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Evaluating the Potential of Brown lands in increasing urban resilience with a Sustainable Development Approach

(Case Study: Boshruyeh city)

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Keywords:
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Abbreviations:

QSPM	Quantitative strategic planning matrix;
GIS	Geographic Information System;
TOD	Transit-Oriented Development;
BRT	Bus rapid transit

A B S T R A C T

Objective: This study investigates the role of brownfield redevelopment in enhancing urban resilience through a sustainable development approach. The primary objective is to evaluate strategies for repurposing these lands and assess their impact on environmental quality, social interactions, economic opportunities, and pollution reduction. The central research question is how brownfield reuse can contribute to improving urban sustainability and resilience.
Methods: The research applies the Quantitative Strategic Planning Matrix (QSPM) method, incorporating expert opinions to evaluate proposed redevelopment strategies. Data collection was carried out through library research, field observations, and expert interviews. Several urban resilience layers, such as building age, road quality, and service accessibility, were analysed using GIS software. The strategies were then scored based on their impact on internal and external urban factors.
Results: Findings indicate that brownfield redevelopment significantly enhances urban resilience by improving air quality, increasing social engagement, fostering economic growth, and mitigating environmental issues. The study analysed strategies such as mixed-use development, green space integration, and improved transportation infrastructure to reduce car dependency and promote pedestrian- and cyclist-friendly urban designs. The scoring results revealed that Strategies 1 & 2 received 22%, Strategies 3 & 4 received 18%, and Strategy 5 received 20%, indicating their relative effectiveness in promoting urban resilience.
Conclusion: Brownfield redevelopment emerges as a key strategy for sustainable urban transformation. The study highlights its potential in addressing environmental challenges, enhancing social interactions, and reducing urban inequalities. Additionally, it underscores the need for greater coordination among policymakers and urban planners to ensure effective brownfield revitalization. Future research should further explore context-specific challenges and opportunities in various metropolitan areas to optimize redevelopment strategies.

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1. Introduction

Brown lands are a great opportunity to regenerate urban areas by converting the land left without any usable use into useful spaces. These locations, at one time polluted, are able to be cleared and reused for sustainable development, thereby offering economic, social, and environmental gains for the local area. (Wolff & et al. 2023) If one can think ahead and provide money, blighted areas could be the real centres of innovation and development in the future. New things are possible, too, through this scheme of redeveloping the sites. For example, job creation, increased peace of mind, and minimized bluestone are the consequential by-products. Brown lands redevelopment has been proven, with the right way to convert those still-unidentified sites, communities being able to eliminate the troublesome sites of the area and enhance the environment with limited usage of resources. (Li & et al., 2023) In that respect, by integrating various features such as green infrastructure, renewable energy sources, and sustainable design practices into Brown lands, they become role models of sustainable development for environmental and community purposes and enhance the quality of life. (Ang & et al., 2022).

The rapid growth of urbanization and the destructive effects of climate change have created many environmental and social challenges for cities. One of the critical issues raised, especially in recent years, as a solution to these challenges is the reuse of brown lands. Such lands are usually represented by abandoned industrial, commercial, or even residential grounds that mostly present specific environmental problems, such as soil or water pollution, whereas, due to their highly valued location in developed urban areas, they provide great opportunities for regeneration in conjunction with sustainable development. The sustainable reuse of these lands can increase the resilience of cities against environmental and social crises and help improve the quality of life in urban communities. (De Sousa, 2006) Dysfunctional urban contexts, as part of the city's body, are considered areas vulnerable to natural hazards that require coordinated planning and intervention to regulate. These tissues are characterized by instability and a set of economic, physical, social, and other deficiencies. Urban regeneration is one of the approaches that has emerged as an important emerging area of public intervention and is intended to support less developed areas. (Saeidi mofrad & et al., 2022). This research investigates the potential of reviving brown lands to increase urban resilience with a sustainable development approach. Studies in the field of regenerating brown lands have addressed the environmental, economic, and social effects of these lands. It has been shown that the regeneration of brown lands can play a key role in revitalizing urban areas and reducing pollution. (De Sousa, 2006). They have emphasized the importance of the role of these lands in the economic and social revitalization of urban areas and have raised the improvement of social interactions and the return of economic capital as key benefits. (Thornton et al., 2007). Also, they have mentioned the social benefits of regenerating brown lands and have studied the effect of these lands on increasing urban resilience. (Couch et al., 2011) They have also addressed the aspects of environmental justice and pointed out the effect of these lands in reducing social inequalities. While there are several studies that have taken place regarding highlighting the importance of Brown lands restoration, essential research gaps persist, and this research will try to fill in the following:

1- Resilience and sustainable development: There are different studies that separately deal with either economic or environmental impacts. At the same time, a comprehensive review concerning brown land restoration in relation to resilience and sustainable development has not been explored yet. (Adams et al., 2010).

2- Lack of studies in arid and semi-arid areas: Most of the research carried out in the field of reclamation of brown lands has been in humid and urban areas, and less attention has been paid to the characteristics of dry areas. It underlines that such areas do require special strategies and are also less studied up to now.

3- Environmental and social justice: While considerable attention has been paid to the environmental effects of Brown lands redevelopment, its contribution from an environmental and social justice perspective remains scant. Further research is hence required on how the

process of regeneration affects social inequalities (Anguelovski, 2016). These are the deficiencies this research tries to make up for:

The present study attempts to bridge some of these gaps in knowledge:

1- A comprehensive review of the resilience of cities through the intervention of sustainable development in rehabilitation brown lands.

2- **Studying and developing innovative strategies for reviving these lands in arid and semi-arid areas, which have been less investigated so far.**

3- **Analysis of the role of environmental justice in the process of regeneration of brown lands and its effect on social resilience and reducing ecological inequalities. This research brings innovations that include focusing on arid and semi-arid cities and developing new strategies for the regeneration of brown lands in these areas. Also, the current research examines the link between urban resilience, sustainable development, and environmental justice in a multilateral manner. One basic hypothesis of this research is that brown land regeneration can play a positive role in improving urban resilience with innovative and sustainable approaches while reducing social and environmental inequalities. In general, this research tries to offer practical strategies for brown land regeneration by enhancing urban resilience and accelerating sustainable development. These would include needs-based solutions, designed and oriented to contribute to the improvement of the quality of life in urban areas of arid and semi-arid regions.**

2. Theoretical Foundation of The Research

2.1. Brown lands

Brown lands are abandoned or underutilized sites that may be contaminated by hazardous substances in soil or water or both. (Berman & et al., 2022). While sometimes causing an environmental and health risk for the neighbouring communities, they also have the potential to foster economic growth and urban development. Properly assessed, remediated, and redeveloped Brown lands can become very valuable assets. Such contaminated sites can be considerable and productive in order to ensure sustained growth and vibrancy in urban areas. However, Brown lands redevelopment requires effective coordination of governments, developers, and stakeholders in the community. Such redevelopment must not only meet environmental and health requirements but also needs to ensure conformance with the needs and aspirations of the community. The outcomes will include a much fairer share of the available economic resources and opportunities across the urban area. (Newton & et al., 2023). Through Brown lands redevelopment, productivity is expected to rise and capture new businesses while attaining better sustainability in the built environment for the city. (Feng & et al., 2023). Note that through the creation of new funding mechanisms and various incentives, cities can encourage private investment in Brown lands redevelopment projects, which will eventually spur economic growth to generate jobs. (Alshehri & et al., 2023). Other benefits the projects can do are resolve concerns about environmental contamination and facilitate the adoption of green technology within a city. All these will result in sustainable development and might mostly remain long-term positive impacts to the environment and the community. This paper shall therefore conclude that Brown land redevelopment has huge potential on turning contaminated sites into useful assets both to the environment and the community. (Alshehri & et al., 2023). Offerings in public-private cooperation and creative funding can help cities open up the economy to undertake urban development sustainably. (Shi & et al., 2020). Besides, Brown lands redevelopment can help reduce urban sprawl and support infill development. (Jian, et al., 2023). This has the added advantage that the Brown lands redevelopment might increase the property value and life

quality of those people who would be staying in the neighbourhoods around a redevelopment area. In this way, it will be helpful in the establishment of vibrant and more attractive urban communities. (Zhang & Ma, 2020).

2.2. Urban Resilience

Urban resilience enhances a city's ability to absorb and recover from several shocks and stresses. Therefore, this approach allows cities to self-manage their process of becoming more resilient to climate change and natural disasters, it is all about making more resilient urban systems through the integration of social, economic, and environmental dimensions. (Peng & et al., 2023). Some of these sustainable urban planning strategies, notably focusing on green infrastructure, mixed land-use development, and compact city design, reduce vulnerability and thus increase city sustainability in light of the new emerging challenges. Therefore, sustainable urban design methods can be a catalyst leading toward better health, quality of life, and more economic opportunities for urban residents if properly implemented. On the whole, an urban development that is infused enough with sustainability has much to add concerning the resilience and long-term sustainability of cities. This interwovenness of the social, economic, and environmental, conceived in the minds of its designers, shall achieve better resistance and recovery of the disturbance in cities and realize well-being for their inhabitants. Sustainable development does not only contribute to the present generation but also lays a strong foundation for future generations in which resilient and sustainable urban environments thrive.(Naess, 2021) Resilience and sustainability will avoid daily challenges, creating a beautiful future with positive impacts on people and the planet. It, therefore, includes the practice of sustainable urban development as a universally guaranteed means of ensuring the welfare and sustainability of the environment for present and future generations. (Zeng & et al., 2022). At a time when the world is changing fast, it becomes very important to embrace sustainable urban development practices as a way of ensuring the well-being of their inhabitants and the environment for generations to come. (Amoako & et al., 2022). During the different stages of urban planning processes, there are opportunities for collaboration and innovation, and therefore, solving complex challenges generates prospects for a more sustainable future for all citizens. (Zeng & et al., 2011).

2.3. Sustainable Approach in Urban Development

The reason for making a sustainable city is because of climate change and population growth. It can decrease the risks of natural disasters to cities and enhance the capability of dealing with burdens that may arise in the future, hence making it more sustainable. (Dehghani & et al., 2023). In attainment of a healthier community and a better quality of life, design Sustainable urban planning has strategies to improve health, raise the standard of living, and offer economic opportunities to people. Thus, in view of the challenges posed by climate change and high population growth, it becomes very essential to have a sustainable approach toward the development of urban regions. (Allam & et al., 2022). In its turn, sustainable urban planning could basically help to reduce risks from natural disasters and increase total sustainability against future challenges. It can support healthier communities with a better quality of life and more significant economic opportunities. (Zanella & et al., 2014). Not only that, but sustainable practices promote community and social cohesion; this creates a liveable sense of community and social cohesion. Therefore, realize that cities must value sustainable urban development to achieve an appreciable sense of liveable community with social cohesion. Also, sustainable urban development means that there is a low emission of greenhouse gases and air pollution, making cities even cleaner and healthier for all citizens. (Hepburn & et al., 2021). Sense of Community and Social Cohesion: Finally, embracing sustainability not only helps the environment but has also brought about a sense of community and social cohesion. (Amirzadeh & et al., 2022). The priority in the development of sustainable cities is to make urban centres liveable. This, when integrated with green infrastructure to improve walkability and investment in renewable energy sources, will make the city more resilient to climate change. Green spaces and parks generally have additional advantages associated with improving the air through some recreational opportunities and reducing the urban heat island effect. (Grabowski &

et al., 2023)

2.4. Sustainable Development & Urban Resilience

Sustainable development goes in line with enhancing urban resilience by making sure there is environmental protection, social equity, and economic prosperity within the brown lands. (Khatana & et al., 2021). Ending, since cities face so many challenges in delivering sustainable infrastructure and green spaces, they, therefore, have to be at the forefront of the respective agenda in implementing sustainable development practices in a bid to attain long-term resilience within their respective city areas. (Peng & et al., 2023). Sustainability development is not only a strategy against the adverse impacts of urbanization and climate change but is also one comprehensive way of making sure that human well-being is guaranteed at present and in the future. (Lawrence, 2022). Brown land is therefore highly advocated by sustainable development in an environmental protection, social equity, and economic prosperity more balanced manner. Further, sustainable development can promote community resilience by encouraging green infrastructure and sustainable transport systems. (Giulia, 2023). It also provides for urban planning, considering all the interested parties, and encourages liveable communities to be inclusive. Sustainable development is the way to make urban areas resilient, adaptive, and viable in the face of uncertainty while mitigating their environmental footprint over the long term. (Abdillah & et al., 2023). But cities face another challenge that of infusing sustainable development into each and every part of urban planning and development—in order to set the stage for resilient, robust communities. The answer concluded that sustainable development gives a balance between environmental protection, social equities, and economic prosperity in brown lands. (Brown & Van Hooser, 2015). Further, it builds resilience at community levels through green infrastructure and sustainable transport systems for the long-term sustainability of urban areas.

Modern environmental and social challenges require that the sustainable development of the practice city be taken into consideration to enhance resilience. For a healthy and sustainable future for all, sustainable development leads towards it. (Jones & et al., 2022). The global challenges of climate change, resource depletion, and social inequality are inextricably linked and must be solved since they promote care for the environment, social inclusion, and economic growth. (Entrich, 2020). The strategy advocates technological innovation and infrastructural adjustment as more sustainable means for the development of a city. All this secures the future resilient and prosperous for generations to come. A call is also made for cooperation amongst the government, businesses, and members of the community regarding work toward the attainment of set sustainability goals. (Zeng & et al., 2022). That is, sustainable development comes as part and parcel of the principal solution towards coping with climate change, resource depletion, and social inequality. It enhances renewable sources of energy and sustains proper practices, preserving the environment for future generations. (Müller & Klein, 2023). Through its impacts, sustainable development tames urbanization on both ecosystems and biodiversity. It improves efficient use of resources with reduced waste so as not to degrade the environment. (Qian & et al., 2022). Sustainable development is positively correlated with the co-existence of economic growth and environmental protection. It is a way of putting into action progressive betterment and welfare for all. Can give low Greenhouse gas emissions by keeping under control the climate change. (Umar & Safi, 2023). This also has the tendency to reduce costs for organizations in the long run. Healthcare of the people and improvement in quality of life in cities. Energy-related costs can be reduced in a way when companies become more energy-efficient and introduce green technologies. Countries, therefore, encourage the use of sustainable transport modules by incentivizing them. (Rezvani & et al., 2023). The improved public health and quality of life in cities and towns fifty curbs air pollution and congestion in the form of emissions from vehicles, quite regardless of the vehicle class specification. (Macdonald, 2020). This will not only be good for the environment but also for society through the creation of a healthy and liveable community. Through sustainability investment, we can ensure a resilient, environment-friendly future for our generations. This is a very essential intrinsic attribute of the development that would deal with the interlocked problems. (Forzieri & et al., 2022)

3. Methodology Research

In this research, by preparing a scoring questionnaire in QSOM Method, points have been given to the variables defined by experts and specialists in this field, and for a better understanding of the preparation of the required layers of library documents, than the preparation of a resilience map that is Several layers of information on the wear and tear of the fabric, the age of the building, the quality of the roads and the accessibility of the roads have been prepared. Finally, the variables compared to the proposed strategies are scored by experts and the best strategies are adopted in this research.

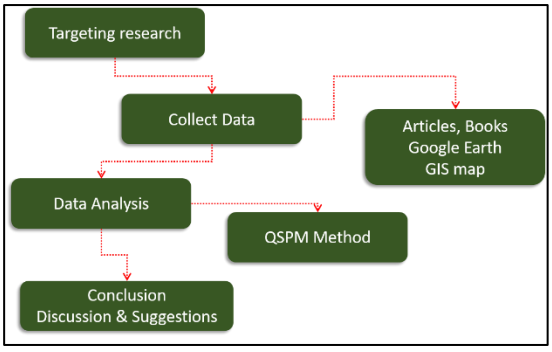

Fig. 1 Research Method

Boshruyeh city is in the northwest of South Khorasan province and is one of the major parts of Ferdowsi city. The main and primary core of the city is located in the center of the current city, and in fact, the primary core of the city was around the core of the mosque and the water reservoir on the edge of this mosque and next to the municipal square. Then the city has been developed into two parts, north, east, and northwest, and the development of the city has been towards the south. In the following years, the construction has been gradually extended from the side of Tabas Road to the Boshruyeh-Ferdowsi Road, and especially after the presentation of the first guide plan for this city, the lands in the south of the city have been considered the best place for development, and the development of the city has moved in this direction. The city has been developed in an orderly manner, and the initial construction of the city was woven in a circular shape around the core of the city, which is a reservoir and a mosque. During recent years, especially after the years of 1350 Hijri Shamsi, the fabric of the city has been developed in a checkerboard shape. This city has a long cultural and historical background. Throughout history, the livelihood of the people of Boshruyeh has been mainly based on agriculture, animal husbandry, and handicrafts. Agriculture is based on the underground water resources and the prone lands of this region, and the main products are cotton, barley, wheat, saffron, pistachios, and pomegranate. The presence of a delta on the coastal edge of the desert, which is the place where the underground water rises, has provided the ground for cattle breeding by creating favorable vegetation. The functional zoning of the city is divided into several zones based on the appropriate capacity for different uses, which include the residential zone, the commercial and service zone, the cultural and religious zone, the educational zone, the health and treatment zone, the tourism zone, the administrative and law enforcement zone, the sports zone, and the green space. It is an industrial and workshop area and a horticultural area. In the city of Boshruyeh, where most of the central tissues have organic texture and fine-grained texture and dilapidated buildings, which is one of the indicators of deterioration, in other words, old houses with basic materials that have no resistance against natural disasters and calamities, it is also important that the central organic tissue of Boshruyeh has The road network is completely organic in terms of its physical structure, so it is narrow alleys, which in times of natural disasters, firefighting, and medical services cannot or are difficult to access. The information collected in this research has been done using library documents and field impressions, and interviews with experts and specialists in this field who

have full knowledge of the research components have been collected. Also, due to the fact that all underlying factors have been scored using the Delphi method, these inefficient factors have been scored by experts, and finally, data analysis has been done using the QSPM method, which is very appropriate in this matter.

Fig. 2 Examples of the Brown lands texture of the city of Boshruyeh

Fig. 3 Examples of the Brown lands texture of the city of Boshruyeh

Fig. 4 Examples of the Brown lands texture of the city of Boshruyeh

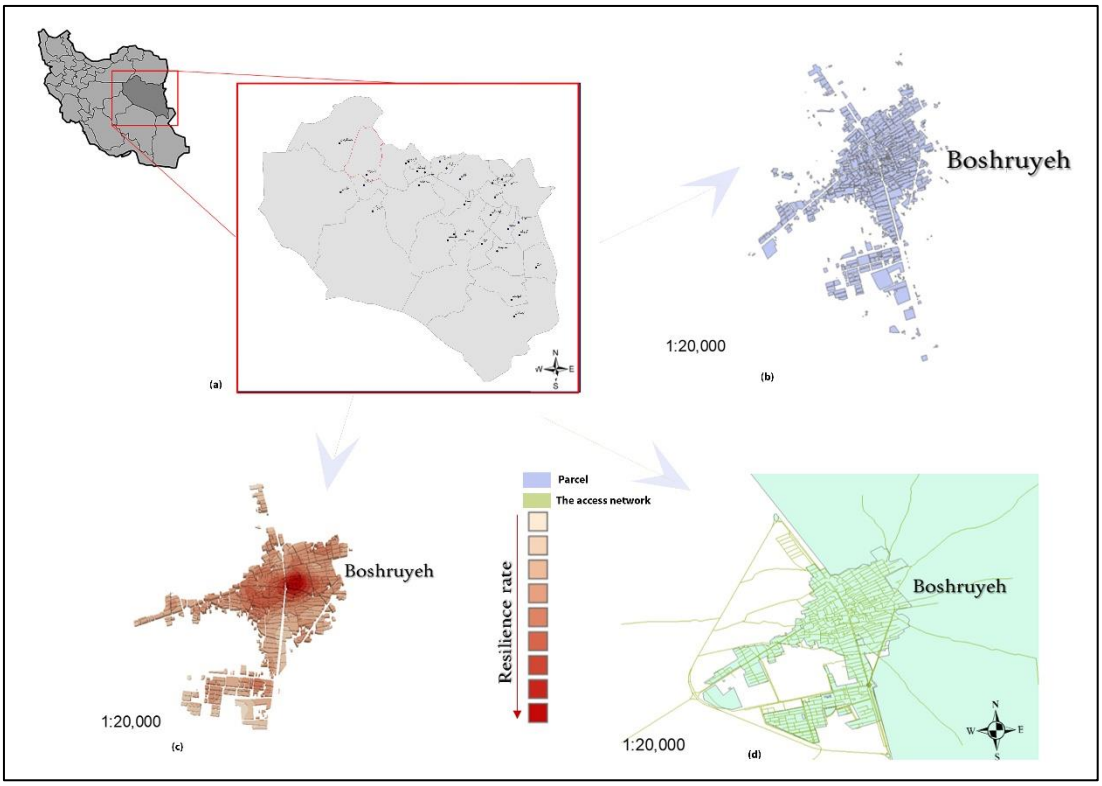

Fig. 5 The Location of Boshruyeh (a) The fineness (Blocking) and organic texture of the city of Boshruyeh (b) The access network of Boshruyeh city, whose organic texture is clearly visible. (c) Resilience rate (d)

For the Figure 5 which is Resilience rate:
Using ArcGIS software, the elements that reduce the resilience of the urban fabric—such as age, materials, low road width, small fineness (blocking), and numerous damages from accidents and natural disasters—were created for the creation of this map. As you can see, this range is in terms of the existence of all the physical variables that are effective in lowering urban resilience, such as age, quality, building life, etc.

4. Data Analysis

Underlying factors of inefficiency of the Boshruyeh city:

- ❖ Economic factors
  - Housing of low income groups
  - Employment
  - Land price drop (reduction in construction)
  - Balanced investment
- ❖ Physical factors
  - Unstableness of existing buildings

- The vulnerability of the buildings
- Penetration and adverse access
- Lack of services and urban facilities

❖ Social factors

- Dispersion and heterogeneous population load
- Reduction of security and social anomaly
- Shifting social class groups

❖ Environmental factors

- Collection of urban waste and construction waste
- Comfort and absence of noise and air pollution
- Access to greenery

Due to the existence of numerous problems in all aspects of the Boshruyeh city, the Delphi method has been used to adopt a better approach. In this method, first the problems are scored and prioritized by the experts in this field, and then the opportunities and threats are prioritized by the experts. In the opportunities and threats phase, they are prioritized by the experts. In the last stage, the proposed strategies are scored in relation to the internal and external influencing factors selected from the previous stages, and all the scoring has been done by experts and specialists in this field according to the scope of the research study of Boshruyeh city. All the steps are presented in the following tables in order.

Table 1 Prioritizing Boshruyeh city problems using Delphi method

Prioritizing the problematic factors of Boshruyeh city by Delphi method													
Economic factors	Expert1	Expert2	Expert3	Expert4	Expert5	Expert6	Expert7	Expert8	Expert9	Expert10	Expert11	Expert12	Total
Housing of low income groups	4	3	2	2	3	2	1	2	2	1	3	1	2.0
Employment	3	3	3	2	4	4	2	1	1	2	2	2	2.2
Land price drop (reduction in construction)	3	3	3	2	4	2	1	1	2	2	1	1	1.9
Balanced investment	4	2	2	3	3	2	2	1	1	2	2	1	1.9
Total score													2.0
Physical factors	Expert1	Expert2	Expert3	Expert4	Expert5	Expert6	Expert7	Expert8	Expert9	Expert10	Expert11	Expert12	Total
Unstableness of existing buildings	2	3	4	3	3	4	4	4	3	4	4	4	3.4
The vulnerability of the buildings	4	3	3	3	3	2	4	3	3	4	4	4	3.3
Penetration and adverse access	2	3	3	4	3	4	4	4	4	2	4	4	3.3
Lack of services and urban facilities	4	3	3	3	4	4	4	3	4	4	4	4	3.6
Total score													3.4
Social factors	Expert1	Expert2	Expert3	Expert4	Expert5	Expert6	Expert7	Expert8	Expert9	Expert10	Expert11	Expert12	Total
Dispersion and heterogeneous population load	3	3	4	3	2	2	2	1	4	1	2	4	2.3
Reduction of security and social anomaly	4	4	3	4	4	3	1	4	3	1	3	4	2.9
Shifting social class groups	4	4	2	3	3	4	2	1	4	3	3	3	2.8
Total score													2.7
Environmental factors	Expert1	Expert2	Expert3	Expert4	Expert5	Expert6	Expert7	Expert8	Expert9	Expert10	Expert11	Expert12	Total
Collection of urban waste and construction waste	4	3	3	2	2	2	3	3	2	2	2	2	2.4
Comfort and absence of noise and air pollution	1	2	1	1	1	1	1	1	1	1	1	1	1.1
Access to greenery	2	1	1	1	1	1	1	1	1	1	2	1	1.1
Total score													1.5

In this method, after this prioritization of the problems of the studied area based on the scoring of experts and specialists in this field, we will proceed to the scoring of the prioritization of external factors, which, as we can see, are scored in the table below.

Table 2 Prioritizing External Factors

	EXTERNAL FACTOR EVALUATION				
	Opportunities	Score	Importance factor	Reaction score	Final score
1	The presence of a valuable historical building	19	0.065	4	0.259
2	Strengthening the economic sector	14	0.048	2	0.096
3	Reinforcement of cultural spaces	15	0.051	3	0.154
4	Investment to create educational and residential spaces	16	0.055	2	0.109
5	The possibility of improving the quality of residential buildings	19	0.065	3	0.195
6	Correct location of users according to incompatible users	18	0.061	4	0.246
7	The possibility of increasing the safety of pedestrians in terms of the design of sidewalks and urban passages	18	0.061	4	0.246
8	Existence of suitable spaces for development	19	0.065	4	0.259
9	The possibility of creating green space and public open space	17	0.058	4	0.232
10	The possibility of developing agricultural fields due to the presence of suitable soil	16	0.055	3	0.164
	Threats	Score	Importance factor	Reaction score	Final score
1	The municipality's lack of attention to municipal facilities and equipment	17	0.058	3	0.174
2	Improper placement of users	17	0.058	3	0.174
3	The possibility of flooding of urban roads due to the low quality of urban roads	18	0.061	4	0.246
4	Weakness in the public transport system	16	0.055	3	0.164
5	Lack of social justice (lack of dispersion of urban facilities and equipment)	19	0.065	2	0.130
6	Risk of visual pollution due to poor public transport system	16	0.055	3	0.164
7	Lack of strict construction supervision	19	0.065	4	0.259
	Total	293	1.000		3.270

In the next step, we will prioritize the internal factors identified by experts and specialists in this field, which are based on the factors defined for the scope of the research.

Table 3 Prioritizing Internal Factors

	INTERNAL FACTOR EVALUATION				
	Strenght	Score	Importance factor	Reaction score	Final score
1	Availability of agricultural land	15	0.057	4	0.227
2	The existence of brown land	19	0.072	4	0.288
3	The existence of public tranport station (Bus)	17	0.064	3	0.193
4	The low price of residental land	17	0.064	2	0.129
5	Uniform skyline	15	0.057	2	0.114
	Weakness	Score	Importance factor	Reaction score	Final score
6	Lack of adequate facilities for proper waste disposal	17	0.064	2	0.129
7	Lack of access road	17	0.064	2	0.129
8	Lack of proper flooring on the sidewalks	18	0.068	4	0.273
9	Lack of compatibility between the residental context & the neighborhodd's uses	19	0.072	4	0.288
10	Absence of day & night uses	18	0.068	4	0.273
11	Non-observance of the access hierarchy of city roads	17	0.064	3	0.193
12	Lack of security due to extensive brwon lands in the neighborhood	19	0.072	4	0.288
13	The heterogeneity of commercial & industrial uses with a trans-neighborhood scale as incompatible use	18	0.068	4	0.273
14	Lack of proper penetration into the tissue due to the presence of passages less than 6 meters	19	0.072	4	0.288
15	Not having a suitable structure & building resilience & safety	19	0.072	4	0.288
	Total	264	1.000		3.371

Finally, after determining the internal and external influencing factors, the factors that have a higher impact score are collected at the end to evaluate the proposed strategies for the study area, and each strategy is scored based on the influencing internal and external factors.

Table 4 Scoreboard for strategy 1

		S1		
		Relative importance factor	Attractiveness score	Strategy attractiveness score
Opportunities	The presence of a valuable historical building	0.065	3	0.195
	The possibility of improving the quality of residential buildings	0.065	4	0.26
	Correct location of users according to incompatible users	0.061	3	0.183
	The possibility of increasing the safety of pedestrians in terms of the design of sidewalks and urban passages	0.061	4	0.244
	Existence of suitable spaces for development	0.065	3	0.195
	The possibility of creating green space and public open space	0.058	3	0.174
Threats	The municipality's lack of attention to municipal facilities and equipment	0.058	3	0.174
	Improper placement of users	0.058	2	0.116
	The possibility of flooding of urban roads due to the low quality of urban roads	0.061	4	0.244
	Weakness in the public transport system	0.055	3	0.165
	Lack of social justice (lack of dispersion of urban facilities and equipment)	0.065	4	0.26
	Risk of visual pollution due to poor public transport system	0.055	3	0.165
	Lack of strict construction supervision	0.065	1	0.065
Strengths	The existence of brown land	0.072	4	0.288
	The existence of public tranport station (Bus)	0.064	3	0.192
	The low price of residental land	0.064	4	0.256
Weakness	Lack of adequate facilities for proper waste disposal	0.064	2	0.128
	Lack of access road	0.064	2	0.128
	Lack of proper flooring on the sidewalks	0.068	2	0.136
	Lack of compatibility between the residental context & the neighborhood's uses	0.072	4	0.288
	Absence of day & night uses	0.068	3	0.204
	Non-observance of the access hierarchy of city roads	0.064	1	0.064
	Lack of security due to extensive brwon lands in the neighborhood	0.072	4	0.288
	The heterogeneity of commercial & industrial uses with a trans-neighborhood scale as incompatible use	0.068	4	0.272
	Lack of proper penetration into the tissue due to the presence of passages less than 6 meters	0.072	3	0.216
	Not having a suitable structure & building resilience & safety	0.072	4	0.288
				5.188

Table 5 Scoreboard for strategy 2

		S2		
		Relative importance factor	Attractiveness score	Strategy attractiveness score
Opportunities	The presence of a valuable historical building	0.065	4	0.26
	The possibility of improving the quality of residential buildings	0.065	3	0.195
	Correct location of users according to incompatible users	0.061	3	0.183
	The possibility of increasing the safety of pedestrians in terms of the design of sidewalks and urban passages	0.061	4	0.244
	Existence of suitable spaces for development	0.065	3	0.195
	The possibility of creating green space and public open space	0.058	3	0.174
Threats	The municipality's lack of attention to municipal facilities and equipment	0.058	2	0.116
	Improper placement of users	0.058	2	0.116
	The possibility of flooding of urban roads due to the low quality of urban roads	0.061	3	0.183
	Weakness in the public transport system	0.055	4	0.22
	Lack of social justice (lack of dispersion of urban facilities and equipment)	0.065	3	0.195
	Risk of visual pollution due to poor public transport system	0.055	3	0.165
	Lack of strict construction supervision	0.065	2	0.13
Strengths	The existence of brown land	0.072	3	0.216
	The existence of public tranport station (Bus)	0.064	3	0.192
	The low price of residental land	0.064	2	0.128
Weakness	Lack of adequate facilities for proper waste disposal	0.064	3	0.192
	Lack of access road	0.064	4	0.256
	Lack of proper flooring on the sidewalks	0.068	4	0.272
	Lack of compatibility between the residental context & the neighborhood's uses	0.072	3	0.216
	Absence of day & night uses	0.068	4	0.272
	Non-observance of the access hierarchy of city roads	0.064	2	0.128
	Lack of security due to extensive brwon lands in the neighborhood	0.072	3	0.216
	The heterogeneity of commercial & industrial uses with a trans-neighborhood scale as incompatible use	0.068	3	0.204
	Lack of proper penetration into the tissue due to the presence of passages less than 6 meters	0.072	3	0.216
	Not having a suitable structure & building resilience & safety	0.072	3	0.216
				5.1

Table 6 Scoreboard for strategy 3

			S3	
		Relative importance factor	Attractiveness score	Strategy attractiveness score
Opportunities	The presence of a valuable historical building	0.065	3	0.195
	The possibility of improving the quality of residential buildings	0.065	1	0.065
	Correct location of users according to incompatible users	0.061	3	0.183
	The possibility of increasing the safety of pedestrians in terms of the design of sidewalks and urban passages	0.061	3	0.183
	Existence of suitable spaces for development	0.065	2	0.13
	The possibility of creating green space and public open space	0.058	4	0.232
Threats	The municipality's lack of attention to municipal facilities and equipment	0.058	2	0.116
	Improper placement of users	0.058	2	0.116
	The possibility of flooding of urban roads due to the low quality of urban roads	0.061	2	0.122
	Weakness in the public transport system	0.055	2	0.11
	Lack of social justice (lack of dispersion of urban facilities and equipment)	0.065	2	0.13
	Risk of visual pollution due to poor public transport system	0.055	2	0.11
	Lack of strict construction supervision	0.065	2	0.13
Strengths	The existence of brown land	0.072	4	0.288
	The existence of public tranport station (Bus)	0.064	2	0.128
	The low price of residental land	0.064	3	0.192
Weakness	Lack of adequate facilities for proper waste disposal	0.064	2	0.128
	Lack of access road	0.064	2	0.128
	Lack of proper flooring on the sidewalks	0.068	4	0.272
	Lack of compatibility between the residental context & the neighborhood's uses	0.072	4	0.288
	Absence of day & night uses	0.068	4	0.272
	Non-observance of the access hierarchy of city roads	0.064	2	0.128
	Lack of security due to extensive brwon lands in the neighborhood	0.072	2	0.144
	The heterogeneity of commercial & industrial uses with a trans-neighborhood scale as incompatible use	0.068	2	0.136
	Lack of proper penetration into the tissue due to the presence of passages less than 6 meters	0.072	2	0.144
	Not having a suitable structure & building resilience & safety	0.072	2	0.144
				4.214

Table 7 Scoreboard for strategy 4

			S4	
		Relative importance factor	Attractiveness score	Strategy attractiveness score
Opportunities	The presence of a valuable historical building	0.065	4	0.26
	The possibility of improving the quality of residential buildings	0.065	3	0.195
	Correct location of users according to incompatible users	0.061	3	0.183
	The possibility of increasing the safety of pedestrians in terms of the design of sidewalks and urban passages	0.061	3	0.183
	Existence of suitable spaces for development	0.065	3	0.195
	The possibility of creating green space and public open space	0.058	2	0.116
Threats	The municipality's lack of attention to municipal facilities and equipment	0.058	2	0.116
	Improper placement of users	0.058	2	0.116
	The possibility of flooding of urban roads due to the low quality of urban roads	0.061	2	0.122
	Weakness in the public transport system	0.055	2	0.11
	Lack of social justice (lack of dispersion of urban facilities and equipment)	0.065	3	0.195
	Risk of visual pollution due to poor public transport system	0.055	1	0.055
	Lack of strict construction supervision	0.065	2	0.13
Strengths	The existence of brown land	0.072	4	0.288
	The existence of public tranport station (Bus)	0.064	3	0.192
	The low price of residental land	0.064	4	0.256
Weakness	Lack of adequate facilities for proper waste disposal	0.064	2	0.128
	Lack of access road	0.064	2	0.128
	Lack of proper flooring on the sidewalks	0.068	2	0.136
	Lack of compatibility between the residental context & the neighborhood's uses	0.072	2	0.144
	Absence of day & night uses	0.068	3	0.204
	Non-observance of the access hierarchy of city roads	0.064	2	0.128
	Lack of security due to extensive brwon lands in the neighborhood	0.072	3	0.216
	The heterogeneity of commercial & industrial uses with a trans-neighborhood scale as incompatible use	0.068	2	0.136
	Lack of proper penetration into the tissue due to the presence of passages less than 6 meters	0.072	2	0.144
	Not having a suitable structure & building resilience & safety	0.072	2	0.144
				4.22

Table 8 Scoreboard for strategy 5

		S5		
		Relative importance factor	Attractiveness score	Strategy attractiveness score
Opportunities	The presence of a valuable historical building	0.065	3	0.195
	The possibility of improving the quality of residential buildings	0.065	4	0.26
	Correct location of users according to incompatible users	0.061	4	0.244
	The possibility of increasing the safety of pedestrians in terms of the design of sidewalks and urban passages	0.061	2	0.122
	Existence of suitable spaces for development	0.065	2	0.13
	The possibility of creating green space and public open space	0.058	2	0.116
Threats	The municipality's lack of attention to municipal facilities and equipment	0.058	3	0.174
	Improper placement of users	0.058	3	0.174
	The possibility of flooding of urban roads due to the low quality of urban roads	0.061	2	0.122
	Weakness in the public transport system	0.055	2	0.11
	Lack of social justice (lack of dispersion of urban facilities and equipment)	0.065	3	0.195
	Risk of visual pollution due to poor public transport system	0.055	2	0.11
	Lack of strict construction supervision	0.065	2	0.13
Strengths	The existence of brown land	0.072	4	0.288
	The existence of public tranport station (Bus)	0.064	3	0.192
	The low price of residental land	0.064	4	0.256
Weakness	Lack of adequate facilities for proper waste disposal	0.064	2	0.128
	Lack of access road	0.064	2	0.128
	Lack of proper flooring on the sidewalks	0.068	2	0.136
	Lack of compatibility between the residental context & the neighborhood's uses	0.072	4	0.288
	Absence of day & night uses	0.068	3	0.204
	Non-observance of the access hierarchy of city roads	0.064	2	0.128
	Lack of security due to extensive brwon lands in the neighborhood	0.072	4	0.288
	The heterogeneity of commercial & industrial uses with a trans-neighborhood scale as incompatible use	0.068	3	0.204
	Lack of proper penetration into the tissue due to the presence of passages less than 6 meters	0.072	2	0.144
	Not having a suitable structure & building resilience & safety	0.072	4	0.288
				4.754

Strategies:

- S1: Repurpose Brown lands sites for mixed-use development, incorporating residential, commercial, and recreational spaces to increase urban density and resilience.
- S2: Improve transportation infrastructure around Brown lands sites by incorporating pedestrian-friendly and cyclist-friendly designs to reduce reliance on personal vehicles.
- S3: Utilizing and abusing brown lands to produce green areas
- S4: putting in place financial facilities and incentive schemes to help rebuild and replace Brown lands.
- S5: Using land use location to arrange incompatible lands

5. Discussion:

Brown land generation is one of the most important approaches to making cities resilient and continuing their further development in a sustainable way. In this respect, the results of the research at hand underline that such redevelopment of land will enhance city resilience against future crises by improving environmental, social, and economic indicators. Lands in arid and semi-arid areas have high potential for efficient use of this scarce resource to mitigate adverse impacts of climate change. (Dixon et al. 2018). These results, if compared to the previously conducted research studies, depict that the findings of this study stand along with the research studies conducted to date. For example, research has depicted that land degradation reverses climate change effects and degraded brown lands regenerate via environmental improvement. Similarly, (Yang, 2021). He also painted a positive relationship between the contribution of these lands, first in increasing green space and secondly in reducing environmental pollution in urban spaces. In this regard, (Nijhuis & Jauslin, 2015) note that community involvement

and the intertwining of social bonds are principal issues at the time of the regeneration process, to which the results of current research also correspond. Conclusively, therefore, from this research, it was found that the regeneration of brown land may help increase social interaction and improve existing inequalities of urban society, which corroborates findings by (Kamalipour & et al. 2018). That is in tune with the arena of environmental justice. In sum, considering that most of the previous research targeted areas that are predominantly wet, this paper has no doubt managed to capture arid and semi-arid regions—a scientific literature gap that not only addresses the scientific literature gap but underlines the role of the local strategies in brown land regeneration. This research has great potential for enhancing Brown lands redevelopment using a sustainable development approach towards enhancing urban resilience. In that respect, the study shows that lands regarded as Brown lands can be used to improve aspects such as community participation, green space, and reductions in air quality, among other virtues, enhancing resilience in the urban ecosystem. These findings further underline the necessity for an integrated, proper approach toward Brown lands redevelopment, of first concern to the local communities, and encouraging additional sustainable urban growth. The research has far-reaching implications and may apply in cities around the globe. Brown lands site redevelopment might help cities to be much more resilient, liveable, and sustainable; other than revitalizing underutilized neighbourhoods, it offers a crucial advantage in the creation of communities. Results also put into relief that legislators and urban planners must broaden the horizons of planning. Based on the findings of this study, certain recommendations could be made for further research and policy-practice initiatives concerning integrative urban planning, putting additional weight on the social, economic, and environmental dimensions of sustainability. First and foremost, further studies have to be carried out about the particular challenges and opportunities of Brown lands rehabilitation in different metropolitan contexts. Second, increasing the integration of Brown lands redevelopment into the urban planning process requires heightened coordination among the respective policymakers and urban planners. Third, through long-term monitoring, one can get a clear picture of whether initiatives related to Brown lands rehabilitation are sustainable and what their longitudinal impact is on local ecosystems. This paper ultimately illustrates how Brown lands redevelopment could be a key strategy in achieving improved urban resilience to natural disasters and other sustainability-related events. By embracing a sustainable development approach to Brown lands redevelopment, cities can create more liveable, sustainable, and resilient communities for current and future generations. According to the results obtained from the scoring of experts in the QSPM method, strategies such as repurposing Brown lands sites for mixed-use development, incorporating residential, commercial, and recreational spaces to increase urban density and resilience, and improving transportation infrastructure around Brown lands sites by incorporating pedestrian- and cyclist-friendly designs to reduce reliance on personal vehicles have been adopted as priority strategies in the scope of the case study of Boshruyeh city.

6. Conclusion:

This research has a high potential for the redevelopment of brown lands with a sustainable development approach and increasing urban resilience. The results show that brown lands can help strengthen resilience in urban ecosystems by improving green spaces, reducing air pollution, and increasing social participation. These findings will also form a basis for the integration of comprehensive and integrated approaches within the Brown lands regeneration process by attending to the needs of the local community while fostering sustainable growth of the cities. This study is different because the Brown

lands regeneration has proved to be a major strategy in the revitalization of underutilized urban neighborhoods; it also makes the city resilient and contributes to attaining sustainable communities. In particular, our findings are consistent with the results of (Dixon et al. 2018) and (Yang, 2021) are consistent, which emphasize the importance of revitalizing these lands in reducing the effects of climate change and improving environmental quality. The research also highlights some shortcomings. For example, one of the weaknesses of the research method is that more research is needed on some of the specific challenges of metropolitan areas and regions with different climates. Also, the lack of coordination between policy makers and urban planners in different stages of Brown lands redevelopment is considered as a key limitation. Nevertheless, the advantages of this approach are clearly evident. Using brown lands to develop mixed uses and strengthen transportation infrastructure around these areas helps to improve urban resilience. At the same time, reducing dependence on personal vehicles through the design of walking and cycling routes is also one of the advantages of this strategy. Application and implications these findings of the research, therefore, underscore the need to widen the perspective of policymakers and urban planners in the regeneration of brown land by paying more attention to the social, economic, and environmental dimensions of sustainable development. It is also dependent on long-term monitoring that is expected of the Brown lands reclamation projects in respect of general longitudinal effects on local ecosystems. Suggestion: It is also recommended that future studies be conducted on the challenges and opportunities with respect to the regeneration of Brown lands in different urban contexts. Additionally, an increased coordination should be considered among policy makers and urban planners in view to reaching more integrative approach in the course of development and revitalization of the lands in issue. By contrast, decision-making can be improved by a precise analysis of strategies for the long-term impacts on environmental and social resilience.

At the end, strategies have been proposed for these Solution

1- **Mixed-Use Development on Brown lands Sites** :Repurpose Brown lands sites for mixed-use development, incorporating residential, commercial, and recreational spaces to increase urban density and resilience.This strategy can help revitalize underutilized areas, increase tax revenue, and provide a range of services and amenities to residents.

2- **Transit-Oriented Development (TOD) :**Improve transportation infrastructure around Brown lands sites by incorporating transit-oriented development (TOD) principles .TOD involves designing mixed-use developments around public transportation hubs, reducing reliance on personal vehicles and promoting a more sustainable, walkable community.

3- Pedestrian-Friendly Infrastructure : Incorporate pedestrian-friendly infrastructure into Brown lands redevelopment plans, such as:

- ✓ Wide sidewalks and crosswalks
- ✓ Pedestrian-only zones
- ✓ Public art installations
- ✓ Accessible ramps and elevators .This strategy can help reduce traffic congestion, promote walkability, and enhance the overall quality of life for residents.

4- **Multimodal Transportation Hubs :**Create multimodal transportation hubs that integrate different modes of transportation, such as:

- ✓ Bus rapid transit (BRT)
- ✓ Bike-share systems

- ✓ Car-sharing programs
- ✓ Electric vehicle charging stations .These hubs can reduce traffic congestion, promote alternative modes of transportation, and increase access to employment and education opportunities.

These tactics seek to show how Brown lands can boost urban resilience through the creation of mixed-use neighbourhoods, better transit systems, and astute traffic control. These strategies can be included into plans for Brown lands redevelopment to help cities build more resilient, liveable, and sustainable communities.

AUTHOR CONTRIBUTIONS

Performing literature Review, collection of raw data, design, and distribution of questionnaires work with related software for data processing, and preparation of manuscript text and manuscript edition have been done by Hossein Balali. (Including substantive translation).

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.

Declarations

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