone a variety of changes related to urban development, in addition the variety, the intensity and speed of change is also more significant than 6 others (Bahrami *et al.*, 2019). It rises 3410 meters height and flows in a narrow and relatively steep catchment with 3100 hectares in area (Forman Asgharzadeh *et al.*, 2016), the flow is 0.23 m3/s per year averagely and the mean of sedimentation has been estimated 8 MCM yearly (Samadi *et al.*, 2017). Fig. 1, shows the the study area.

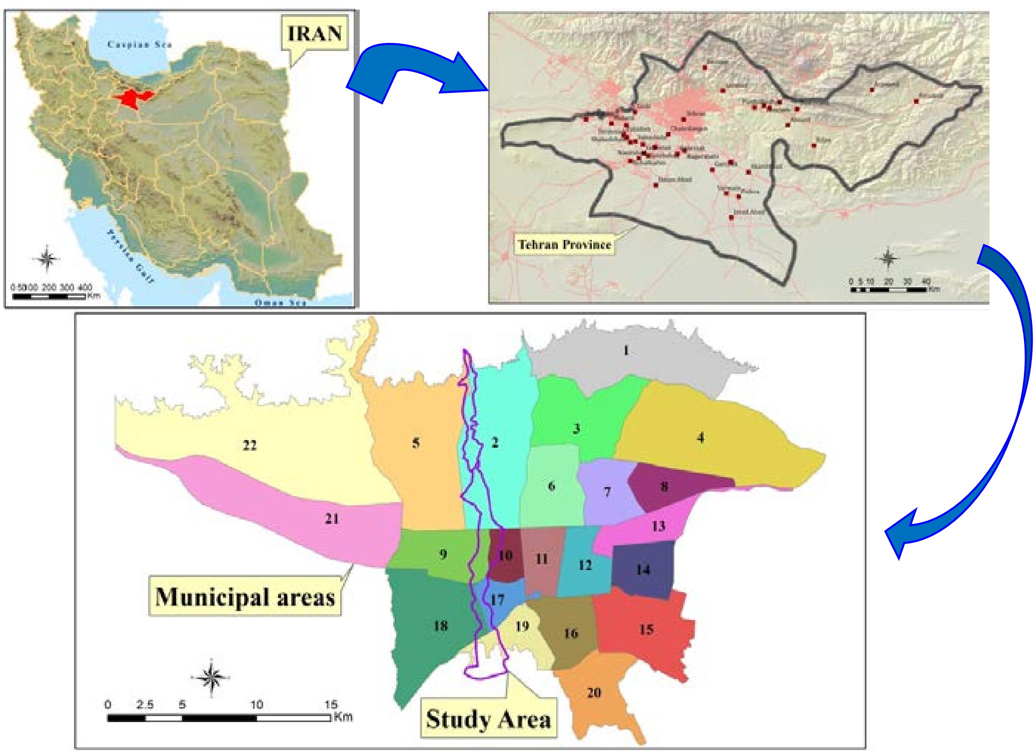

Fig. 1: Geographic location of the study area in Farahzad basin area, Tehran, Iran (Karimi *et al.*, 2018)

Farahzad River Valley had different changes during the recent decades (Bemanian, 2008), that has converted to a sewage canal with a cement bed and its surface covered (Barghjelveh and Sayad, 2011). Taking lands for residential complexes, extending road networks and bridges (Karimi *et al.*, 2018) led to a large scope of high level risks on Farahzad River Valley ecosystem, its structure and functions have affected in long term (Bahrami *et al.*, 2019) as well as its environmental benefits to air, ground water, habitat supporting and biodiversity declined and erosion and sedimentation increased. Therefore, it is necessary to select a comprehensive and integrated management method to improve Farahzad River Valley which considers environmental components in the city. Thus, the study is focused on a single river valley in Tehran which is known as "Farahzad River Valley" and tried by providing a managerial strategies to improve the environmental condition of the area. The current study have been carried out in Tehran in 2018.

MATERIALS AND METHODS

Essentially, a very convenient framework has been defined in the conceptual model of study. Thus, every aim of incorporated management in Farahzad River Valley would be cover up on the process. So that the framework includes all categories of integrated management model comprising ecological, spatial, socio-cultural, economic and managerial indices. In order to apply the integrated management model on Farahzad River Valley and its surrounding area, some environmental management methods are used in combined. In first stage, Urban River Surveying (URS) is used that prepares an exact process to identify all features around the river (Allam and Jones, 2018) as well as can focus on land use planning and economical activities around the river and consider relationships between environmental components and social activities (Yu *et al.*, 2020), so that illustration of these properties GIS is an accurate tool which is used in this study and all of maps has been prepared by Arc-GIS soft ware. GIS can facilitate characterization of field information during time (Boori *et al.*, 2015), so it is used on Farahzad River Valley to show spatial features surrounding river valleys. The required information is entered from Remote Sensing (RS) and satellite monitoring in the earth. All information of land uses and Farahzad basin has been gathered via these tools. Result of this section showed by map drawing. There were three considerable land units including upstream mountain area, middle foothill and downstream land for development management in the catchment, maps drown by remote sensing and GIS (Ostrowski and Falkowski, 2020). Farahzad River Valley has several changes during the route, that those depend on human activities and land uses (Foman Asgharzadeh *et al.*, 2016). For this purpose, catchment, sub-basin, slope, habitat and signs features have been considered hierarchically (Fig. 2) to identify land uses by using URS and GIS.

For second stage, has gone ahead by using management methods. In order that achievement of problem solutions and information analysis, Multi-Disciplinary Criteria Decision Making (MCDM) methods have been selected. Among of those

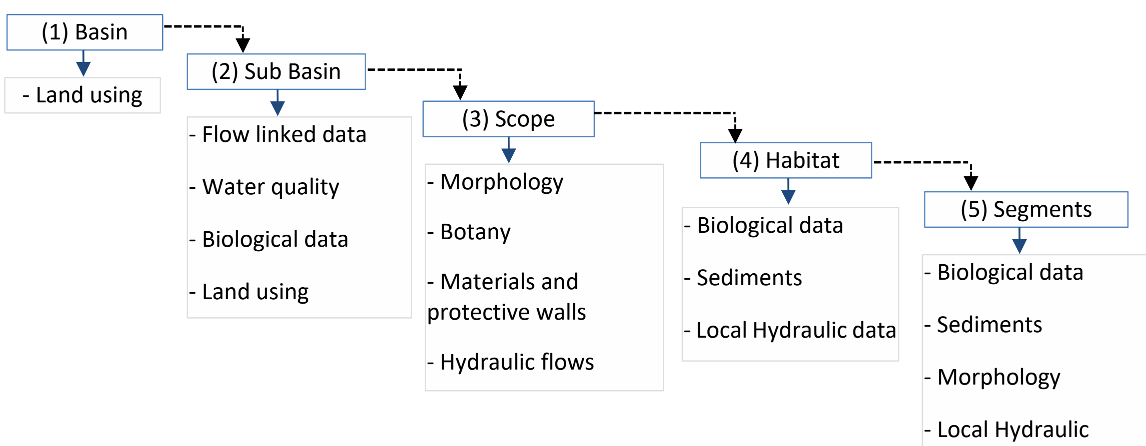

Fig. 2: Spatial hierarchical structure of basin integrated management (Linke *et al.*, 2019)

methods, SWOT analyzing method has been used in combined AHP. The hybridized SWOT-AHP method is an integrated and flexible model which can quantify and prioritize managerial strategies (Purahmad *et al*., 2013). To perform this section, the strengths and weaknesses (Internal factors) and opportunities and threats (external factors) have been categorized on Internal Factors Evaluation matrix (IFE) and External Factors Evaluation matrix (EFE) respectively. Matrices would be identify dominant condition between internal or external components, it means If the average of weight scores of IFE is greater than 2.5, the environment is generally strong and either in EFE, if the mean of weights is greater than 2.5, opportunities are dominant. Then, in order to find effective and efficient ways to improve the current situation, possible and usable strategies are classified in the SWOT matrix. In fact, SWOT matrix organizes strategies in 4 categories involving aggressive strategies (SO), diversification Strategies (ST), review strategies (WO) and defensive strategies (WT) listed in SWOT matrix. In addition, Quantitative Strategic Planning Matrix (QSPM) is used which can quantify and prioritize strategies (Pazouki *et al*., 2017). While the SWOT method was done, a set of 21 professional experts have assisted in each step, comprising identification, quantifying and prioritizing of factors and strategies. Specialists have been selected based on their sufficient knowledge and experience in various fields of urban management, river valleys or urban surface water resources and the environment. In third section, in order to verify the scores AHP and Expert Choice (EC) software have been used, to compare pair-wisely; the combination of these methods has been known as AHP-SWOT. Saaty defined the comparison matrix with 1-9 scale, which is summarized in the following comparison matrix and Table 1. Then by using expert choice soeftware (EC), the scale is converted to fuzzy numbers from zero to 1. In this study fuzzy numbers and graphs have been applied to illustrated ranks.

Table 1: Scale for pairwise comparison (Celik, 2018)

Scale	The relative importance of the two sub-elements
1	Equally important
3	Moderately important with one over another
5	Strongly important
7	Very strongly important
9	Extremely important
2, 4, 6, 8	Intermediate values

RESULTS AND DESCUSSION

According to the combination of preliminary data and the hierarchical study of the river valley morphology the basic environmental indicators in the Farahzad River Valley include three groups of descriptive material characteristics, habitat characteristics, plant structure and biomass. The bed materials of the river in the urban part include two fixed and moving parts. Its fixed part consists of concrete, brick and bedrock and the moving part consists of silt, sand and gravel. There are several types of river bank protection that have a numerical value from zero to three based on their reliability and permeability. Leached side edges receive zero numerical value, edges with marshes, willow trees and wood plant species with a conservation value receive one, side gabions receive two (is one of the watershed management practices), and finally edges with hard material coating such as concrete blocks and bricks receive there. These numerical values can be zoned and localized in the Farahzad River Valley route and used to calculate the value of protection indicators of ecological dimension, which receives three numerical values largely in the urban area. Another indicator of primary indicators is land use that is analyzed at both basin and sub basin levels. The results of land use status in Farahzad catchment area are presented based on the latest changes in Map of Fig. 3.

This river intersected by the main communication ways and highways on the surface that crossed it through the bridges. As well as, subway light rail ways intersect the river route underground and pass it by tunnel. Therefore, the river has been exposed to risks on the intersection points. Habitat indices include river flows and are grouped on secondary and tertiary indicators, which it usually has gentle currents within the city of Tehran, because of surface water flow pattern and the predominant water flow of the river. The third level of indicators are addressed at the sub-basin level, and simulated by GIS for classifying their effects, along with the results from URS, used for land use planning in reverie environments to consequent integrated river valley management. Consideration of the current environmental settings including internal and external factors showed that in general 15 strengths and 15 weaknesses are

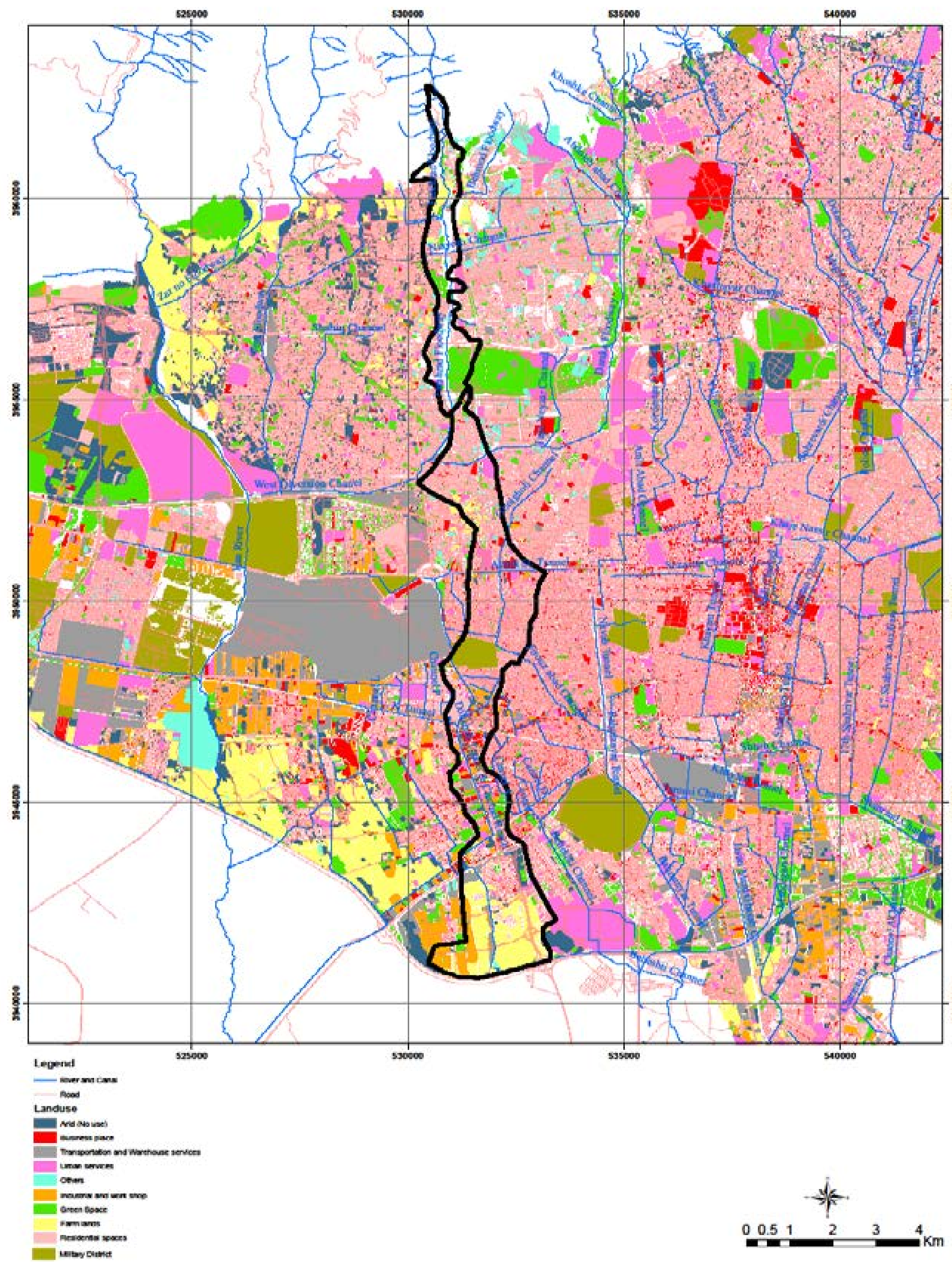

Fig. 3: Map of land use in Farahzad Basin

predictable in the Farahzad River Valley area, which categorized in Table 2. The sum of scores is 2.4, which means the environmental aspects are generally weak which indicates the dominance of environmental weaknesses over environmental strengths.

In order to prioritize internal factors (strengths and weakness) and ensure the scores, scores are calculated through the AHP method and EC software (Fig. 4).

Overall, 14 opportunities and 15 threats have been distinguished and categorized in Table 3. The sum of score is 2.61 and indicates the dominance

Table 2: IFE of Farahzad River Valley area

No.	Internal Factors	Weight	Score	Total Score
	Strengths			
S1	The function of river canals for transferring air and climatic effects	0.056	3	0.168
S2	Green spaces around the river valley	0.018	3	0.054
S3	Regardless to the erosion of the bed and sides	0.056	3	0.168
S4	Establishment in the vicinity of the valuable rural areas	0.028	4	0.112
S5	Related to the recreation and tourism areas directly	0.025	3	0.075
S6	The connection of the river with its old bed	0.016	3	0.048
S7	Prediction of walking, cycling, city train, bus, taxi and minibus routes around the river valley	0.035	4	0.140
S8	Potential of creating different facilities	0.033	4	0.132
S9	Proximity to residential texture, natural recreational areas, scientific and educational areas	0.035	4	0.140
S10	Cultural and social area around the river	0.039	4	0.156
S11	Subjective records and public memories, rural recreational and entertainment functions, gardens, mountain hiking	0.031	3	0.093
S12	Suitable areas for the citizens to engage and attend social interactions	0.040	4	0.160
S13	Possibility of economical activities in the area	0.025	۴	0.100
S14	large lands for green spaces in the middle part of valley river area	0.021	3	0.063
S15	Preparation of cadastral map of the river area	0.042	4	0.168
	Weakness			
W1	Land taking of the river upstream by private owners and changing the morphology	0.050	1	0.050
W2	Closure of the river water metering station	0.017	1	0.017
W3	Short attention to environmental health in the upstream areas	0.023	1	0.023
W4	Destructive effects of bridges and changing of river valley morphology	0.051	1	0.051
W5	Deviation of the river from its natural path to the flood reversal	0.052	1	0.052
W6	Land transfer by various institutions, mass construction and cooperatives, construction of highways and completion of land storage in other suburbs	0.039	2	0.078
W7	Influence to river basin with land taking and constructions	0.049	1	0.049
W8	Lack of connection between immediate basin of river and historical or valuable textures	0.018	2	0.036
W9	Functional interruption and discontinuity of implemented projects along the river route	0.030	1	0.030
W10	none complete and suitable sewage network in places and lands around river valley	0.028	2	0.056
W11	Insufficient attention to the design of surrounding structures and landscaping	0.016	2	0.032
W12	Low security in some areas due to issues such as marginalization and drug dealing	0.022	2	0.044
W13	Decreased recreational and leisure activities due to increased residential functions	0.032	1	0.032
W14	Lack of income generation of river valley as a new environmental space	0.020	1	0.020
W15	Lack of integrate management and large number of organizations involved	0.053	1	0.053
Sum		1.000	-	2.4

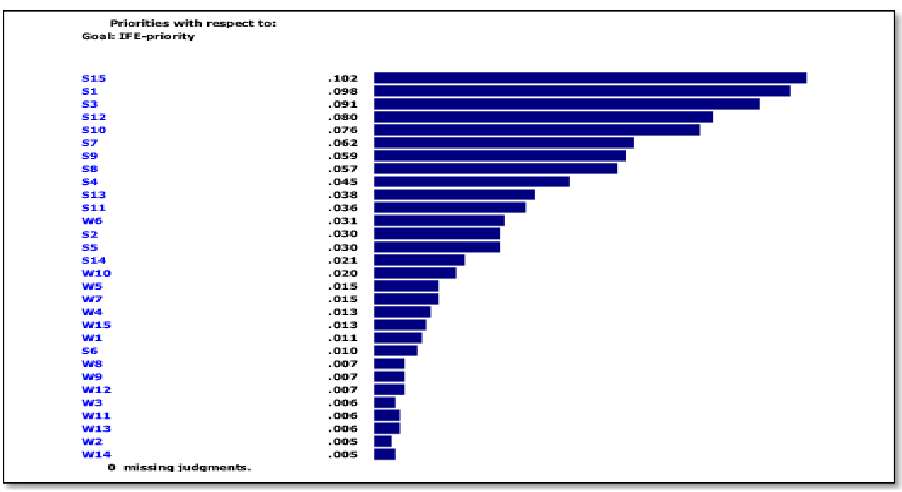

Fig. 4: Internal factors of existing environment by AHP and EC

Table 3: EFE of Farahzad River Valley area

NO.	External factors	Weight	Score	Total Score
	Opportunities			
O1	The function of the river valley as a natural corridor upstream	0.053	4	0.212
O2	Solid waste and debris gathering by NGOs and publics in upstream to improve environmental quality (public participation)	0.018	3	0.054
O3	Possibility of creating different facilities	0.013	4	0.052
O4	Possibility of various activities in the economic field of this area	0.032	3	0.096
O5	Environmental friendly architecture by using new technologies (such as roof garden)	0.038	3	0.114
O6	Public transportation networks utilization for air pollution mitigation in the area	0.032	3	0.096
O7	The spatial composition of Farahzad River Valley and its continuity and the potential of creation a linear park	0.069	4	0.276
O8	Suitable corridor for mountaineering	0.026	3	0.078
O9	Possibility of residents participation to supply spatial social security	0.026	3	0.078
O10	Capability of supplying required conditions to play role as a recreational river valley	0.056	4	0.224
O11	Residents social cohesion in the neighborhoods adjacent to the river due to the common use of space and the desire to participate in new economic activities of education and research	0.024	3	0.072
O12	Economic efficiency due to the possibility of deploying land uses together	0.041	4	0.164
O13	Possibility of investment in recreational section and preparing public areas for citizens	0.034	3	0.102
014	Prosperity of the surrounding areas through the tourism economy	0.038	4	0.152
	Threats			
T1	Flooding in some sections especially bridges	0.041	2	0.082
T2	Continuation of upstream environmental pollution and waste water entrance	0.015	1	0.015
T3	Extinction of existing species in the area	0.019	2	0.038
T4	Destruction of edge natural space due to urban population and edge accommodation	0.035	2	0.070
T5	Probable disasters (earthquake, flooding and etc.)	0.042	2	0.084
T6	Disruption by land taking of river valley area in some sections	0.037	1	0.037
T7	Interruption in vital and ecological corridors by constructions	0.046	2	0.092
T8	preventing water penetrating into groundwater aquifers by concrete requirements	0.047	2	0.094
T9	Shortage of a continuous pedestrian path due to frequent intersections	0.038	2	0.076
T10	Deficiency of sewerage network organization	0.014	1	0.014
T11	Absence of attention to access to the river, which causes the loss of visual and sensory connection with the river	0.016	1	0.016
T12	Potential social problems in case of lack of social supervision	0.018	1	0.018
T13	Increasing buildings around the river by organizations, institutions and individuals	0.022	1	0.022
T14	Expanding land transfer to governmental organizations and bodies for construction	0.039	1	0.039
T15	Decentralized and non-integrated management	0.071	2	0.142
	Sum	1.000	-	2.61

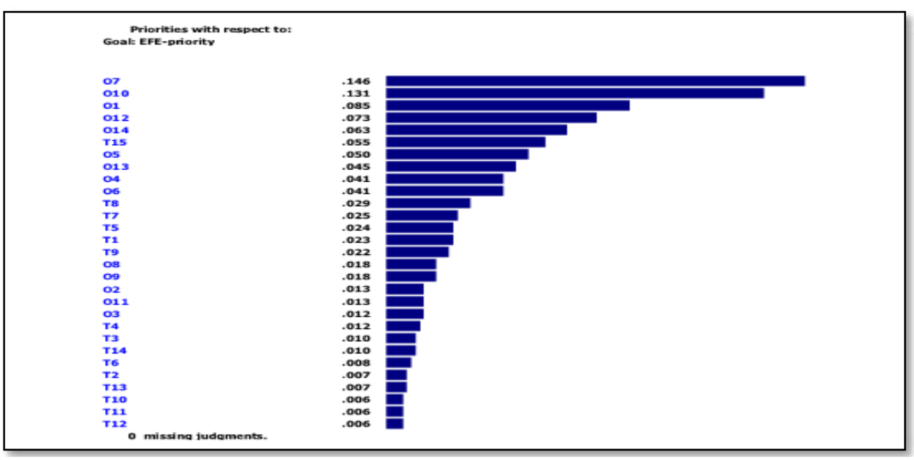

Fig. 5: External factors of existing environment factors by AHP and EC

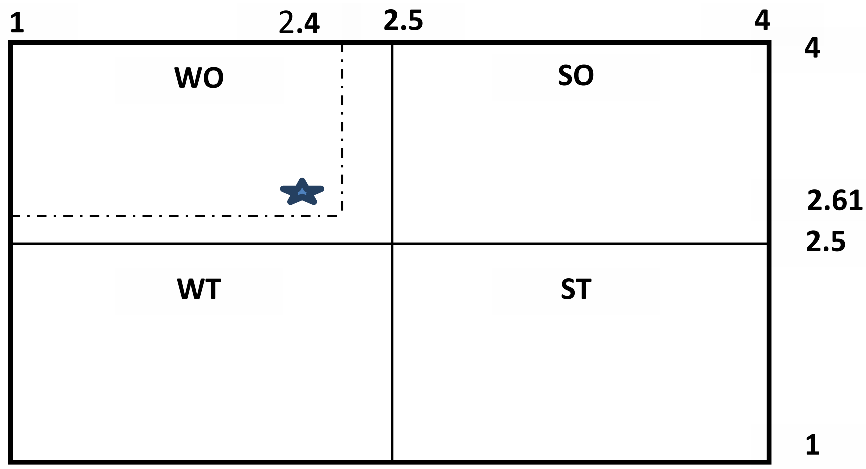

Fig. 6: Strategy classification

Table 4: Strategies prioritization by QSPM matrix in terms of total attractiveness coefficients of WO strategies

Strategies	Total attractiveness coefficients	priority
Establish integrated and comprehensive rules and regulations related to River Valley (WO11)	5.616	1
Creating a link between green spaces and other natural areas (WO3)	5.589	2
Prevention of arising residential functions around the river valley along with improving public access to the river (WO9)	5.375	3
Determination and utilization of suitable natural factors to improve environmental and landscape (WO6)	5.318	4
coordinating all decisions by establishment of permanent integrated executive and management organization (WO12)	5.269	5
Prevent the changes of use of environmentally friendly lands to other uses and consider the principles of compatibility in the design of environment (WO5)	5.103	6
Stepped design of river profile to reduce the destructive effects of floods and rehabilitate the old route of Farahzad Valley (WO4)	5.042	7
Establish communication and promote public participation in social activities and security (WO8)	4.999	8
Increasing revenue generation in the environment due to issues such as tourism boom (WO10)	4.898	9
Construction of hydrometric station to evaluate the quantity and quality of water in order to manage water resources (WO1)	4.648	10
Prioritize the completion of the sewerage system in the Farahzad River Valley area in order to reduce the inflow of sewage into the river (WO7)	4.511	11
Collection of construction waste and debris to reduce water pollution (WO2)	4.410	12

of environmental opportunities over environmental threats. Prioritization of external factors by EC and AHP scores is displayed in Fig. 5.

Results showed strategies are in conservative (WO) class (Fig. 6). This status arose from the dominance of weakness over strengthened and dominance of opportunities over threatened. Thus, proper strategies to desirable condition achievement should improve internal weakness via environmental opportunities. Main strategies and prioritization summarized in Table 4. The result of strategies prioritization by AHP and EC has been illustrated in Fig. 7. As shown WO11 strategy (0.256) and WO3 (0.192) have a higher score than other strategies.

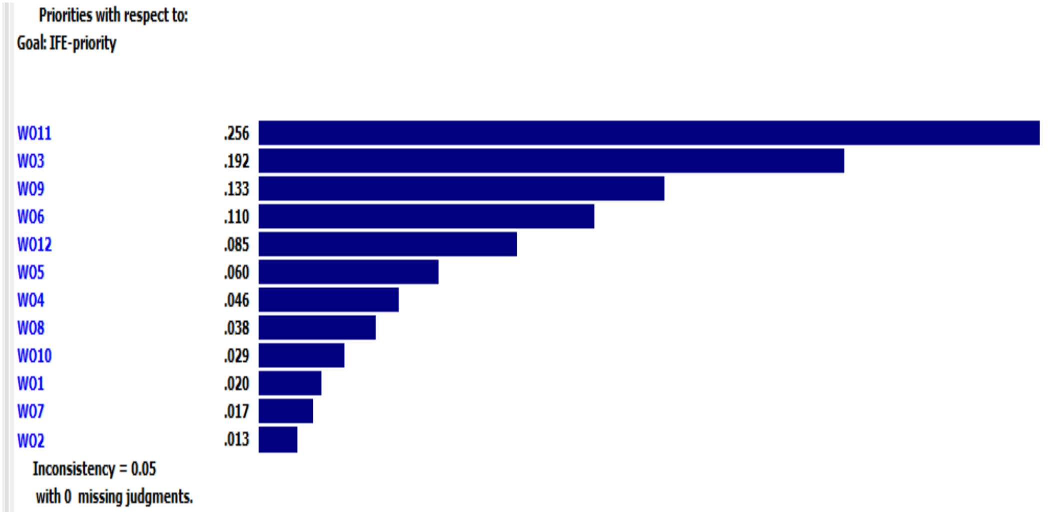

Fig. 7: WO strategies prioritization by AHP and EC for Farahzad River Valley

CONCLUSION

In this paper, Farahzad River Valley has been considered as a largely reformed urban river, from upstream to down lands. All exposed spaces such as gardens and flora were ruined and converted to built-up areas; this study confirmed the occurred development throughout the route similar to previous studies, and has recommended strategies to solve the actual complicated concerns of the river. Hence, the most appropriate methods were selected by reviewing previous studies; by using an integrated management method tried to realize a modernized moderation measures to propose some effective and sufficient procedures to enhance river circumstances. The hybridized URS-GIS-SWOT-AHP has used, which can significantly encompass five dimensions of integrated management framework, including ecological, spatial, economic, socio-cultural, and managerial dimensions. URS is a technique is used to monitor and deliberate the dynamic phenomenon of urbanization with the aid of GIS, RS and satellite images. With regard to previous studies in the field, SWOT-AHP is a known method to determine, analyze, and conclude managerial strategies and provides appropriate information to planners for decision-making. The approaches of previous researches on Farahzad River Valley are generally towards urban development and planning for land use around the valley river. While other issues such as vegetation, floods, bed material, qualitative and quantitative boundary of the river, its ecological resilience and interaction between ecological parameters and human-made are very important in development plan around the river valley. Indeed, Practical conceptual management model is an advantage of this study, essentially provides a framework for determining the direction of integrated river management. The suggested strategies preserve the declining natural values of the urban river ecosystem in case of Farahzad River Valley. According to the results, WO strategies are dominant strategies in this case, among the WO strategies, “establish integrated and comprehensive rules and regulations related to River valley” (WO11), “creating a link between green spaces and other natural areas” (WO3), and “prevention of residential functions development around the river valley along with improving public access to the river“(WO9) are three first prioritized WO strategies which have been ranked via QSPM matrix and AHP. In order that revitalization of Farahzad River Valley, implementing strategies is necessary. Monitoring of land uses on certain period and consideration of changes are significant action plans of integrated environmental urban river management. Consequently, the method of this study is recommended for future studies of river valleys managements.

AUTHOR CONTRIBUTIONS

M. Sadreazam Nouri performed the literature review, experimental design, analyzed and interpreted the data. J. Nouri prepared the manuscript text, and manuscript edition. F. Habib revised the urban data and literature review, M. Rafian helped in the literature review and urban subject revision.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATIONS

%	Percent
AHP	Analytical Hierarchy Process
DEM	Digital Elevation Map
EC	Expert Choice
EFE	External Factor Evaluation
EI	Environmental Indicators
GIS	Geographic Information System
IFE	Internal Factor Evaluation
IMMs	Integrated Management Methods
Land Sat	Satellite of Land Sat
MCDM	Multi-criteria decision Making
QSPM	Quantitative Strategic Planning Matrix
RS	Remote Sensing
SWOT	Strengths, Weaknesses, Opportunities, Threats (Strategic Environmental Management)
IRS	International satellite Remote Sensing
SO	Strengths and Opportunities strategies
ST	Strengths and Threats strategies
URS	Urban River Surveying
WO	Weaknesses and Opportunities strategies
WT	Weaknesses and Threats strategies

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