

Article

Heritage and the Regeneration of Urban Brownfields: Insights on Public Perception in Tehran, Iran

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Abstract: Brownfields particularly in old city centers reveal the story of abandonment and concealment, shaping the identity and collective memory of urban areas. Therefore, research and practice must prioritize both reutilization and heritage values. This study centers on the regeneration of historical brownfields in Tehran, the capital of Iran, and assesses public perceptions of redeveloped historical brownfields. Based on their approach to patrimony, the study categorized reclaimed brownfields as interpretive, cultural, or ecological sites. A questionnaire was administered to citizens who visited three sampled sites (n = 385) to collect data. According to the results of principal component analysis (PCA), women preferred the non-economic component, which includes environmental, social, heritage, and aesthetic dimensions, while men and older, highly educated respondents preferred the economic dimension in relation to brownfields. Despite positive attitudes towards brownfield regeneration, environmental and heritage dimensions, especially intangible heritage, are less well-known. However, heritage justifies and determines brownfield redevelopment. Increasing commitment to preserving heritage during brownfield regeneration has a positive effect on the perception of respondents.



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Keywords: urban regeneration; brownfield; heritage; public perception; Tehran

1. Introduction

Brownfields refer to sites that have been previously utilized or developed and are currently abandoned, idle, or inadequately used. While not all brownfields are contaminated, they may suffer from soil and groundwater contamination that requires intervention to return them to beneficial use [1–3]. Brownfields have diverse origins and histories. Despite their presence in both rural and urban areas, they present a significant concern specifically within urban environments [2,4,5]. Brownfields hinder urban growth but offer unrealized potential [6]. Brownfield regeneration supports urban development [1,7] and promotes sustainable development through environmental, social, and economic benefits [8–17].

Cities widely adopt urban regeneration to improve physical, economic, social, and environmental conditions by revitalizing urban areas [18–20]. As a specific type of urban regeneration, brownfield regeneration has the potential to address challenges in cities and further the objectives of urban regeneration [17,21,22]. Cities are now implementing innovative approaches for urban regeneration, such as culture-based and tourism-based strategies that exploit cultural assets for generating tourism while improving economic growth and social cohesion [23–25]. The transformation of brownfields into novel spaces has the potential to promote cultural events, recreational pursuits, and tourism attractions [20,26–28].

In addition to their potential for rehabilitation, brownfields offer cultural and historical importance [4]. By taking into account heritage preservation, sustainable brownfields regeneration may be accomplished [28–30]. The stagnation created by these sectors may be transformed into economic development [26–28] via the preservation of historical buildings and the utilization of heritage brownfields for tourism and recreation. In addition, heritage sites are major physical landmarks that have emotional and communal importance in modern culture, serving as memory triggers. The city's reputation and the sense of community may both benefit from their transformation into tourism destinations [31,32]. Brownfields are being maintained and used for regeneration as the idea of heritage receives more attention. However, there is often a conflict between heritage preservation and economic interests, and heritage preservation is not always given top priority [33,34]. The regeneration of brownfields thus requires special consideration for heritage preservation.

Smaller businesses in Iran have had the biggest drops in output over the past two decades. The abandoning of many sectors has also expanded fast [35], mostly as a result of economic sanctions and political tensions with the West. The lack of a definite legal definition for brownfields in Iran [35–38] has led to their continued disuse. Only 8% of Iran's many vacant sites are put to use, and 24% are at risk of being demolished [39]. The heritage problem of Iranian brownfields hence needs careful consideration. The public may be made aware of the importance of redeveloping these regions through their preservation, which can also strengthen historical and regional identity.

There has been less focus on the topic of heritage as a key concern in public views of brownfields, despite the fact that scholarly literature emphasizes the importance of heritage preservation in brownfield regeneration. Furthermore, research on how the general public views brownfield regeneration in developing countries like Iran is extremely scarce. Long-term abandonment and physical degradation of Iranian brownfields is a result of structural and economic hurdles such as institutional inconsistencies and disagreements between local governments and developers [35]. Iranian brownfields lack a formal definition, although discussion of them may be facilitated by looking to the past. With heritage as a central component, this study examines brownfields and their revitalization. Residents' perspectives of brownfield heritage in Iran's changing context are the focus of this study, which tries to fill a knowledge vacuum.

The primary objective of this research was to understand how Tehran's residents see the role of heritage in revitalizing brownfields. As case studies, three sites were selected.

The research questions are as follows: (1) How do residents perceive the role of heritage in brownfield regeneration? (2) How does the existing heritage in brownfields affect residents' priorities? (3) How does the treatment of heritage during brownfield redevelopment affect public perception of the site?

2. Theoretical Background

2.1. Urban Brownfields and Public Perception

Urban brownfields have a notable impact on urban development and structures [6]. Brownfields may be abandoned and contaminated after being used for economic activities [2,40]. Environmental pollution heightens anxiety, worsens health risk perceptions [41], and reduces economic value and nearby attractions [1,28]. Revitalizing brownfields positively affects nearby communities and inhabitants [42–47]. Hence, these sites garner local interest [6,42], making it crucial to involve residents as primary stakeholders in developing regeneration strategies [44]. Therefore, sustainable regeneration should strengthen public participation and prioritize local perspectives [13,48,49]. Moreover, the vital role of residents' opinions in brownfield regeneration has been highlighted by various studies such as those by Bartke and Schwarze [50], Glumac et al. [51], Haase [52], Johnson et al. [53], Meyer and Lyons [54], and Navratil et al. [55].

However, the residents' views in practical projects have received scant attention [56], and market demands and public sector interests typically take precedence over meeting community needs during the reuse process [57]. Therefore, public support is crucial for

brownfield projects [58,59]. Differences exist between the viewpoints of people and experts [2,13,51,60,61], and planners need to comprehend local attitudes towards brownfield types, reuse strategies, and planning procedures to foster societal participation [59]. People have diverse perceptions and priorities concerning brownfields [58,62], resulting in varying satisfaction levels when implementing similar regeneration strategies across different regions [49,58]. The issue of brownfields is perceived by residents in relation to the conditions of their city [63]. This highlights the need to study public opinions across various regions.

Table 1 presents an overview of previous empirical studies conducted on brownfield regeneration and public opinion. The table outlines the key findings and methodologies employed in each study.

2.2. Brownfield Regeneration and Heritage Preservation

Brownfield physical structures, whether historical or non-historical, can be preserved for reuse as a symbol of the site's past identity [36]. In addition to physical preservation, the building's authenticity should be preserved by assigning suitable functions [64]. In other words, intangible aspects such as social activities, collective memories, and meanings should be considered alongside tangible heritage [24,34] to define the site's unique identity and strengthen the sense of belonging [65]. Given that these sites and buildings have been integral to cities and served as workspaces for decades, the locals have developed a strong emotional attachment to these places due to their daily interaction with them. This bond can be utilized during site regeneration to enhance local identity [66,67]. Additionally, creating an accessible and open environment can revive a community's emotional connection to historical sites and expose them to visitors and innovative uses [68,69]. Thus, although the sites' primary function is no longer present, the adaptive reuse project aims to maintain their unique historical and cultural identity [70], preserving *genius loci* [39] while accommodating contemporary needs [71].

Preserving historical structures in brownfield regeneration facilitates tourism's economic impact and supports sustainable urban development [28]. Tourism motivates heritage preservation [34]. Historical brownfields with architectural and urban significance can be transformed into tourist attractions and increase the possibility of their preservation [72]. Brownfields in city centers have the potential for integration into urban life, and their reuse for tourism and recreation can support urban development [73]. These tourist attractions can help to reconstruct the economy, revive industrial history, and enhance local identity [31,32]. However, tourism development may lead to disregard of society's cultural and intangible heritage value for commercial purposes [34,74]. Heritage interpretation maintains authentic place identity and provides a meaningful heritage experience for visitors and local stakeholders [24,34,75], positively impacting their behavior and connection to the site [76]. Therefore, preserving the authenticity of heritage buildings is crucial to strengthen the sense of identity, connect past with present and future, and consolidate collective memory [77].

Nevertheless, the brownfield regeneration process faces several limiting barriers. Economic factors are the primary obstacle, followed by legislative, procedural-administrative, and political hurdles [78]. Economic factors are the main barriers in the United States [79], Canada [80], and Pakistan [81]. Mehdipour [35] highlights the economic implications of land development and marketing on future brownfield policies in Iran. Preserving brownfields for industrial heritage may be the preferred social choice [72]. However, demolition and landscaping to create green spaces [10], or economically driven new development after demolition [82] are alternative options. The destiny of brownfields should be determined through negotiations involving investors, local government officials, and stakeholder representatives. Notably, brownfields of significant historical importance offer distinct regeneration prospects [27].

Table 1. Summary of previous empirical research on brownfield regeneration and public opinion.

Study No.	Authors	Year	Location	Data Collection Method	Variable/Criteria/Index	Data Analysis Method	Findings
1	K'oyoo et al. [83]	2022	Kenya	Questionnaire survey; interview with key informants.	Public perception of effects of the post-mine brownfields on the environment; public perception on dumping of waste; public perception on air pollution; public perception on possible contamination.	Descriptive statistics including percentages; qualitative data analysis (thematic analysis).	Brownfields experienced waterlogging and illegal dumping, causing health risks in adjacent residential areas. Each brownfield possesses distinctive spatial features that have led to negative impacts on the neighboring environment.
2	Martinat et al. [57]	2018	Czech Rep.	Questionnaire survey.	Satisfaction with the aesthetic and functional state of present regeneration; possibilities for the reuse of present brownfield.	Nonparametric Wilcoxon and Friedman test; multivariate statistical techniques including PCA, RDA.	The predominant choices for reuse were culture/sport and children's park. Gender significantly predicted reuse options.
3	Mathey et al. [84]	2018	Germany	Questionnaire survey; photomontages.	Perception of urban brownfields; use of brownfields; preferred uses and design of urban brownfields.	Descriptive statistics; cross-correlations.	Locals possess specific opinions on brownfield utilization or development, with a desire to participate in the transformation process.
4	Navratil et al. [27]	2018	Czech Rep.	Questionnaire survey.	The perception of the given regenerated brownfield; general perceptions of brownfield regenerations; regenerated brownfields as a tourism "destination"; satisfaction with heritage preservation.	Nonparametric Kruskal–Wallis and Friedman test; multivariate statistical techniques including RDA.	The awareness of brownfield regeneration is low. The conditions and technical status of brownfields significantly influence respondents' views on regeneration choices. The visitors' response to the leisure time reuse of brownfields is favorable. Concern for cultural heritage in society can accelerate regeneration.
5	Navratil et al. [55]	2018	Czech Rep.	Questionnaire survey	Reuse of brownfields; brownfields location within city; spatial factors influencing attitudes of residents towards brownfields. Regeneration; involvement with brownfield regeneration.	Two-factorial ANOVA.	Citizens' perceptions of brownfield regeneration options depend on (1) the extent of brownfields in a city, (2) brownfield location within a city's borders, (3) place of residence, and (4) type of regeneration.

Table 1. Cont.

Study No.	Authors	Year	Location	Data Collection Method	Variable/Criteria/Index	Data Analysis Method	Findings
6	Kim and Miller. [59]	2017	Virginia, the United States	Questionnaire survey; visual preference survey (VPS).	Six landscape-based types to classify brownfields; the effect of preconception; the effect of health concern.	Descriptive statistics including mean rating and frequency analysis, analysis of variance (MANOVA and ANOVA).	Preserved historical buildings and landscapes were prioritized for redevelopment, while sites containing industrial remnants received lower priority. Respondents associated these types with harmful pollutants that may affect human health.
7	Loures et al. [13]	2016	Portugal	Questionnaire survey.	The importance of planning and design dimensions to landscape transformation; the actual condition of the municipal landscape; main responsibility for post-industrial land transformation; uses/functions that should be implemented in the redevelopment.	Descriptive statistics.	Brownfield regeneration projects are well received by the community. The most popular options are multifunctional and leisure green spaces.
8	Martinat et al. [6]	2016	Czech Rep.	Questionnaire survey.	Options for reusing post-mining brownfields; the urgency of regeneration of local brownfields; financial sources for brownfield regeneration projects.	Descriptive statistics.	Public awareness of brownfields is limited. Brownfields in remote areas offer chances for new industries to create jobs in a city struggling with unemployment.
9	Rink and Arndt [85]	2016	Germany	Questionnaire survey; photomontages.	Perception of successional brownfields; perception of afforestation sites; perception of threats (natural, social and contamination); perception of usability.	Descriptive statistics.	Residents viewed park-related green structures and traditionally designed urban nature areas positively. Afforestation on brownfields was more accepted than natural succession. Afforestation was considered less threatening than successional scenarios. The usability of forestry scenarios was markedly superior to that of succession scenarios.

Table 1. Cont.

Study No.	Authors	Year	Location	Data Collection Method	Variable/Criteria/Index	Data Analysis Method	Findings
10	Kunc et al. [86]	2014	Czech Rep.	Questionnaire survey.	Awareness, urgency and rate of apprehension of pollution about brownfields; evaluation of brownfield regeneration policy in two cities; the most problematic locality and best practice for the regeneration project of two cities; future utilization.	Descriptive statistics including percentages.	The term “brownfield” was not widely known. The most popular options for reuse were housing and greenery. An open and responsive urban policy is crucial for brownfield regeneration, increasing local satisfaction.

Drawing from the theoretical background, an academic exploration can be undertaken to examine people’s opinions on heritage brownfields in relation to abandoned sites and regenerated sites. These two categories encompass a range of distinct subcategories that are presented within the following conceptual framework (Figure 1).

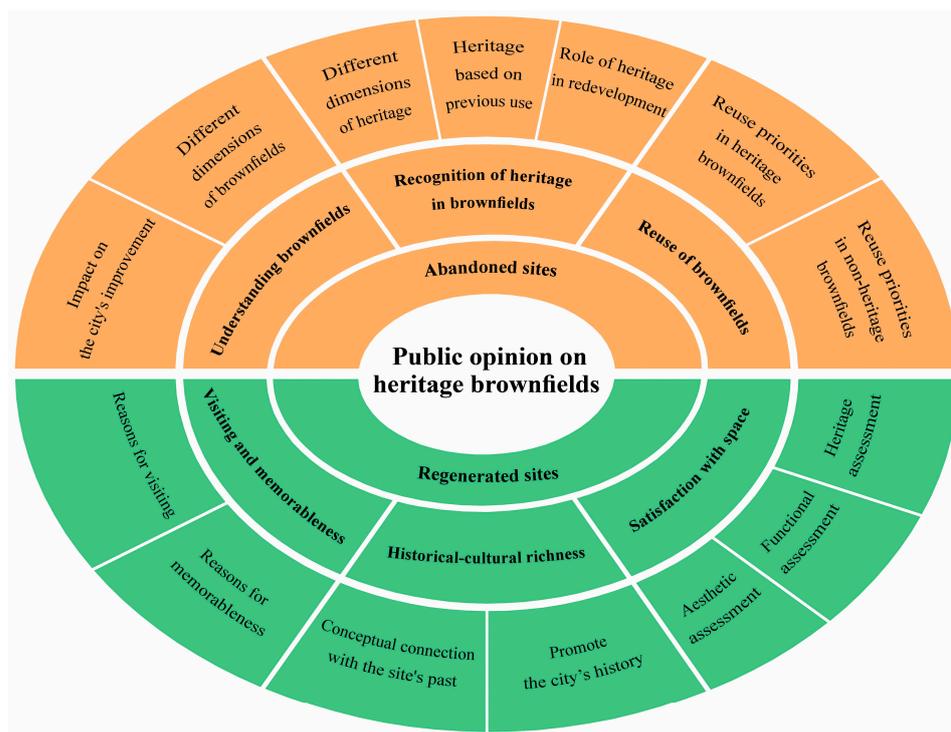


Figure 1. Conceptual framework of public opinion on heritage brownfields.

3. Geographical Context

3.1. History of Brownfields in Iran

In Iran, most brownfields trace their origins to industrial and military sites founded after World War I with the accelerating trend of modernization during the Pahlavi dynasty (1925–1979) [87,88]. Due to their long history, these abandoned fields have a remarkable historical heritage. These abandoned fields possess significant historical heritage due to their long history. The constructions’ size is appropriate for their spatial function, and the decorations and façades reflect Iran’s climatic and cultural features, thereby creating a valuable combination of traditional and modern architecture [89,90]. Besides their architectural significance, the activities and civil society linked to these spaces describe a vital part of

a city or nation's past. They provide proof of cultural, social, and economic shifts that document important values for urban heritage [91]. Thus, any regeneration of these spaces should consider the heritage aspects associated with their activities as well as social and cultural dimensions.

Iranian industrial brownfields are primarily small urban factories and workshops, including textile or food production plants, established in the early Pahlavi era [35]. Numerous industries have ceased operations due to urban expansion, environmental issues, and economic shifts in Iran toward service-based [92] and heavy production sectors [93]. Military sites have been relocated to suburban regions as a result of urban growth and government policy. Governmental decision-making in the reuse of these sites was influenced by rising land value, site location suitability, and social concerns for citizen welfare [35]. Nevertheless, the absence of redevelopment roadmaps [36], undefined land use systems [94], and inadequate legal policies to overcome environmental issues and economic instability [35,36] have resulted in the neglect and deterioration of numerous brownfields in Iranian urban areas.

3.2. The Description of Brownfields in Tehran

The case study took place in Tehran, the administrative and political capital of Iran. According to the most recent official census, the metropolitan area has an estimated population of 8,668,070, making it the most populous metropolis in Iran [95]. Tehran has the greatest urban sprawl among 190 Iranian cities [96]. Tehran's north and south sections have varied temperatures due to their hilly and desert surroundings, respectively. The north is chilly and dry, whereas the south is hot and dry [97]. Modernism in Iran at the middle of the 20th century helped the city double in size and population in 60 years [98]. Tehran has also the highest GDP and ICT coverage in the country [99].

Tehran has numerous brownfields due to its history as a hub of industries and military facilities, some now abandoned. Moreover, as its municipality is economically and institutionally more potent than other cities [35], Tehran has considerable experience in the regeneration of brownfields. The comprehensive plan for Tehran has identified more than 5400 hectares of land plots as unsuitable for current uses and designated them for urban renewal projects [100]. According to estimates, military centers and barracks occupy approximately 5% of the total land area of Tehran [101]. Despite aims defined in the new comprehensive plan of Tehran (2007), such as "prevention of excessive urban growth", "use of the potential of spatial-physical development inside the city", and "following sustainability principles", as well as specific projects such as "revival of industrial and natural zones" [102] that implicitly involve brownfield redevelopment, there exists no explicit policy regarding brownfield redevelopment for attaining said aims. Brownfield redevelopment in Tehran has been limited to a few isolated architectural projects, lacking a comprehensive approach for effective intervention in these locations [36]. The projects prioritize heritage preservation and aim to revive Tehran's industrial past in accordance with the municipality's current policies [103]. There is limited literature on brownfields in Tehran. Zekavat and Motamedi [36] propose a location-based classification of brownfields for design purposes. Afradi [94] and Afradi and Nourian [104] evaluate the use potential of two military sites. Arbab and Alborzi [105] highlight redevelopment principles for an abandoned industrial area in Tehran. However, no study has examined public perceptions, priorities, and knowledge regarding brownfields in Tehran and Iran.

4. Materials and Methods

4.1. Typology and Selection of Study Sites

To choose our sample, we reviewed urban regeneration documents, Tehran's comprehensive plan, and relevant research. In addition, we conducted thorough field studies in Tehran to identify regenerated brownfields within the city (Figure 2). Public use and registration in the list of national monuments of the Cultural Heritage Organization of Iran were considered identification indicators. A classification system was established for the

identified sites to thoroughly evaluate residents' perceptions. Two criteria of preserving the physical structure (tangible heritage) and maintaining a conceptual relationship with the historical character and previous use (intangible heritage) were considered for the typology of sites. Adherence to these two criteria was confirmed or rejected by experts for the identified sites. Consequently, the sites were categorized into three distinct types (Figure 3). Here is a breakdown of the various classes. Sites of Type 1 preserve the historical character of the location and explain its legacy. The second category consists of cultural sites that are merely physical in their approach to heritage and have no semantic relationship to their historical character and function. Sites of the third kind are those that prioritize the addition of public green spaces and the exclusive use of any existing buildings for economic or ecological ends. Ultimately, we have chosen a representative example from each category that is commonly known and frequently visited by Tehran's residents (Table 2). This recognition was achieved through meticulous on-site observations coupled with research efforts.

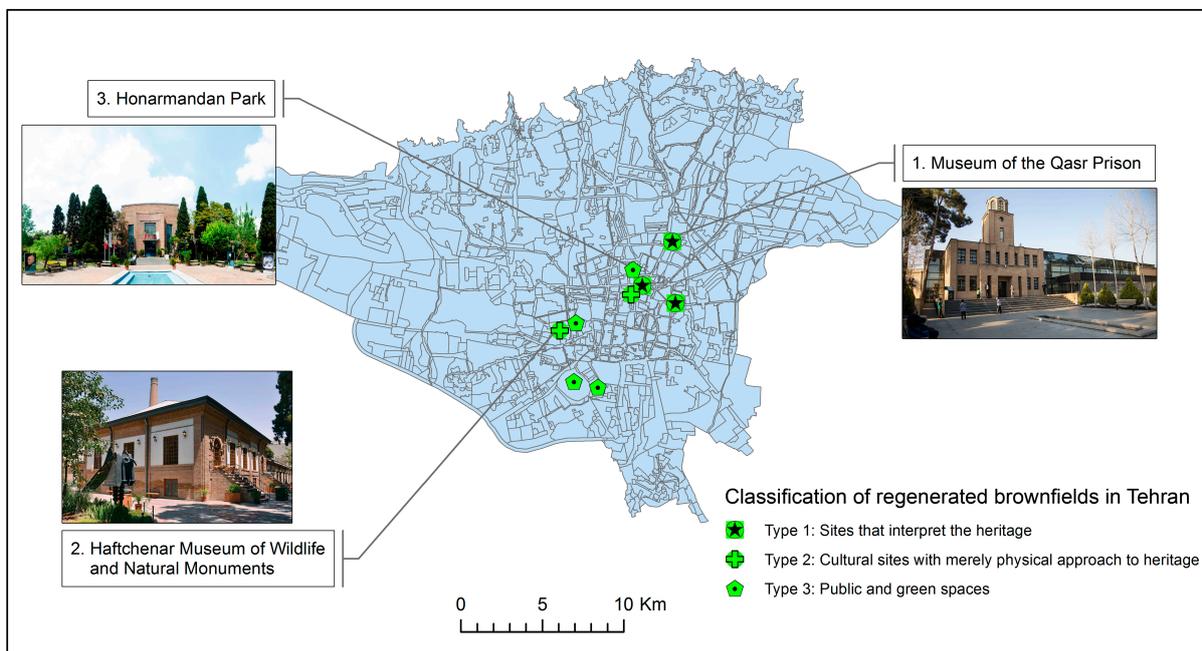


Figure 2. Location of the surveyed study sites within Tehran.

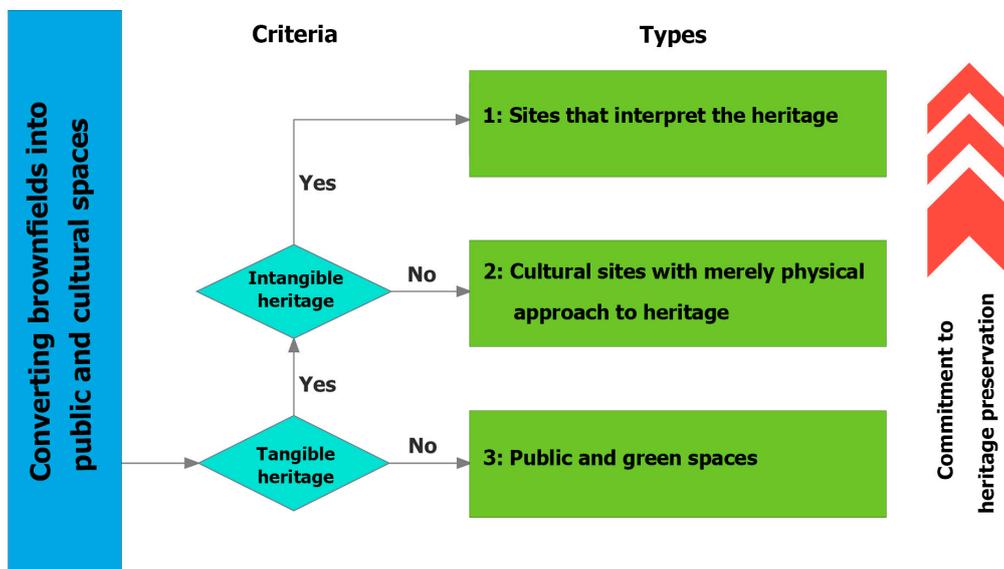


Figure 3. Classification of regenerated brownfields in Tehran.

Table 2. Main characteristics of the selected sites (source: authors).

Name of the Brownfield Site	Original Use	Contemporary Use	Location	Size of the Site (m ²)	Type
Museum of the Qasr Prison	Qasr prison	Historical complex, public park	Wider city center	69,000	1
Haftchenar Museum of Wildlife and Natural Monuments	The Beryanak sock weaving factory	The museum of nature & wildlife	Wider city center	7100	2
Honarmandan Park	The Fisher Abad garrison	Public park, cultural center	City center	59,140	3

4.2. Questionnaire Survey

For our purpose, we developed a questionnaire and distributed it to the residents who visited the three sites. The questionnaire was developed through a literature review and piloted by ten experts. It was administered to 385 subjects in November and December 2021.

Two broad areas are covered by the survey's 14 questions: first, the role that people think heritage plays in brownfield regeneration, and second, how people think heritage is dealt with in brownfield regeneration. Except where noted, the items are presented on a five-point Likert scale, with 1 representing very little and 5 representing a great deal.

Three components made up the first topic. Using two questions, the first part of the study evaluated public perception of brownfield regeneration. (1) To what extent can brownfield regeneration aid in the improvement of quality of life and the resolution of urban issues? (2) Explain the importance of the following objectives for brownfield regeneration: environmental, social, economic, heritage, and aesthetic. Using three questions, the second part assessed the importance of heritage in brownfield regeneration. (1) Describe the significance of the following heritage elements in relation to brownfield regeneration: tangible and intangible heritage. (2) To what extent do the historical and identity values of a city benefit from the regeneration of various brownfields (industrial, military, transportation-related, commercial, and administrative)? (3) If there are historical and heritage features in brownfields, to what extent do these factors support their redevelopment? In both heritage and non-heritage brownfields, the third part examined locals' preferences for reuse priority (cultural, open space, office, commercial, and residential).

Three case studies were evaluated in three sections in the second topic of the questionnaire. The first part examined the main factor of site memorability (due to historical buildings, cultural spaces, social activities, space design, other causes, or whether "the site is not memorable at all") as well as the primary purpose of visiting (historical sightseeing, cultural spaces, leisure time, social gatherings, and other reasons). Using two questions, the second part of the study looked at how various preservation techniques affected people's perceptions of a site's historical relevance and the significance of the site to the whole city. (1) To what extent would a visit to this area provide information about the history of the site? (2) To what extent can this area contribute to the preservation and promotion of Tehran's historical qualities and recollections? Satisfaction with the practical, heritage, and aesthetic features was queried in the last part.

Regarding respondents' demographics, the gender distribution was relatively even. A significant proportion (42%) was between 25 and 34 years of age, while the majority of participants had a secondary education level (47%). More information on participant demographics can be found in Table 3.

4.3. Data Analysis

Using IBM SPSS Statistics 26 and the Canoco 5 program, the questionnaire data were analyzed. Using descriptive statistics, we first arranged and analyzed the data. Since the data did not follow a normal distribution, non-parametric tests were used to conduct additional analysis. The Friedman test was used to compare mean ranks and to prioritize multiple dimensions, whereas the Wilcoxon test was used to analyze differences between two paired variables and to prioritize dual dimensions. The effect of the independent

variable on the replies was analyzed using the Kruskal–Wallis test. In three case studies, we used Pearson’s chi-squared test to assess the level of fit between the gathered categorical data, including visitor motivation, and site recall. Redundancy analysis (RDA) and principal component analysis (PCA) were used as multivariate statistical methods to test the link between independent and dependent variable structures.

Table 3. The demographic structure of the respondents of the survey.

Gender	Female	50.6%
	male	49.4%
Age	18–24	24.7%
	25–34	42.3%
	35–44	19.7%
	45–54	6.5%
	55–64	2.3%
	65<	1.8%
Education	Elementary	7.5%
	Secondary	47.3%
	Tertiary	45.2%

5. Results

5.1. Public Perception of the Role of Heritage in Brownfield Regeneration

5.1.1. Perception of Brownfields

Urban regeneration greatly contributes to quality improvement and problem-solving in urban areas, as indicated by residents’ mean score of 4.57 out of 5 (Table 4). Hence, their opinion on brownfield regeneration appears strongly favorable.

Table 4. Descriptive statistics on brownfield regeneration’s impact on quality improvement and problem-solving in urban areas.

N	Minimum	Maximum	Mean	Std. Deviation
385	2	5	4.57	0.638

In brownfield regeneration, the importance of the five dimensions differed significantly ($X^2F(4) = 321.371$, $p < 0.001$, Figure 4), with mean ranks as follows: social (3.86), aesthetic (3.40), economic (2.88), heritage (2.47), and environmental (2.38). Due to this diversity in preferences for different dimensions, multivariate statistical techniques such as PCA and RDA were also employed. The first two PCA axes were identified as the most critical (Table 5). The two components were separated along the first two axes. The first axis can be referred to as the “non-economic” axis due to its heavy loading with environmental, social, heritage, and aesthetic dimensions, while only the economic dimension is loaded onto the second axis (Figure 5A). The respondents’ structure analysis indicates that men and older, highly educated participants favored the economic component, while women preferred the non-economic aspects (Figure 5B). RDA analyzed the association between preference structure and independent variables. The findings suggest that gender (pseudo F-ratio = 21.095; $p = 0.001$), level of education (pseudo F-ratio = 14.543; $p = 0.001$), and age of respondents (pseudo F-ratio = 2.774; $p = 0.028$), significantly influenced preferences.

5.1.2. Understanding and Evaluation of the Role of Heritage in Brownfields

The findings on the importance of heritage aspects in brownfield regeneration suggest a significant statistical distinction (Wilcoxon test = -13.365 , $p < 0.001$). Tangible heritage received greater attention (mean rank = 133.69) than intangible heritage (mean rank = 116.28).

The study examined residents’ views on heritage potential based on the original land use, revealing significant differences in perception ($X^2F(4) = 249.196$, $p < 0.001$,

Figure 6). The results showed that original industrial use had the greatest perceived potential while military use had the least (mean ranks: industrial—3.52; transportation—3.44; commercial—3.24; administrative—2.55; military—2.25).

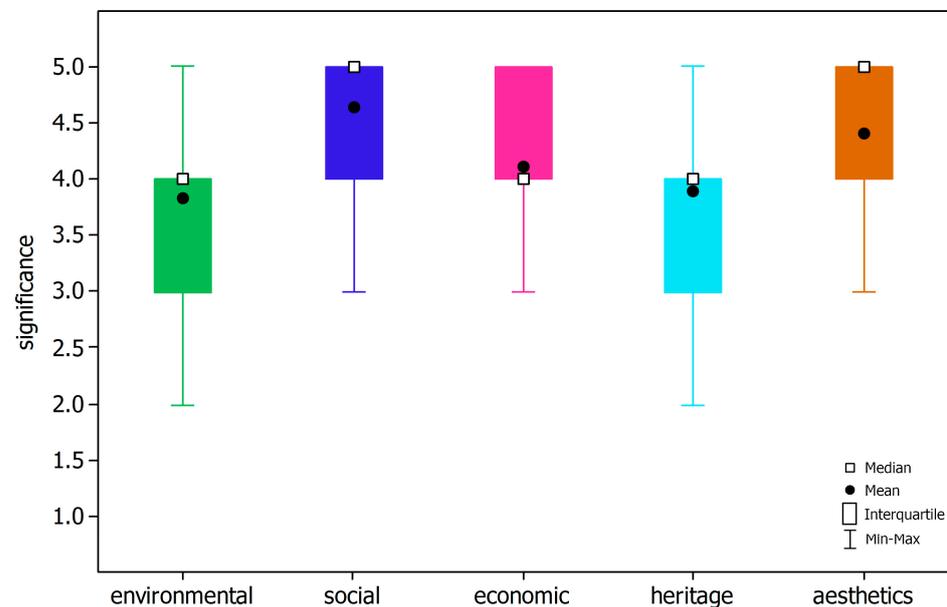


Figure 4. Importance of different dimensions in brownfield regeneration.

Table 5. The summary of PCA and RDA to evaluate the importance of the dimensions of brownfields (n = 385) (source: authors).

	Axis	PCA	RDA
Eigenvalues	1st	0.339	0.054
	2nd	0.246	0.036
	3rd	0.171	0.002
	4th	0.145	0.304
(Pseudo-) canonical correlations	1st	0.326	0.467
	2nd	0.418	0.338
	3rd	0.225	0.143
	4th	0.124	0.000
Explained cumulative percentage	1st	33.9	5.4
	2nd	58.6	9.0
	3rd	75.7	9.2
	4th	90.3	-

Most respondents consider heritage as highly impactful in justifying redevelopment, scoring it 4.60 out of 5. Therefore, residents consider heritage to be a crucial aspect of brownfield regeneration.

5.1.3. Comparing the Presence and Absence of Heritage in Redevelopment

The study found that there were significant differences in residents' preferences for the reuse of heritage brownfields ($X^2F(4) = 996.790, p < 0.001$), and non-heritage brownfields ($X^2F(4) = 664.329, p < 0.001$). As illustrated in Figure 7, for heritage brownfields, cultural spaces was given the highest priority, followed by open space, office, commercial, and residential redevelopments. In contrast, for non-heritage brownfields, open spaces were prioritized first, followed by commercial, cultural, office, and residential reuses. The Wilcoxon test compared the utilization of heritage and non-heritage brownfields. Results showed

a higher preference for cultural uses in heritage brownfields (Wilcoxon test = -14.586 , $p < 0.001$), while other uses were prioritized in non-heritage brownfields.

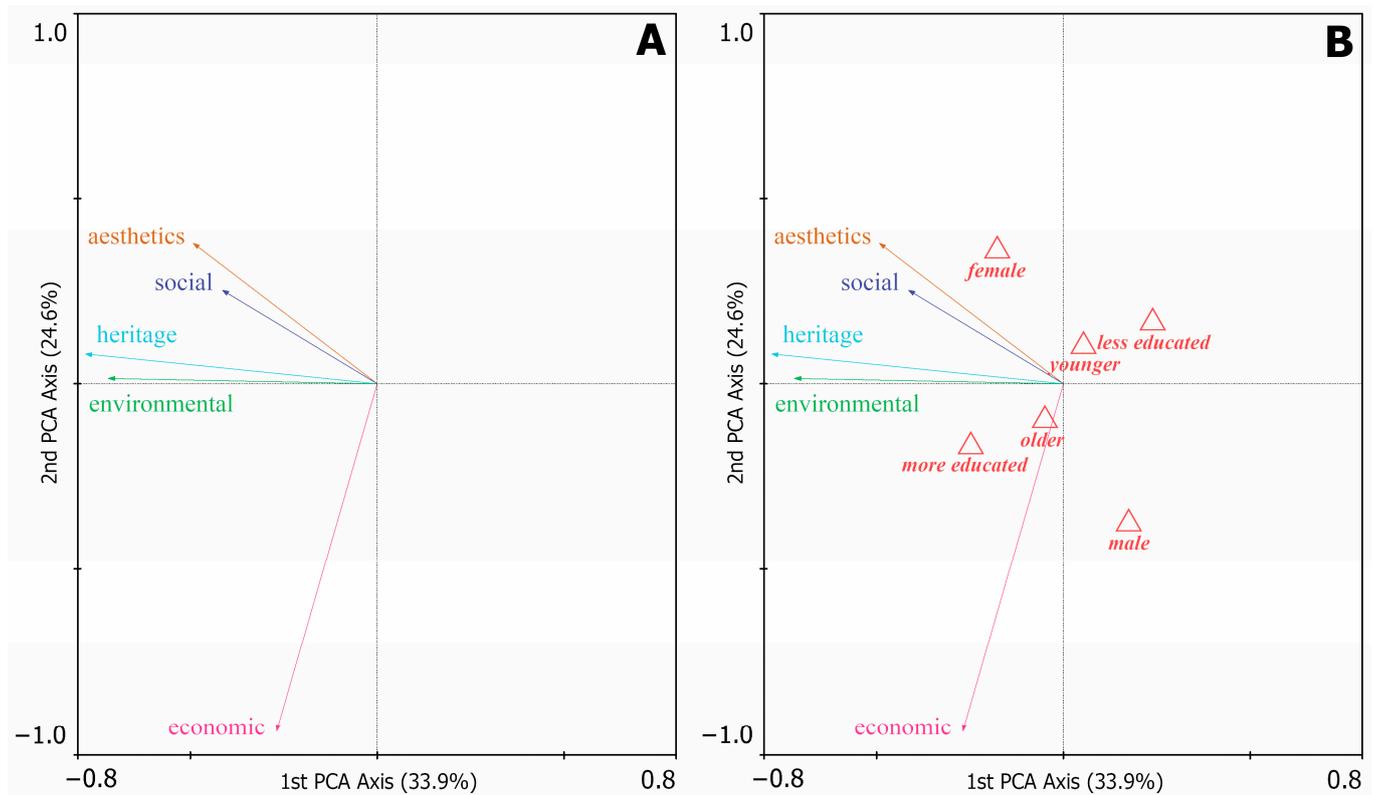


Figure 5. PCA ordination plots. (A) PCA ordination plot with dependent variables to evaluate the importance of different dimensions of brownfields. (B) PCA ordination plot with independent variables to evaluate the importance of different dimensions of brownfields.

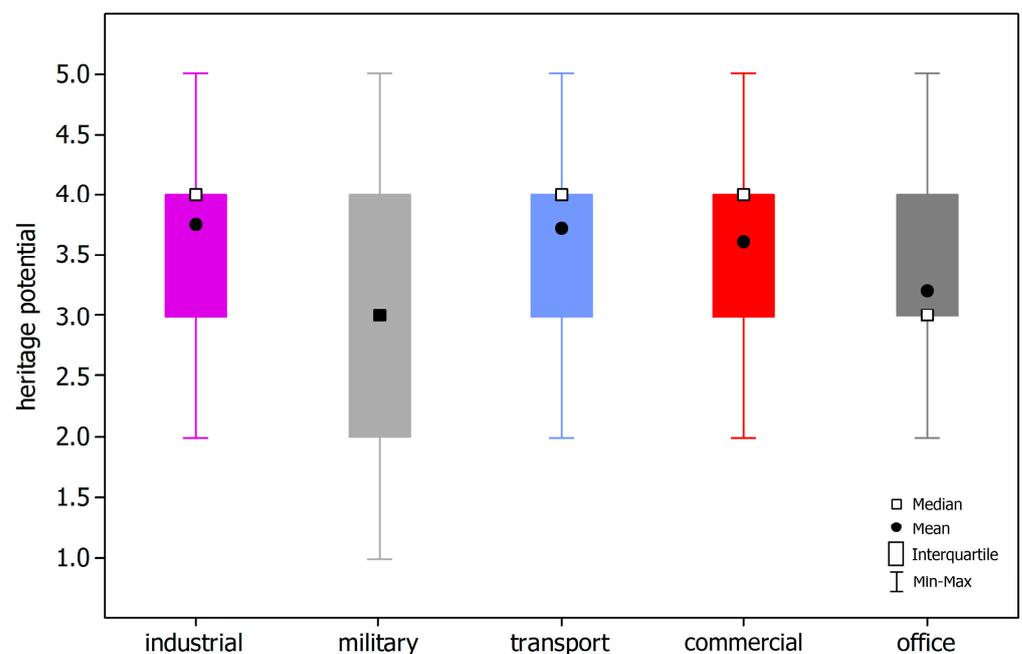


Figure 6. Heritage potential based on the original land use.

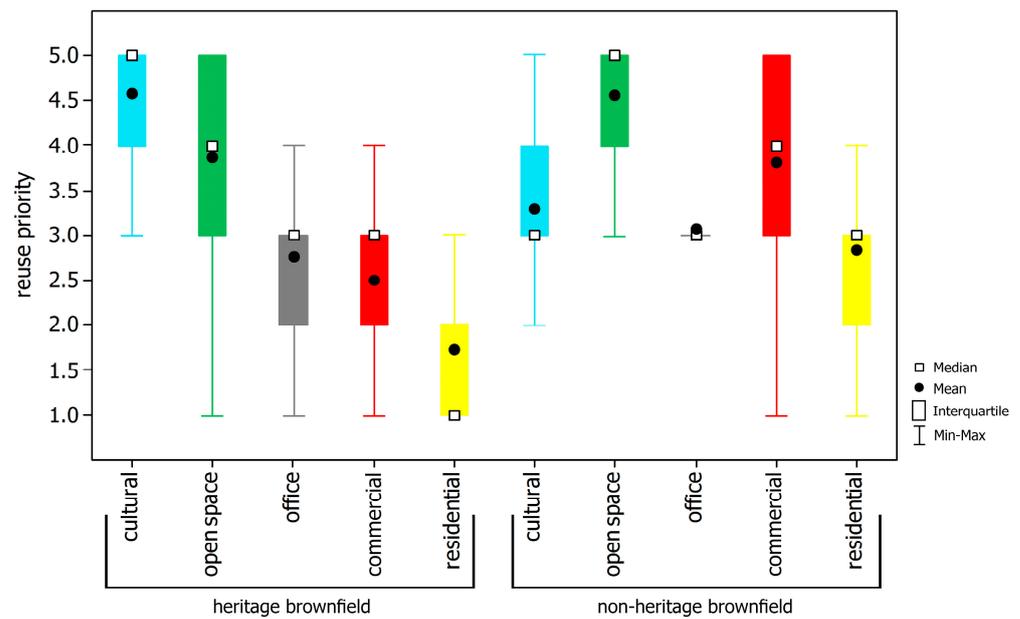


Figure 7. Priority for reuse in heritage and non-heritage brownfields.

5.2. Public Perception of the Approach to Heritage in Brownfield Regeneration

5.2.1. Reasons for Visiting and Memorability of Sites

The Pearson’s chi-square test results for the main reason behind visiting Qasr Prison Museum, Haftchenar Museum, and Honarmandan Park were significant ($X^2(8, N = 1155) = 494.647, p < 0.001$). The crosstab (Table 6) reveals that the primary purpose of visiting Qasr Prison Museum was historical sightseeing, whereas Haftchenar Museum and Honarmandan Park were preferred for leisure activities and social gatherings, respectively.

Table 6. The crosstab of the reasons for visiting the three sites (n = 385) (source: authors).

Variables	Group						Total	
	The Museum of Qasr Prison		Haftchenar Museum		Honarmandan Park			
	Count	%	Count	%	Count	%	Count	%
Historical sightseeing	172	44.7	40	10.4	11	2.9	223	19.3
Galleries and artistic cultural spaces	61	15.8	126	32.7	59	15.3	246	21.3
Leisure time	97	25.2	170	44.2	92	23.9	359	31.1
Social gatherings	48	12.5	10	2.6	182	47.3	240	20.8
Other	7	1.8	39	10.1	41	10.6	87	7.5
Total	385	100.0	385	100.0	385	100.0	1155	100.0

The Pearson’s chi-square test found significant relationships between memorability factors in Qasr Prison Museum, Haftchenar Museum, and Honarmandan Park ($X^2(10, N = 1155) = 631.90, p < 0.001$). The crosstab (Table 7) indicates that the prominent heritage buildings and historical atmosphere were the primary cause of memorability of Qasr Prison Museum. Haftchenar Museum’s artistic and cultural spaces were found to be significant in making the museum memorable, whereas Honarmandan Park’s human presence and social activities were found to be significant in making the park memorable. The order of sites was: Qasr Prison Museum, Haftchenar Museum, and Honarmandan Park, in terms of notable heritage structures and historical atmosphere. Honarmandan Park ranked worst in terms of memorability, followed by the Haftchenar Museum, and the Qasr Prison Museum.

Table 7. The crosstab of the reasons for the memorableness of the three sites (n = 385) (source: authors).

Variables	Group						Total	
	The Museum of Qasr Prison		Haftchenar Museum		Honarmandan Park			
	Count	%	Count	%	Count	%	Count	%
Prominent heritage buildings and historical atmosphere	269	69.9	98	25.5	14	3.6	381	33
Artistic and cultural spaces	58	15.1	135	35.1	52	13.5	245	21.2
Designing spaces and landscape	37	9.6	102	26.5	84	21.8	223	19.3
People's presence and social activities	8	2.1	20	5.2	157	40.8	185	16
Other	11	2.9	11	2.9	44	11.4	66	5.7
Lack of memorableness	2	0.5	19	4.9	34	8.8	55	4.8
Total	385	100.0	385	100.0	385	100.0	1155	100.0

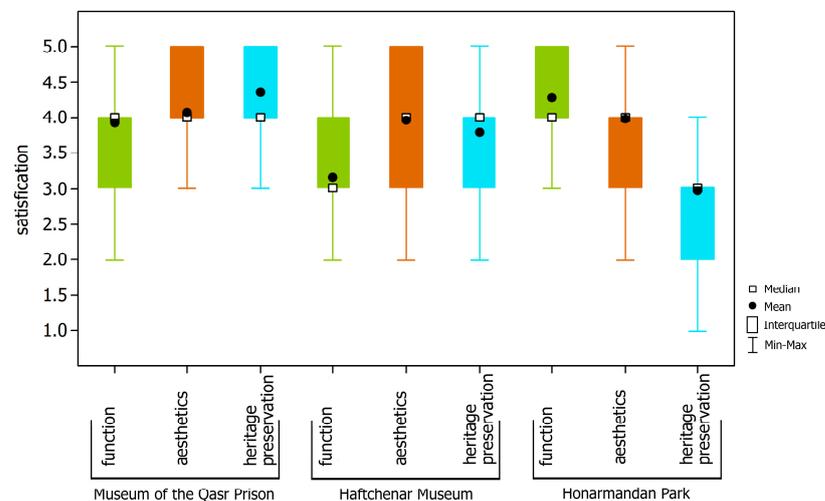
5.2.2. The Effect of Heritage Preservation Approaches on Understanding the History of the Site and Fostering a Sense of History at the City Level

The study utilized the Friedman test to compare the three sites and determine the effect of preservation type on recognizing their history. The findings were statistically significant ($X^2F(2) = 565.058, p < 0.001$). The ranking showed that the Museum of Qasr Prison had the highest mean rank (2.85), followed by Haftchenar Museum (1.83), and Honarmandan Park (1.32).

The Friedman test showed significant results ($X^2F(2) = 514.922, p < 0.001$) when comparing the three sites in terms of preservation type and its effect on creating a historical sense at the city scale. The rankings showed that the Museum of Qasr Prison had the highest mean rank (2.80), followed by Haftchenar Museum (1.81) and Honarmandan Park (1.39).

5.2.3. Satisfaction Assessment with Function, Aesthetics, and Heritage Preservation

The Kruskal–Wallis test revealed significant differences among the three sites in terms of satisfaction levels for function ($X^2(2, N = 1155) = 319.30, p < 0.001$), and heritage preservation ($X^2(2, N = 1155) = 400.73, p < 0.001$). However, no significant difference was found regarding aesthetics ($X^2(2, N = 1155) = 4.441, p = 0.109$). The ranking of satisfaction with function was led by Honarmandan Park, followed by the Museum of Qasr Prison and Haftchenar Museum. Meanwhile, the ranking for heritage preservation was topped by the Museum of Qasr Prison, followed by Haftchenar Museum and Honarmandan Park (Figure 8).

**Figure 8.** Satisfaction assessment with function, aesthetics, and heritage preservation.

6. Discussion

This research investigated the significance of heritage in brownfield regeneration across three types of regenerated sites in Tehran. Below are summarized findings.

6.1. *Public Perception of Brownfield and Heritage*

Residents believe that regenerating brownfields can solve urban issues and improve the city's quality, in line with previous studies [13,26,58,86]. The social dimension is crucial in brownfield redevelopment, while environmental and heritage aspects are less important to residents. However, Loures et al. [13] discovered that the environment was perceived as most critical by residents. The absence of a report on brownfield pollution's environmental impact in Iran has hindered public and governmental recognition of the issue [35]. Brownfields in Iran have significant architectural and aesthetic value in modern history due to their rich social and cultural past. However, many other sites with greater cultural and historical significance have overshadowed them. Residents of Iran show a relatively limited knowledge of these places, and institutions like the Iranian Cultural Heritage Organisation have taken little effort. There are significant ramifications for ancestry that stem from this lack of information [27], potentially leading to the destruction of a substantial portion of Iran's industrial heritage [39].

Economic and non-economic components were revealed by the principal component analysis of locals' opinions on brownfields. Members of more powerful demographics, such as males and older, better-educated respondents, gave economics a greater priority. Mehdipour's focus on the economic role in redeveloping Iran's brown-fields is consistent with this [35].

For many, the intangible aspects of a heritage are sometimes overlooked in favor of the more obvious material ones. Understanding the intangible aspects is crucial to preserving a society's past and present, nevertheless. Facilitating heritage interpretation helps stakeholders and visitors obtain a positive experience and perspective of heritage [34]. This fosters recognition of the heritage and generates concern for its conservation and redevelopment [106]. With respect to brownfields resulting from industrial, transportation, and commercial land use, the estimate of historic potential was appropriate. However, there appeared to be less optimism regarding military-originated brownfields despite the successful examples of reconstruction seen in Iran. This discrepancy may be due to the fact that military sites are security-focused. This emphasizes the role that experience and knowledge play in shaping public opinions [107].

6.2. *The Effect of Heritage on Reuse Priorities*

Heritage is a significant factor in brownfield redevelopment, as the respondents indicated. Kim and Miller [59] found that society readily accepted the revitalization of brownfields with preserved landscapes, historical signs, and scattered structures. However, remediation should still take place when necessary. Conversely, Osman et al. [108] and Frantál et al. [78] did not find historical value to be a major factor in brownfield redevelopment.

The reuse of heritage brownfields gives cultural spaces precedence over open spaces, whereas the reuse of non-heritage brownfields gives open spaces precedence over open spaces. Except for cultural use, non-heritage brownfields are given preference over heritage brownfields for all other reuse options. This indicates that non-heritage brownfields provide more options for redevelopment than heritage brownfields do. Residents' values on heritage factors greatly impact the sort of brownfield reuse, creating obstacles but also unique opportunities for redevelopment [55,72]. Residential reuse is a low priority in both types of brownfields due to the city center's dense fabric, which results in a high preference for open spaces. Regardless of heritage or non-heritage status, brownfield reuse prioritizes open spaces followed by cultural uses; as Loures et al. [13] suggest, multifunctional and leisure green spaces are the most favored options.

6.3. Impact of the Type of Approach to Heritage on Public Perception

We divided Tehran's brownfields into three types based on how important it is to maintain heritage in order to study the link between inhabitants' perspectives and heritage preservation measures in regeneration.

The Qasr Prison Museum (type 1), the Haftchenar Museum (type 2), and Honarmandan Park (type 3) are the recommended stops in order to learn about the region's past via visits to sites and conceptual linkages between past and contemporary usage. Heritage interpretation is crucial for understanding a site's significance [77], while neglecting intangible heritage hinders comprehension of cultural and historical sites [34]. This chronological arrangement of case studies is thought to best showcase the unique character and rich history of the city. Thus, heritage preservation has a visible effect on the site and the city, drawing attention to the abundance of history.

Type 3 reasons for visiting and being memorable, including "historical sightseeing" and "historical buildings", increased in popularity as a type 1 cause. The other two sites were picked for reasons connected to recent developments, although visitors mostly visited Qasr Prison Museum (type 1) as a result of this decision. Instead of solely depending on the site's facilities, preserving legacy and restoring historical values encourages visitors to visit and witness the brownfield directly [27].

Attention given to heritage aspects in regeneration increased satisfaction with heritage preservation from type 3 to type 1. Satisfaction levels regarding aesthetic and functional dimensions differed, showing no correlation between heritage and other dimensions. This is supported by Navratil et al. [27] and Firth [34].

In this subsection, we draw the conclusion that prioritizing heritage preservation influences visitor perception positively. By concentrating on different facets of the heritage, engagement and comprehension may be improved, which will ultimately lead to an increase in desire to visit and a better memory.

7. Conclusions

This study could have lessons for brownfield regeneration in emerging nations with rich cultures. These nations typically leave brownfields due to structural, legal, and economic impediments, destroying their legacy. Iranian urban regeneration regulations confine brownfield developments to historic protection. This research analyzes inhabitants' evaluation of the importance of heritage in rehabilitating Iranian brownfields. The results aid problem-based research on historical brownfield regeneration in emerging and historical nations. The study has policy and urban planning implications and limits that require additional debate.

Iran's top-down urban planning should include citizen input and citizen science. This work advances this purpose methodically and substantively. Iranians lack environmental awareness and see legacy as a driver for brownfield development, according to studies. This differs from international research. Brownfield contamination is underreported due to Iran's Environmental Protection Organization's inadequate laws, regulations, and oversight. Iran's rich history and culture pique the public's interest in history. Awareness of brownfield heritage may stimulate decision-making and accelerate brownfield regeneration. Brownfields need public attention and should be reused, even temporarily. The remodeling must follow place-making concepts and provide appealing public areas to match neighboring neighborhoods. Creatively resurrecting historical importance and recollections may strengthen the place's identity and introduce others to its past. Residents' views on brownfield redevelopment are economic and non-economic. Influential organizations emphasize the commercial component, including urban branding and creative place-making for revitalizing ancient locations. Industrial tourism and brownfield openings may also justify rehabilitation economically.

This study has some limitations which need to be addressed in future research. Tehran's administrative services and appeal to outsiders may have affected the results. Because heritage has many aspects and values, classifying brownfields as heritage or non-

heritage for new purposes is speculative. Thus, although valuable for comparative analyses, residents' subjective preconceptions affected the conclusion. These constraints necessitate socio-geographic study in various situations. Qualitative methodologies would help study Iranian opinions; examining brownfield and heritage policies would help to address poor understanding. Given Iran's long-term brownfield abandonment, redevelopment plans should be considered.

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