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Expectation and reality of urban green space: A case study on landscape planning and development of Islamabad city, Pakistan

Zile Huma[1,2*], Lakhte Hyder[1,3]

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Author Affiliation:
[1]Department of Architecture, COMSATS University, Islamabad, Pakistan
[2]South China University of Technology, Guangzhou, Guangdong, China
[3]School of Architecture, Harbin Institute of Technology, Harbin, China

***Corresponding author:**
Email: zilehuma@comsats.edu.pk

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ABSTRACT

Urbanization is a multidimensional process that causes complex changes in the socio-ecological system, and the urban landscape is a typical reflection medium of such changes. Many current studies focus on socio-ecological theory, but there is a lack of empirical research on the quality of socio-ecological practice. The article aims to reveal the gap between socio-ecological theory and practice through a case study of Islamabad city in Pakistan, the ekistics-based planning practice project. The "ekistics" proposed by Doxiadis focuses on the relationship between man and nature regarding the human settlement environment. This study monitored the land use dynamics of Islamabad and investigated the landscape perceptions of stakeholders, to measure the statue of urban landscape resilience, an indicator used to feed back the socio-ecological system. The data were collected by GIS spatial analysis, field observations and questionnaires and interviews. The results showed that the landscape resilience of Islamabad was not satisfactory, facing many challenges, and in current planning and management practices, the research-action gap is widespread. In response to these issues, the study emphasized the points in the urban green spaces policies and management: considering user needs and strengthening multiple participatory and cooperation between government, managers, researchers, engineers, and citizens. Moreover, the study highlighted the need to formulate strategies in some key areas, including public engagement, collaborative planning guidelines, specific context innovations, ecological knowledge and awareness, and innovative techniques.

Keywords: Urban landscape, socio-ecological practice, resilience, urban management, urban sustainability

1. INTRODUCTION

Urban areas are a place of 54% global population that is projected to increase to 70% by 2050 (UN-Habitat, 2015). Rapid urbanization makes cities vulnerable to adverse socio-ecological consequences (Sarker et al., 2018). Changes in 'land use'

and 'land cover' also hinder sustainable urban development (Ciftcioglu, 2019). Rapid urbanization creates stress on the social, and physical resources, resulting in less contact with nature, limited social interaction, increased pollution (Dennis & James, 2018) and damage to natural habitats and ecosystems (Shams & Barker, 2019). The major challenge in this proposition is to incorporate the complex relationships between the social, environmental, and socio-ecological systems (Cumming, 2011) to construct a discourse on sustainability (Sarker et al., 2020).

Landscapes can be described in many ways. A socio-ecological landscape consists of diverse people dependent on each other and the natural environment in multiple, intersecting relationships over time (Sarker, Wu, et al., 2020b). It comprises multi-ecosystems, financial, and social systems. A socio-ecological perspective presents the opportunity to visualize the interrelated city, its inhabitants, and the environment (Chaffin & Scown, 2018; Li et al., 2019; Sarker et al., 2020). The 'resilience' concept enables ecologists to study and explain the impact of changes resulting from various disturbances and the post-disturbance recovery of the socio-ecological system (Wilkinson, 2012a; Holling, 1973; Feliciotti, 2015; Folke et al., 2016).

In urban environments, green spaces play an important role in preserving the balance between the natural and the built environment, which is destroyed by loss of urban green spaces (Shams & Barker, 2019). Urban green space may be considered an integrated area of natural, semi-natural, or artificial green land that serves various demographic groups (Tzoulas et al., 2007). The vegetation cover of metropolitan cities has diminished due to population growth, industrial expansion, construction activities and land encroachment. As part of a green infrastructure network, green urban spaces can be built to serve a single purpose or multiple functions. Together with other nature-based solutions, green urban spaces reduce carbon emissions and climate disturbances and ensure that urban citizens can survive and prosper in changing environments by providing ecosystem services (Wilkinson, 2012b; Krauze & Wagner, 2019). These spaces foster urban recovery and regeneration after a shock or stress (Liu et al., 2019). Preservation of UGS contributes to increasing urban resilience in the most cost-effective way (Dennis & James, 2018).

'Ecological resilience' focuses on the ecosystem, whereas 'social resilience' focuses on the social system (Chaffin & Scown, 2018; Liu et al., 2019; Sarker, Wu, et al., 2020a). Thus, socio-ecological resilience is the interaction among the actions of human beings, social organizations and markets through the use of natural resources (Liu et al., 2019). Landscape resilience enhances the ability of a landscape to regulate its ecological functions under changing climatic circumstances (Marcus & Colding, 2011; Ahern, 2013; Beller et al., 2015). Herein, a focus that reaffirms landscape planning is needed in practice and research (Bergamini et al., 2013), which is broadly referred to as "a strong forward-looking action to design, enhance or restore landscapes" (Council of Europe, 2000), serving to interface between knowledge and practice (Council of Europe, 2000; Albert et al., 2019). Based on the above review, academic research on socio-ecological practice appears to be limited. The challenge of connecting the socio-ecological theoretical ideology with actual practices necessitates empirical research.

Previous studies have focused on perceptions on landscape (Li et al., 2019), citizens' preferences (Hu et al., 2019), societal challenges (Albert et al., 2019), land cover changes (Mannan et al., 2019), greening policies (Naeem et al., 2018a), and comparison of urban planning policies (Bokhari, S.A.; Saqib, Z.; Ali, A.; Zaman, 2018). However, a focus on urban landscape resilience-based development is still lacking. Therefore, this article aims to explore urban landscape status by analyzing the natural and human processes. This article can broaden the current knowledge of social-ecological functions in an adaptive mode (strategic mode), especially in an urban socio-ecological context that embodies multifarious 'people-nature' interactions.

2. METHODS AND MATERIALS

2.1. Geographical Features of the Study Areas

This study was carried out in an urban setting in Islamabad, which was developed in 1959 as Pakistan's new capital and located at 33◦30′ N–33◦40′ N latitude and 72◦50′0″ E–73◦20′0″ E longitude (Figure 1).

Islamabad was planned based on the Ekistics principle (science of human settlement) (Doxiadis, 1968). Formal ekistics studies were conducted to determine the most suitable site of the new capital on a regional, national and neighborhood scale. This was the first large-scale application of ekistics in the world. Doxiadis termed Islamabad as the city of the future based on his idea of 'Dynapolis' – a dynamically growing city whose single, unilinear center grows from a small polis to a large metropolis, provided that the city does not become a multi-nuclei metropolis. This center was designed to to expand without invading adjacent neighborhoods (Chen, Wang, et al., 2020). The principles of Ecumenopolis were applied for the first time to build regional connectedness. Islamabad is divided into 2 km by 2 km neighborhood blocks that function as sub-centers within the metropolitan area.

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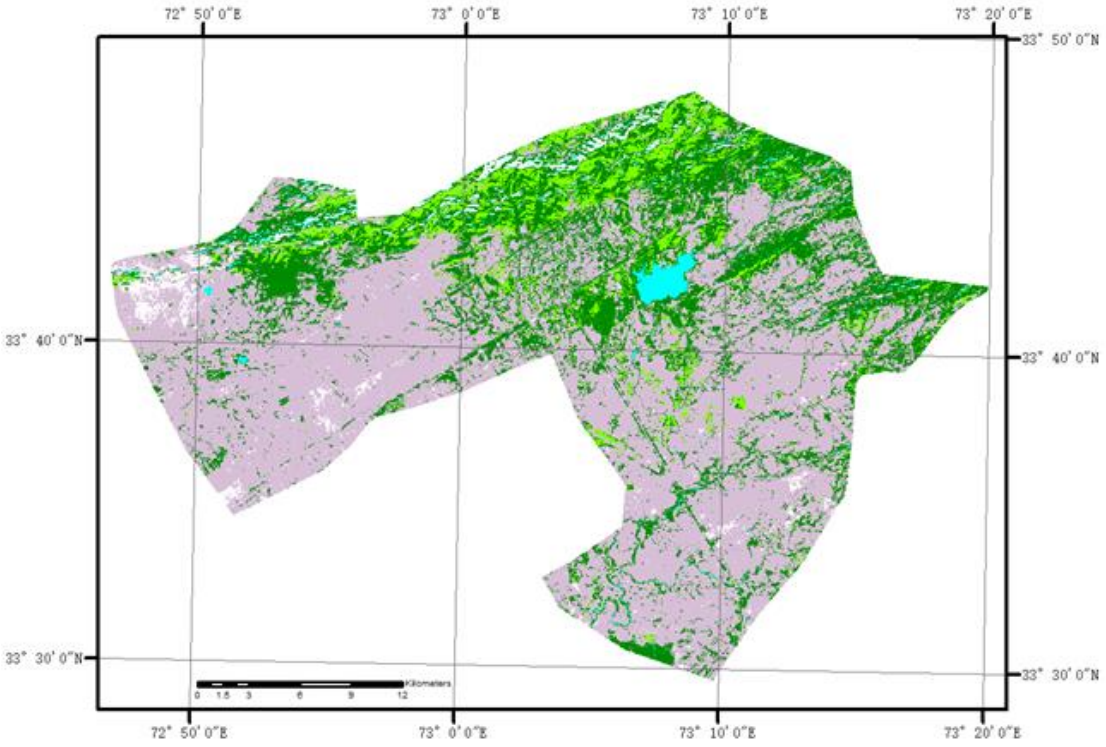

Figure 1. Map of Islamabad city

Within the ecological perspective, ekistics tends to balance the man-made and natural landscape to preserve its best qualities (Mannan et al., 2019). Under the social perspective, urban centers, highways, and parks are classified into different scales, ranging from regional and national to local centers in each class. These are further subdivided into communities of various classes, each having the corresponding spatial structure (Naeem et al., 2018b), including a center serving the entire community, and encompassing industries, parks and public facilities (Feliciotti, 2015). Under the 'Ecumenopolis' principle, Islamabad is a 'city built on a human scale that can be expanded to a regional scale' (Wicaksono et al., 2019). It was conceived as a self-evolving city whose renewal would not be forced by unexpected evolution (Kamruzzaman et al., 2019). It would gradually create newer and better areas (Dennis & James, 2018).

2.2. Contemporary Islamabad City

Islamabad has a population of 2.5 million according to 2020 data [Source: Gridded population of the world, version 4. (http://sedac.ciesin.columbia.edu/data/collection/gpw-v4)]. Its rapid growth and precarious urbanization pose challenges to experts and planners alike, creating social-ecological disorders. This empirical study has been conducted to analyze these transformation and growth patterns, land use and land cover changes, and their consequential impacts on the local ecology. To analyze users' perceptions and key informants about the urban landscape of Islamabad and the issue of urban resilience (Daechsel, 2013), pragmatic strategies and a policy framework have been devised.

2.3. Data Collection

2.3.1. Spatial Mapping

Satellite imagery tools of Landsat-8 (OLI_TRIS) and Landsat-4-5 (TM) from Earth Explorer (https://earthexplorer.usgs.gov/) were used for analyzing changes in land use and land cover (LULC) of urban areas of Islamabad [38, 39]. Land cover data from 2000 to 2010 was obtained using Landsat-5 data, while Landsat-8 provided data from 2015 to 2019 (Table 1). Pre-processing or radiometric correction of Landsat data was collected through Radiometric Calibration in ENVI. Supervised Landsat Image Classification using ENVI 5.3 was obtained for vegetation, built-up area, water body, barren area, urban green areas (Figure 2).

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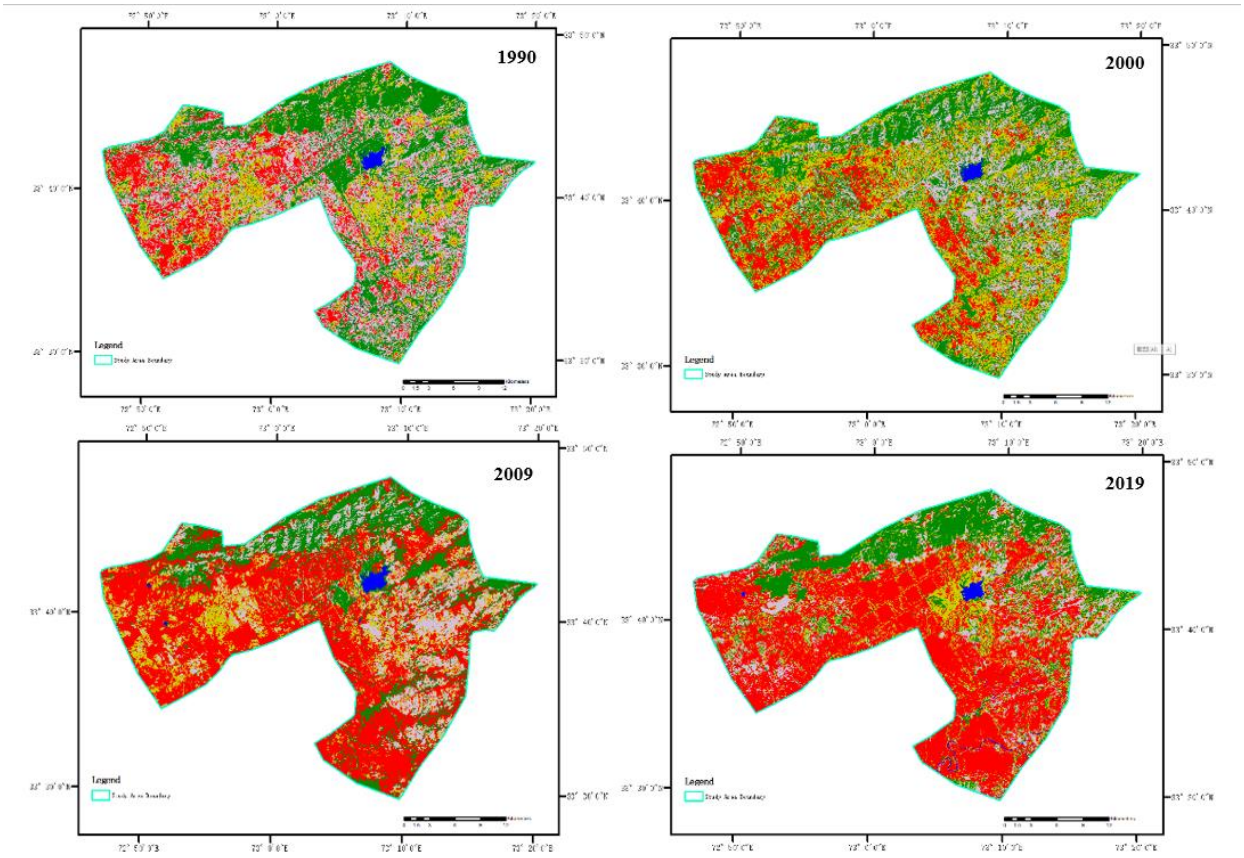
Table 1. The TM/ETM+/OLI data used in the study

No.	Landsat satellite	Acquisition date	Sensor
1	Landsat-4	1990	TM
2	Landsat-5	2000	TM
3	Landsat-8	2010	OLI TRIS
4	Landsat-8	2019	OLI_TRIS



Legends	Class name	Description
	Boundary	Islamabad Capital Territory
	Barren Area	Barren Rocks, Sand, Bare Soil
	Mixed vegetation	Forest Types, Shrubland, Grassland
	Built-up area	All Kinds of Construction Land.
	water body	Lakes, Rivers, Drainages
	Urban Green	Green Land Inside the Urban Periphery

Figure 2. Landsat mapping 2000-2019 with classification and description

Study sites were selected within 5 km of the central business district as locations nearer to the urban core reflect greater variety in culture, knowledge, and users' expectations. The author selected different landscape sites within a large urban area because, as prescribed by the ekistics grid /ekistics logarithm scale (ELA) [In ekistics theory, the systematic investigation of settlements is devised through a directly proportional framework of human-scale & population size, termed as "ELS / Ekistics Grid" (32)], a city is not an agglomeration of isolated and unrelated spaces but a single entity of interrelated spaces (Doxiadis, 1968). Doxiadis (1968) had planned Islamabad by integrating the ecological structure with the social structure through a 2x2 km small polis hierarchy. He maintained the holistic relationship of the blue-green corridor in his master plan, which promotes regional ecological connectedness. The authors interviewed users and managers to collect data for this study.

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2.3.2. Face-to-Face Interviews

In urban parks, 152 semi-structured face-to-face interviews were done. Interviewees were selected based on random visits to urban parks. For virtual interviews, the authors selected mostly urban residents. The questionnaires were divided into three sections. The first part covered demographic details (e.g., age, gender, occupation, education, and residency status). The second section included Likert-scale questions to record respondents' preferences and knowledge about green spaces. Some open-ended questions were included to probe the reasons for respondents' responses. The third part featured an photo elicitation exercise (Hoversten & Swaffield, 2019) to relate respondents' opinions about their acceptance of variations in UGS.

2.3.3. Key Informant Interviews

Approximately 13 interviews with regional and city level managers and academicians from interdisciplinary fields were conducted to learn about their preferences, in-depth understanding of the current socio-ecological changes, and policy and management practices preferences. The interviewees were also asked to share their opinions on the practice-research gap.

2.4. Approach for Measuring Urban Landscape Resilience

Qualitative data from Landsat images was analyzed by converting the image pixels into sq.km units. Next, the changes in the five classes were analyzed in terms of area and change in area range (Table 2).

Table 2. Land use distribution and change during the year 1990, 2000, 2010 and 2019

Land use Classification	Area (km²)					Change in area range (km²)		
	1990	2000	2010	2019		1990-2000	2000-2010	2010-2019
Urban Green	150	129.95	109	85		-20.05	-20.95	-24
Barren Land	400	425	450	575		25	25	125
Mixed vegetation	505.25	363.46	213.54	206.31		-141.79	-149.92	-7.23
Built up area	149.6	164.59	182.19	260.18		14.99	17.6	77.99
Water bodies	16.452	8.30	8.22	4.85		-8.152	-0.08	-3.37

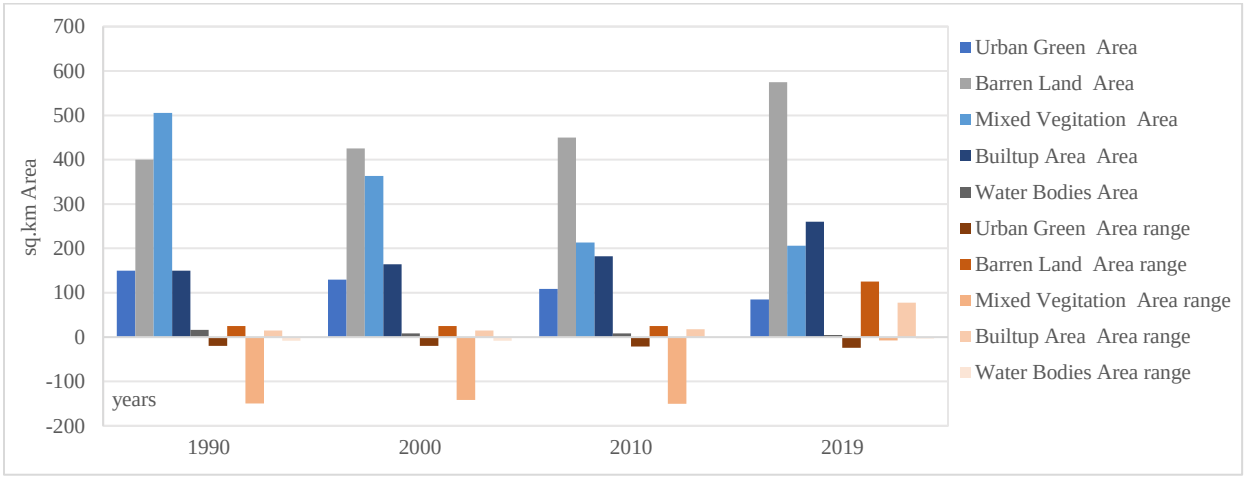

Figure 3. Land use changes in area & magnitude during 1990 to 2019

SPSS software (version 25.0) was used for analyzing data collected from the questionnaires. The data was analyzed through descriptive analysis 'frequencies and percentages' (Table 3), chi-square statistics, rank and standard deviation (Table 4, Table 5).

Table 3. Frequency analysis for public profile and perceptions about urban green spaces

Participant's profile	Category	Frequency	Percentage
Age Group	Up to 20 years	5	3.3
	20-40 years	142	93.4
	41-60 years	5	3.3
Gender	Male	55	36.2

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	Female	97	63.8
Frequency to Visit to city parks and other green spaces	Very frequent	42	27.6
	After every 7 days	22	14.5
	After every 15 days	12	7.9
	Once in a month	35	23.0
	Very rare	41	27.0
Preferred type of Urban green spaces you like to visit frequently?	Cultural Parks	6	3.9
	National parks	11	7.2
	None of above	3	2.0
	Outdoor sports facilities	3	2.0
	Small neighborhood parks	33	21.7
	unused open land	2	1.3
	Water based areas	10	6.6
	Urban parks	26	17.1
	Wilderness areas	58	38.2
Purpose to visit urban green spaces?	Socializing	2	1.3
	Feeding birds/bird watching	1	.7
	General socializing	8	5.3
	Getting fresh air/relaxing in nature	96	63.2
	Organized/unorganized sports	2	1.3
	Picnics/barbecue	5	3.3
	Enjoying family time	19	12.5
	Exercise	19	12.5

Table 4. Univariate statistics of perceptions about urban green spaces characteristics

Characteristics	Rating	Gender		P-value	Std. Dev	Rank[d]
		Male	Female			
Significance of urban green spaces in city	*a*	3.6%	0.0%	.164	0.348	1
	a	85.5%	87.6%			
	a	10.9%	12.4%			
Knowledge about urban green spaces and sustainability	*b*	5.5%	1.0%	.072	0.511	2
	b	69.1%	69.1%			
	b	21.8%	29.9%			
	b	3.6%	0.0%			
Significance of urban green spaces over man-made Structure	*b*	9.1%	3.1%	.131	0.648	3
	b	56.4%	45.4%			
	b	32.7%	47.4%			
	b	1.8%	4.1%			
Need of more urban green spaces in city	*b*	7.3%	3.1%	.191	0.660	4
	b	52.7%	46.4%			
	b	32.7%	47.4%			
	b	7.3%	3.1%			
Transformation of urban green into Built-up structures	*c*	41.8%	33.0%	.030	1.419	5
	c	23.6%	14.4%			
	c	9.1%	17.5%			
	c	10.9%	27.8%			
	c	14.5%	7.2%			

Note: [a]Rating of respondents: don't know = 1, strongly agreed = 2, agreed = 3

[b]Rating of respondents: don't know = 1, strongly agreed = 2, agreed = 3, disagreed, 4

[c] Rating of respondents: don't know = 1, very positive = 2, positive = 3, negative, 4, very negative = 5

The average score was used for scoring urban green space characteristics in ascending order

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Table 5. Univariate statistics of naturalness and density in urban green spaces

Naturalness and density	[a]Rating	Mean	Std. Deviation	Rank[a]
Dense Mixed Landscape of Parbat Road F-7 Sector	*a*	4.42	.939	1
Dense Natural Landscape of Margalla hills	*a*	4.12	.913	2
Dense manicured Landscape of F-9 Park	*a*	4.03	.841	3
Medium Dense Manicured Landscape of F-9 Park	*a*	3.88	.891	4
Sparse Natural Landscape of Margalla Hills	*a*	3.71	1.027	5
Medium Dense Mixed Landscape of Japanese Park	*a*	3.65	.886	6
Sparse manicured Landscape of F-9 Park	*a*	3.43	.940	7
Medium Dense natural Landscape of Japanese park	*a*	3.71	.960	8
Sparse mixed of Sadpur Village	*a*	3.17	.989	9

Note: [a]Rating of respondents: Highly liked = 1, liked = 2, Unsure= 3, disliked, 4, highly disliked = 5
The average score was used for scoring urban green space characteristics in ascending order

3. RESULTS AND DISCUSSION

The concept of resilience has been used in several interdisciplinary studies on sustainability in social-ecological systems (Chaffin & Scown, 2018) to explore complex system dynamics in diverse settings and to offer innovative directions for theoretical and applied research (Delgado-Serrano et al., 2018). In the case of Islamabad, the landscape is planned by inter connected ecological and social grid, which creates spaces, volumes, programs, and a flexible framework for the coherent development of the metropolis (Daechsel, 2013). It can be argued that current development practices demand a rethinking of the process for Islamabad's development and a theoretical rethinking of socio-ecological ideology.

3.1. Landsat Data Analysis

Landsat data in Table 2 shows that mixed vegetation areas have decreased and reached their lowest level in 2019 (206.31 km2). Urban green areas decreased to 55.31% and water bodies dipped to 96% from 2000 to 2019. Conversely, the built-up area shows a rising trend of up to 53.9%. Similarly, barren area increased about 35%. Thus, the city's original concept and socio-ecological systems face a serious threat. New commercial, residential and transportation requirements require reduction of green spaces in the city. Fortunately, sustainable development can be achieved by integrating the new principles with contemporary strategies (Chen, Pei, et al., 2020) and the dynamism of landscape intended in the original masterplan can be maintained (Chen et al., 2019).

3.2. People's Perceptions and Knowledge on Resilience

Most respondents (93.4 %) were female between the ages of 20 - 40 (63.8%). According to Table 3, over 27.6% of participants often visit green places. Surprisingly, 27% frequent green places only sometimes. Furthermore, 21.7% of participants enjoy visiting tiny neighborhood parks or green spaces, while 38.2% enjoy visiting wilderness regions and nature reserves (Margalla Hills). Similarly, 63.2% of participants prefer to visit urban green places for fresh air, while 12.5% prefer to spend time with family.

Using chi-square statistics, Table 4 presents cross-tabulation between gender and urban green space characteristics. Most users are aware of the importance of green spaces in the city; therefore, it has ranked 1st simultaneously; users were concerned about the significance of urban green spaces over man-made built environment; therefore, it ranked 3rd. Finally, users ranked last by transforming green spaces into built-up areas ($p = 0.030$).

The evaluation of urban green space types shows variation in the scores (Table 5). The dense mixed landscape of Parbat Road near F-7 Sector ranked 1st because it is considered the most & well-managed natural area in the vicinity (Figure 5). The dense

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natural landscape of Margalla Hills ranked 2nd. According to the participants, this typology provides a means of escape from urban life (Figure 4). The most disliked photograph was the sparse mixed landscape of Saidpur Village (Figure 6) because of the poorly managed landscape.

Figure 3. Dense natural landscape of margalla hills

Figure 4. Dense mixed landscape of parbat road

Figure 5. Sparse mixed landscape of saidpur village

3.3. Key Actors' Findings

Qualitative data from key informants was transcribed and sorted under different management policies. Professionals' perceptions of the current state of urban green spaces regarding the research-practice gap were considered (Figure 7).

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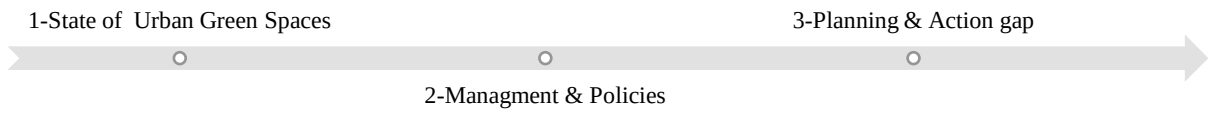

Figure 7. Description of key actors' interviews findings

3.4. State of Urban Green Spaces

More than 76.9 % of the key actors were not satisfied with the current state of urban green spaces. The prime threats include visionless planning and uncontrolled growth in violation of the masterplan. Due to high land values, many green spaces in new settlements are being used for residential and commercial purposes. New housing schemes allocate minimal space for parks, green spaces and public squares. Likewise, new modes of transportation will further reduce the green belts. Other significant ecological threats include planting non-native flora on the city's major green belts. There are also no plans to harvest rainwater. Absence of water retention basins is causing groundwater depletion (Wicaksono et al., 2019).

The key strengths of the Islamabad masterplan are its geographical location, low population density, topography, ecological integration and inclusion of urban farms. Furthermore, the city landscape planning is very flexible. Due to ample green belts in its master plan (Ali & Malik, 2010), these spaces could be more rigorously integrated to enhance socio-ecological functions.

3.5. Key Policies and Management

On the topic of policies and management, the key actors shared diverse opinions. As previously mentioned, cities are intended for people, but green areas in Islamabad serve as urban magnets, attracting people from surrounding communities. Government policies should ensure availability of green spaces for the people. To bridge current gaps and promote engagement of all stakeholders, including the government, legislators, academia, and civil society, supporting policies and procedures are necessary (Ghosh et al., 2020). For enhanced landscape functioning, evaluate the environment holistically on a regional scale. The blue-green corridor should be cleverly interwoven into the constructed form of the metropolis. Various actors in a community should collaborate each other. They should identify areas to be protected from destruction or urban development. Regulations that require a certain percentage of area to be allocated for landscape in new developments should be introduced. Furthermore, the role of architects and urban planners in policy formulation should be recognized (Table 6).

Table 6. Assessment of the current urban green space policy and its relationship to urban landscape development

Urban green space policy	Relationship with urban landscape development
Resource assessment and tracking for Rangeland	Monitoring and evaluation
Cooperative and coordinated preparation of Rangeland capital	Integrated planning
Rehabilitation of Rang Capital and Management	Rehabilitation and management
Boost the supply of forage on other land uses	Forage availability
Promotion of Rangeland Company	Promoting related enterprise
Rangeland management to control sustainable water flow and reduce the production of sediment	Ensuring sustainable water supply
Rehabilitation of habitats for the protection of biodiversity	Biodiversity conservation
Mitigation of global warming and climate change impacts	Mitigating climate change
Raising consciousness of the value and management of rangelands	Awareness development
Improvement of farmers' skills and capacity building of the associated stakeholders	Enhancing skill and capacity building
Science and technology production of applied range and transition	Leveraging technology
Generation of financial capital	Finance
Design coordination and ties	Coordination of development

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3.6 Landscape Planning Perspectives

To avoid important parties' neglect, such as people and the government, questions of access, ownership, and land use definition must be properly addressed. Green places must be maintained regularly.

The Social Perspective: Public activities should be planned in accordance with the needs of the inhabitants. The community's awareness of urban green spaces should be raised. This encompasses understanding of biodiversity, ecology, microclimate, and the effects of human activities. Public installations, cultural nodes, and parks should be included in the design of green spaces. Most importantly, there is a need to improve city inhabitants' connectivity with environment, which was the most crucial element of Doxiadis' Ekistics philosophy (Doxiadis, 1968).

The Ecological Perspective: The local government must ensure preservation of existing green areas by making byelaws for landscape and green areas in new developments.

3.7 Status Quo and Resilience Pattern

Most of respondents agreed about the status quo gap in the current state of planning and management. They suggested reducing this gap through context-specific studies and enabling planners and policymakers to collaborate closely. It is no longer possible to justify the status quo of environmental regulatory actions enforced by disjointed, conflicting and competing schemes. Researchers should analyze requirements by soliciting new ideas and long-term solutions from the general public, whereas practitioners must create a tight monitoring system with incentives by incorporating the general public and experts.

4. CONCLUSION

This study has contributed to theoretical and policy discussions regarding the social and ecological dimensions of Islamabad's urban setting, where the original designer chose Man's interaction with nature and society as the cornerstone for future growth. The findings support existing information regarding current land use and land cover changes, as well as present issues. The technique developed to learn about people's preferences and perceptions of selected urban green places in the city reinforces the conceptual and theoretical significance of the research. The findings of social surveys conducted at the management and user levels give insights towards resilient solutions for socio-ecological problems.

The empirical analysis and sustainability prospects of the master plan of Islamabad identify the need for a collaborative, participatory framework that emphasizes upon user demand and user-defined value of social & ecological functions. User's demand and values of urban green spaces can be enhanced in terms of its function to make it more useful for people of different neighborhoods. Therefore, green spaces should be put under government control to ensure accessibility to the public. People should be invited to these spaces to exercise ownership of green spaces and use them regularly by organizing various activities.

The findings emphasize the importance of developing strategies to bridge the gap between users and managers by prioritizing key areas such as people engagement, collaborative planning, context-specific innovations, ecological awareness, improved legitimacy and regulations, improved implementation guidelines, and the creation of socioeconomic opportunities. Business activities must be monitored continuously. This research explores an approach based on society, ecology & management to understand the gap of theory & practice in the case-based study of Islamabad city. Further extension could be done by conducting case studies on specific sites, detailed ecological surveys, and analyzing governance practices.

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Conflicts of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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REFERENCES AND NOTES

1. Ahern, J. (2013). Urban landscape sustainability and resilience: The promise and challenges of integrating ecology with urban planning and design. Landscape Ecology, 28(6), 1203–1212. https://doi.org/10.1007/s10980-012-9799-z
2. Albert, C., Schröter, B., Haase, D., Brillinger, M., Henze, J., Herrmann, S., Gottwald, S., Guerrero, P., Nicolas, C., & Matzdorf, B. (2019). Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute? Landscape and Urban Planning, 182(September 2017), 12–21. https://doi.org/10.1016/j.landurbplan.2018.10.003
3. Ali, S. M., & Malik, R. N. (2010). Vegetation communities of urban open spaces: Green belts and parks in Islamabad city. Pakistan Journal of Botany, 42(2), 1031–1039.
4. Beller, E., Robinson, A., Grossinger, R., & Grenier, L. (2015). Landscape Resilience Framework: Operationalizing Ecological Resilience at the Landscape Scale. In San Francisco Estuary Institute.
5. Bergamini, N., Blasiak, R., Eyzaguirre, P., Ichikawa, K., Mijatovic, D., Fumiko, N., & Subramanian, S. M. (2013). Indicators of Resilience in Socio-ecological Production Landscapes (SEPLs). In UNU-IAS policy report.
6. Bokhari, S.A.; Saqib, Z.; Ali, A.; Zaman, M. H. (2018). A Comparative Study of Planned Versus Semi-Planned Cities of Islamabad and Rawalpindi, Pakistan. Journal of Ecosystem and Ecography, 8(June), 251. https://doi.org/10.4172/2157-7625.251
7. Chaffin, B. C., & Scown, M. (2018). Social-ecological resilience and geomorphic systems. Geomorphology, 305, 221–230. https://doi.org/10.1016/j.geomorph.2017.09.038
8. Chen, G., Pei, Q., & Kamruzzaman, M. M. (2020). Remote sensing image quality evaluation based on deep support value learning networks. Signal Processing: Image Communication, 83(January), 115783. https://doi.org/10.1016/j.image.2020.115783
9. Chen, G., Sui, X., & Kamruzzaman, M. M. (2019). Agricultural remote sensing image cultivated land extraction technology based on deep learning. Revista de La Facultad de Agronomia, 36(6), 2199–2209.
10. Chen, G., Wang, L., & Kamruzzaman, M. M. (2020). Spectral classification of ecological spatial polarization SAR image based on target decomposition algorithm and machine learning. Neural Computing and Applications, 32(10), 5449–5460. https://doi.org/10.1007/s00521-019-04624-9
11. Ciftcioglu, G. C. (2019). Evaluating resilience for the management of social–ecological production landscapes and seascapes in Lefke Region of North Cyprus through adaptive comanagement. Sustainability Science, 14(4), 1117–1130. https://doi.org/10.1007/s11625-018-0608-8
12. Council of Europe. (2000). European Landscape Convention, Florence, 20 October 2000. In ETC No. 176 (Issue 176).
13. Cumming, G. S. (2011). Spatial resilience: integrating landscape ecology, resilience, and sustainability. Landscape Ecology, 26(7), 899–909. https://doi.org/10.1007/s10980-011-9623-1
14. Daechsel, M. (2013). Misplaced Ekistics: Islamabad and the politics of urban development in Pakistan. South Asian History and Culture, 4(1), 87–106. https://doi.org/10.1080/19472498.2012.750458
15. Delgado-Serrano, M. del M., Oteros-Rozas, E., Ruiz-Mallén, I., Calvo-Boyero, D., Ortiz-Guerrero, C. E., Escalante-Semerena, R. I., & Corbera, E. (2018). Influence of community-based natural resource management strategies in the resilience of social-ecological systems. Regional Environmental Change, 18(2), 581–592. https://doi.org/10.1007/s10113-017-1223-4
16. Dennis, M., & James, P. (2018). Urban Social-ecological Innovation: Implications for Adaptive Natural Resource Management. Ecological Economics, 150(September 2017), 153–164. https://doi.org/10.1016/j.ecolecon.2018.04.005
17. Doxiadis, C. A. (1968). Islamabad the Capital of Pakistan.
18. Duhamel, C. (2012). Land use and land cover, including their classification. In Land Use, Land Cover and Soil Sciences: Vol. I (pp. 1–9).
19. Feliciotti, A. (2015). Socio-ecological resilience and urban design : defining the common ground and a way forward for practice. Terra Spectra: Central European Journal of Spatial and Landscape Planning, VII(1), 3–8.
20. Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. Ecology and Society, 21(3). https://doi.org/10.5751/ES-08748-210341
21. Ghosh, D. K., Hossain, M. N., Sarker, M. N. I., & Islam, S. (2020). Effects of land-use changes pattern on tree plantation : Evidence from gher land in Bangladesh. International Journal of Agricultural Policy and Research, 8(June), 55–65. https://doi.org/10.15739/IJAPR.20.007
22. Holling, C. S. (1973). Resilience and Stability of Ecological Systems. Annual Review of Ecology and Systematics, 4(1), 1–23. https://doi.org/10.1146/annurev.es.04.110173.000245
23. Hoversten, M. E., & Swaffield, S. R. (2019). Discursive moments: Reframing deliberation and decision-making in alternative futures landscape ecological planning. Landscape and Urban Planning, 182(September 2017), 22–33. https://doi.org/10.1016/j.landurbplan.2018.10.005

ISSN 2278–5469 EISSN 2278–5450 I OPEN ACCESS

24. Hu, S., Yue, H., & Zhou, Z. (2019). Preferences for urban stream landscapes: Opportunities to promote unmanaged riparian vegetation. Urban Forestry and Urban Greening, 38(December 2018), 114–123. https://doi.org/10.1016/j.ufug.2018.12.001
25. Kamruzzaman, M. M., He, W., & Peng, X. (2019). Performance of relay assisted uplink wireless communication using multi-layered STBC for multiple access channel. Telecommunication Systems, 71(3), 309–320. https://doi.org/10.1007/s11235-018-0493-6
26. Krauze, K., & Wagner, I. (2019). From classical water-ecosystem theories to nature-based solutions — Contextualizing nature-based solutions for sustainable city. Science of the Total Environment, 655, 697–706. https://doi.org/10.1016/j.scitotenv.2018.11.187
27. Li, X. P., Fan, S. X., Kühn, N., Dong, L., & Hao, P. Y. (2019). Residents' ecological and aesthetical perceptions toward spontaneous vegetation in urban parks in China. Urban Forestry and Urban Greening, 44(July). https://doi.org/10.1016/j.ufug.2019.126397
28. Liu, Z., Xiu, C., & Song, W. (2019). Landscape-based assessment of urban resilience and its evolution: A case study of the central city of Shenyang. Sustainability, 11(10). https://doi.org/10.3390/su11102964
29. Mannan, A., Liu, J., Zhongke, F., Khan, T. U., Saeed, S., Mukete, B., ChaoYong, S., Yongxiang, F., Ahmad, A., Amir, M., Ahmad, S., & Shah, S. (2019). Application of land-use/land cover changes in monitoring and projecting forest biomass carbon loss in Pakistan. Global Ecology and Conservation, 17(35), e00535. https://doi.org/10.1016/j.gecco.2019.e00535
30. Marcus, L., & Colding, J. (2011). Towards a Spatial Morphology of Urban Social-Ecological Systems. Conference Proceedings for the 18th International Conference on Urban Form: ISUF 2011, October 1967, 1–20.
31. Naeem, S., Cao, C., Fatima, K., Najmuddin, O., & Acharya, B. K. (2018a). Landscape greening policies-based land use/land cover simulation for Beijing and Islamabad - An implication of sustainable urban ecosystems. Sustainability (Switzerland), 10(4), 1–22. https://doi.org/10.3390/su10041049
32. Naeem, S., Cao, C., Fatima, K., Najmuddin, O., & Acharya, B. K. (2018b). Landscape greening policies-based land use/land cover simulation for Beijing and Islamabad - An implication of sustainable urban ecosystems. Sustainability, 10(4), 1049. https://doi.org/10.3390/su10041049
33. Rai, R., Zhang, Y., Paudel, B., Li, S., & Khanal, N. (2017). A Synthesis of Studies on Land Use and Land Cover Dynamics during 1930–2015 in Bangladesh. Sustainability, 9(10), 1866. https://doi.org/10.3390/su9101866
34. Sarker, M. N. I., Hossin, M. A., Wu, M., Alam, G. M., Shafi, M., Pervez, A. K., & Rahman, A. (2018). Determinants and Pattern of Urbanization and Counter-Urbanization: The Case of South Asia. The Journal of Social Sciences Research, 4(12), 802–812. https://doi.org/10.32861/jssr.412.802.812
35. Sarker, M. N. I., Peng, Y., Yiran, C., & Shouse, R. C. (2020). Disaster resilience through big data: Way to environmental sustainability. International Journal of Disaster Risk Reduction, 51(December), 101769. https://doi.org/10.1016/j.ijdrr.2020.101769
36. Sarker, M. N. I., Wu, M., Alam, G. M. M. G. M., & Shouse, R. C. (2020a). Administrative Resilience in the Face of Natural Disasters: Empirical Evidence from Bangladesh. Polish Journal of Environmental Studies, 29(2), 1825–1837. https://doi.org/10.15244/pjoes/109527
37. Sarker, M. N. I., Wu, M., Alam, G. M., & Shouse, R. C. (2020b). Livelihood resilience of riverine island dwellers in the face of natural disasters: Empirical evidence from Bangladesh. Land Use Policy, 95(2), 104599. https://doi.org/10.1016/j.landusepol.2020.104599
38. Sarker, M. N. I., Yang, B., Lv, Y., Huq, M. E., & Kamruzzaman, M. M. (2020). Climate Change Adaptation and Resilience through Big Data. International Journal of Advanced Computer Science and Applications, 11(3), 533–539. https://doi.org/10.14569/IJACSA.2020.0110368
39. Shams, I., & Barker, A. (2019). Barriers and opportunities of combining social and ecological functions of urban greenspaces – Users' and landscape professionals' perspectives. Urban Forestry and Urban Greening, 39(August 2017), 67–78. https://doi.org/10.1016/j.ufug.2019.02.007
40. Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. Landscape and Urban Planning, 81(3), 167–178. https://doi.org/10.1016/j.landurbplan.2007.02.001
41. UN-Habitat. (2015). Un-Habitat Global Activities Report 2015: Increasing synergy for greater national ownership. United Nations Human Settlements Programme (UN-Habitat).
42. Wicaksono, B., Siswanto, A., Kusdiwanggo, S., & Anwar, W. F. F. (2019). Change of Element Settlement in Musi Riverside Palembang. Journal of Physics: Conference Series, 1198(8). https://doi.org/10.1088/1742-6596/1198/8/082007
43. Wilkinson, C. (2012a). Social-ecological resilience: Insights and issues for planning theory. Planning Theory, 11(2), 148–169. https://doi.org/10.1177/1473095211426274
44. Wilkinson, C. (2012b). Social-ecological resilience and planning: an interdisciplinary exploration. Department of Systems Ecology, Stockholm University, Sweden

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