



Brownfield Regeneration as a Strategy for Sustainable Development: Amman Case Study

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Abstract. Brownfield regeneration has a positive impact on the quality of life in several dimensions, which enhances the livability and vitality of a city. On the contrary, Amman suffered from intensification of abandoned, derelict sites in the city center, along with severe deficiencies in terms of database and regeneration policy. Therefore, this research study aims to develop a flexible strategy for brownfield regeneration to encourage efforts toward implementation. This initially started by exploring all the brownfield sites in Amman in general and then those located in dynamic, vibrant locations in specific. Four case studies were selected, which included abandoned buildings within an urban setting. Spatial analysis was performed on case studies, including basic descriptive analysis, contextual analysis, and strength, weakness, opportunities, and threats analysis, which helped recognize the opportunities and challenges associated with different sites. The strategies were discussed further by several experts through the Delphi technique, where data were collected from relevant stakeholders to highlight the brownfield regeneration terminology in terms of definition, familiarity, opportunities and risks, governmental role, and policy availability, along with recommendations to improve the practice. Finally, several strategies were developed on the basis of collaboration between stakeholders. These strategies are hard to be generalized to all sites in different regions, as each one has specific issues that need to be considered. Therefore, further studies need to be conducted to validate the results of this study, foster the implementation of brownfield regeneration, and promote sustainable development by reducing urban sprawl and encouraging compactness.

Keywords: Brownfield regeneration; Delphi technique; Spatial analysis; Sustainable strategies

1. Introduction

Deindustrialization and financial crisis have resulted in the creation of abandoned, derelict, vacant, idle, or underutilized sites called “brownfield” sites (Alker et al., 2000; American Planning Association, 2005). Several institutions have attempted to develop a strategy to regenerate these sites because of their significance, along with opportunities to avert any negative impact. This can be seen clearly in developed countries where many relevant issues have been addressed in terms of managing resources, controlling urban sprawl, reducing public health risk, renewing urban cores, retaining existing jobs, and counteracting social stigma, which facilitates the development of brownfield regeneration policy (Kurtovića et al., 2014; Bardos et al., 2016). However, none was achieved in Jordan, except for a few fragmented projects initiated by private institutions or owners. More than 150 sites are spread throughout the city of Amman (the capital of Jordan)—ranging from

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tiny to huge—with various uses, such as industrial, commercial, military, and infrastructure (Yakhlef and Abed, 2019). Therefore, it is necessary to develop a strategy for brownfield regeneration that pursues an ideal intervention.

Currently, there is growing attention toward brownfield regeneration because of consensus on its profits. Several developments have been made throughout the world. In England, the national data show that 77% of the new homes built in 2008 were constructed on brownfield land that helped in limiting the sprawl and containing expansion. Such a strategy helps monitor the reuse of brownfield sites (Doick et al., 2009). Moreover, some countries in Europe have created regional programs with joint funds for land provision and urban renewal. Brownfield sites have been redeveloped into parks, town houses, economic estates, and social and cultural spaces. For example, the Karl-Heine-Kanal project in Leipzig (Germany) involved the redevelopment of an old industrial area. Another example is of Bristol Harbourside, which is made up of 22.7 hectares of previously idle and underutilized warehouses, railway yards, and industrial facilities that have been rehabilitated with a variety of uses (including housing, official, commercial, entertainment, retail, hotel, and parking), which has created about 4,000 new jobs (Perovic and Folić, 2012; Rosén et al., 2015; Gegic and Husukic, 2017). In general, it can be said that the redevelopment and regeneration of brownfield sites are widely performed because of great opportunities.

Consequently, brownfield regeneration is a holistic, integrated thinking strategy that reflects the interconnection of physical, social, environmental, economic, and institutional dimensions. Moreover, it maintains the harmony and balance of the environmental ecosystem by improving the quality of environment, minimizing the use of greenfield land, and speeding up remediation of existent pollution (Luziani and Paramita, 2018). So, it is necessary to discuss regeneration within the sustainability theme to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally sensitive, economically viable, institutionally robust, and socially acceptable ways within a particular context (Frantal et al., 2013; Kurtovića et al., 2014; Bardos et al., 2016). These benefits could be the result of a well-defined framework and flexible policy on the development of brownfield sites in terms of management and rehabilitation. Keeping this in mind, brownfield sites are not considered a harmful issue that needs to be resolved; rather, they are seen as areas with huge potential and opportunities that can be achieved by bringing long-lasting life back to these sites themselves, their surroundings, and the local community.

Despite the success of brownfield regeneration at the global level, along with the spread of several abandoned sites in downtown Amman, about 100 hectares of abandoned sites are concentrated in old districts of the city, and most are in a dilapidated condition. Still, there have been limited efforts in mapping problems and identifying opportunities, as well as there is a lack of a clear policy that would regulate this kind of development. This is combined with insufficient supporting funds that can initiate a change toward redevelopment. The city center has transformed from a place bustling with life into a lifeless structure with no identity (Meaton and Alnsour, 2012; Yakhlef and Abed, 2019). Keeping this in mind, this research study aims to understand the paradox of brownfield sites in facilitating a framework proposal for rehabilitation strategies using a real-life project or scenarios for case study. We hope this study gets developed into a policy that encourages stakeholders to move toward implementation.

1.1. Brownfield Regeneration

The significance of brownfield regeneration is well understood and has been a key element of urban development. This can be seen through benefits in economic, social, environmental, and institutional dimensions, which are called the “pillars of sustainability.”

The economic level includes: (1) being efficient and self-supporting; (2) providing employment opportunities; (3) promoting local economy; (4) encouraging attractive and functional landscapes; and (5) stimulating community prosperity. The social level involves: (1) encouraging social inclusion and cohesion; (2) promoting well-being; and (3) ensuring easy access to public facilities. The environmental level involves: (1) increasing the use of recycled resources; (2) protecting biodiversity and natural environment; (3) conserving natural and cultural heritage; and (4) combating climate change. Lastly, the institutional level covers: (1) planning processes for stakeholders at the local and regional levels; (2) encouraging citizen participation to bridge the gap between policy-makers and locals; and (3) being a mediator to achieve a balance between public and private interests (Doick et al., 2009; Atkinson et al., 2014; Kristianova et al., 2016; Woodhead, 2018). Such an approach can be seen as a practical problem-solving one, as it provides a balance between the four dimensions that seek to optimize the impact and benefits while preserving the potential of flexibility. Therefore, using sustainability as a guiding theme with brownfield regeneration would be a stepping stone to inclusive development.

In spite of the aforementioned rationality of a sustainable approach, brownfield regeneration faces a major challenge in terms of funds because of the huge amount it requires, which heavily affects the budget along with investment risk. Therefore, there is a need to instigate innovative financial paths, with the aim of encouraging private-sector participation in brownfield projects by leveraging a combination of public resource funds and private assets. In this context, four models of finance have been proposed, which are as follows: (1) public-private partnerships that depend on close cooperation between public and private partners; (2) land value finance that is designed to recover the capital cost of urban investment by capturing some, or all, of the increments in land value resulting from the investment; (3) urban development funds that integrate brownfield redevelopment into funds themselves by revolving the obtained funds; and (4) impact investment funds that are socially responsible investments taking the form of balanced investment over a range of projects (Berawi et al., 2018; Yakhlef, 2020). Selection of appropriate options required a full understanding by all stakeholders about the relationship between investment and real estate market to establish partnerships. On the basis of this, it is important to explore the context of brownfield regeneration in terms of feasibility and implementation opportunities, which would provide a better response to urban needs.

Brownfield sites are classified into three types on the basis of economic profit: (1) Viable sites are the ones where the private market works toward regeneration without public-sector funding because there are greater advantages than risks. These sites are mainly located in dense, economically dynamic locations. (2) Marginally nonviable sites are the ones that cannot be redeveloped without public-sector funding because of high remediation cost. (3) Nonviable sites offer limited economic possibilities because of their adverse location, which requires substantial public-sector funding. In this regard, the feasibility of brownfield regeneration is connected with the contamination level and spatial location of these sites. Regeneration would be effective for sites with medium or low contamination levels because of the less cost involved. Also, the location would be more viable if sites are situated in dynamic locations that have an active role in the community. Such sites would have more positive views and stand better chances of being regenerated (Frantal et al., 2013; Martinát et al., 2015). Therefore, this study focuses on dynamic locations that have significant cultural heritage with diverse land use and density attributes.

1.2. Brownfield Sites in Amman

Amman is the capital and largest city of Jordan that was initially established over seven hills and then expanded to include 19 more hills, combining 22 districts with a total area of approximately 700 km² (Al-Rawashdeh and Saleh, 2006; Jordan Department of Statistics, 2016). Amman is under the administration of Greater Amman Municipality (GAM) that has attempted to combine the British model in terms of city planning and the American model in terms of downzoning. This combination is being applied under the local Jordanian conditions of a poor economy, centralization, and lack of participation, along with rapid urbanization, leading to chaos and disorder in the city. Moreover, brownfield regeneration is not part of local policy or planning legislation. So, Amman has no official framework for renewal strategy (Meaton and Alnsour, 2012).

Amman has several patches containing abandoned sites of various uses in general and city center in specific. This was emphasized by Yakhlef and Abed (2019), who discussed the typologies of brownfield sites in terms of size, use, occupancy level, and physical condition. Fortunately, most of these sites have no real or perceived contamination problems because of their original use; therefore, they should be seen as viable sites in terms of feasibility and profitability. At the same time, Amman has several brownfield sites in vibrant locations that are in proximity to the city center or a major transportation axis. However, only one project was rehabilitated, called “Hanger and the New Ras al Ain Art Gallery,” which is located in downtown. It was constructed as an electricity company in 1938, and then it was closed and abandoned. In 2007, a partnership of Jabal Amman Residents Association and Greater Amman Municipality proposed the regeneration of Hangar as industrial heritage into a contemporary public space and special flea market, as shown in Figures 1a and 1b. Currently, Hanger can be considered a vital place that hosts many activities.

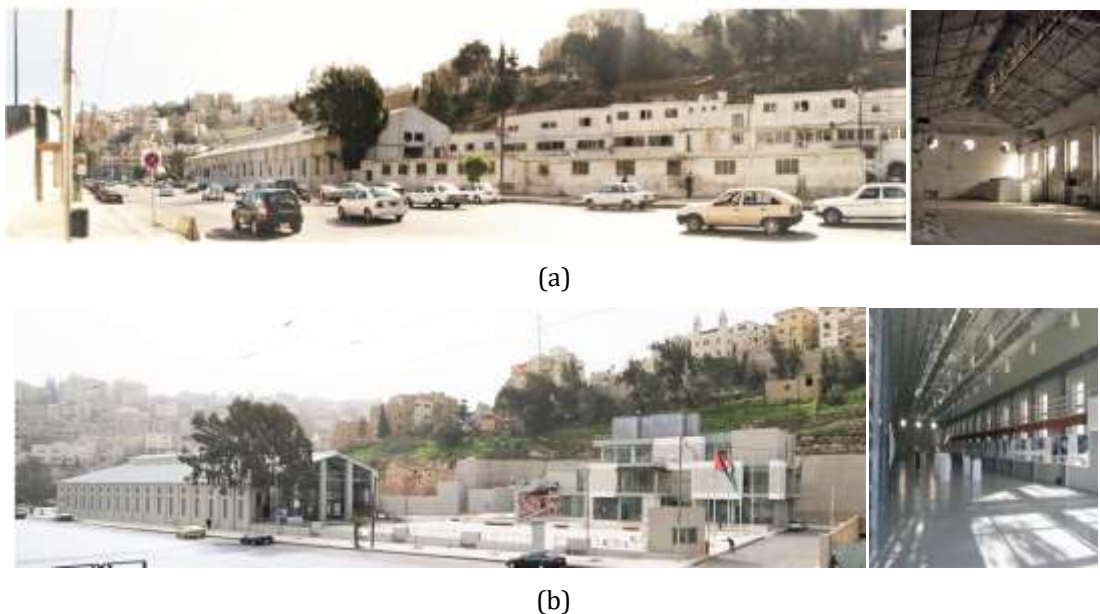


Figure 1 (a) Electricity company before regeneration; and (b) electricity company after regeneration as “Hanger and the New Ras al Ain Art Gallery”. *Source:* R.F. Daher (Turath Consultant), Adaptive Reuse of the Old Electricity Company, 2008.

Despite the success achieved in regenerating this project, unfortunately no other projects have been initiated later. Therefore, it is necessary to discuss the process of brownfield regeneration in a comprehensive manner, trying to motivate decision-makers and encouraging private-sector participation in such projects. Also, it is highly

recommended to study brownfield sites, which would improve the quality of life and enrich the spiritual dimension of the city.

2. Methods

A mixed-method approach was adopted to understand the significance, opportunities, and challenges associated with brownfield regeneration, with the aim of proposing strategies and guidelines. This was achieved through the following steps:

1. Spatial analysis, which is considered a baseline analysis, tackled brownfield attributes to understand the risk versus opportunities of development on the basis of stakeholders' feedback. Brownfield projects were selected on the basis of their proximity to dynamic, attractive geographic locations within the city, thus having a higher probability of being regenerated in the future with various original uses. On the basis of this, four sites were selected: (1) Abu Gorah Building; (2) Al Hussain Cinema; (3) Al Amayrah Building; and (4) Halawa Farm, as shown in Figures 2a to 2d.

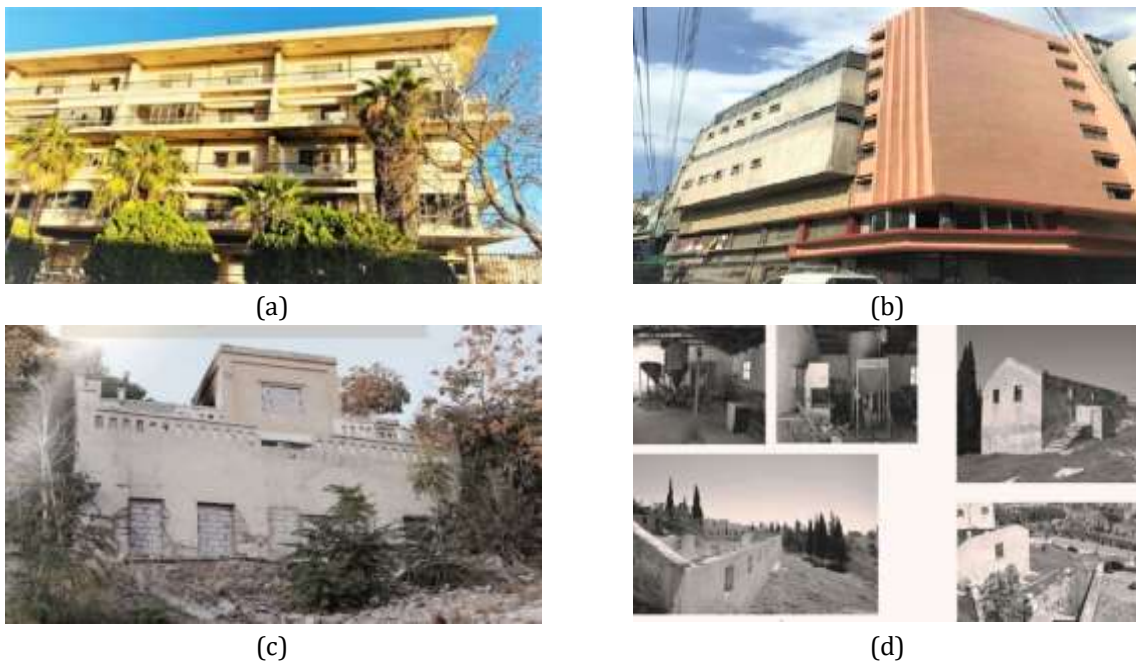


Figure 2 (a) Abu Gorah Building; (b) Al Hussain Cinema; (c) Al Amayrah Building; and (d) Halawa Farm.

Spatial analysis was performed using the following steps:

- a) Basic description of the selected sites included the following: (i) physical attributes (location, size, and construction date); (ii) ownership and function (original and current use); (iii) significance (historical, architectural, environmental, and spiritual values); and (iv) future visions of provincial strategies and municipal plans, as presented in Table 1.
- b) Contextual analysis considered the functional or structural aspects of certain areas within the sociological milieu. These features act as forces that affect the formulation of brownfield sites and their surroundings at macro-, meso-, and microlevels: (i) The macrolevel is associated with general factors, such as legislative instruments concerning national and regional development policies, spatial planning strategies, database availability, and political-institutional practices. (ii) The mesolevel is defined by brownfield attributes at a relevant spatial level that could be neighborhood or a district according to data availability. It captured the geographic location,

transportation accessibility, and sociodemographic structure of local communities, economic prospects, and community participation. (iii) The microlevel is related to the specific characteristics of a particular brownfield site, including property size, original use, current use, structural condition, ownership, contamination level, infrastructure, proximity to transportation, property price, and expected cost (Chrysochoou et al., 2012). The selected sites in this study were analyzed at macro-, meso-, and microscales to identify the urban fabric for these brownfield sites and their surroundings. The analysis was based on three theories of urban spatial design (figure-ground, linkage, and place): The figure-ground theory helps in understanding urban morphology by observing the relationship between the open space and the built form through several layers—including solid (ground) and void (figure)—defining the solid-and-void pattern, land use, growth pattern (tracing changes over time), building height, and open space typology. The linkage theory is based on linking parts of the city to organize a network system. It assists in understanding organizational axes to brownfield facilities in terms of movement and connectivity through several layers, including location, direction, street hierarchy, pedestrian paths, and entrances or exits to reveal accessibility. The place theory aids in understanding the sociocultural characteristics of brownfield sites by identifying cultural features that are driven from context. It helps in identifying human characteristics of physical space, local customs, architectural or heritage identity, and visual or scenery character (panoramic views from the location to surroundings and vice versa; Kiss and Kretz, 2016). Using this analysis can provide guidance on the positive and negative features of potential objectives and strategies toward integrated sustainable development.

Table 1 Basic description of the brownfield case study in Amman

Case study	Location	Construction	Significance	Original Use	Current Use
Abu Gorah Building	Downtown Jabal Amman near the first circle	1957	First modern architectural building in Amman	Residential building 1957, governmental building till 2009	Closed in 2009. Abandoned and unused
Al Hussain Cinema	Downtown Between Sira Street and Moqery Street	1958–1963	First modern movie theater in Amman	Movie theater. Closed in 2003	Closed in 2003. Abandoned and unused
AlAmayrah Building	Downtown Edge of the historic wall of Citadel	Early 1950s	Only cultural heritage residential building still standing along the wall of Citadel	Residential building	Closed in 2000. Abandoned and unused
Halawa Farm	Al Abdali district Alordon Street and Al- Shaheed Street	1952	Vibrant location with mixed-use facilities	Tobacco wrap warehouse, animal barn	Closed in 2007. Mainly abandoned

- c) The SWOT analysis is a strategic technique used to evaluate strengths, weaknesses, opportunities, and threats involved in a project in order to identify priority areas and activities for development (action areas). The significance of SWOT analysis lies in matching strengths to opportunities and converting threats or weaknesses into strengths or opportunities. If threats or weaknesses cannot be converted, they should be either minimized or avoided. The SWOT analysis needs to be performed in the form

of a matrix including external and internal aspects at different scales: (i) Microscale aspects include the current and future use, ecological aspects, financial issues, circulation, remediation potentials, and social or cultural aspects. (ii) Macroscale aspects cover neighborhood uses, infrastructure or transport situation, and market situation. (iii) Stakeholder engagement involves owners, investors, departments of municipalities, and locals (Schug and Ertel, 2011). This matrix was implemented for each case study in order to realize the action areas and potential strategies that can be implemented, as presented in Table 2. Using the SWOT analysis, action areas were identified with possible strategies to improve the quality of life in several dimensions, including environmental, social, and economic.

Table 2 SWOT analysis for selected case studies

Case study	Internal aspects		External aspects	
	Strength	Weakness	Opportunity	Threats
Abu Gorah Building	<ul style="list-style-type: none"> • Main urban node • Good structure 	<ul style="list-style-type: none"> • Abandoned • Negative behavior • Ownership (heirs) 	<ul style="list-style-type: none"> • Mixed use and residential • Public open space 	<ul style="list-style-type: none"> • Demolishing • Landlord's vision (capitalism)
Al Hussain Cinema	<ul style="list-style-type: none"> • Historical strip • Vibrant location • Well preserved 	<ul style="list-style-type: none"> • Abandoned • Negative effect on surroundings 	<ul style="list-style-type: none"> • Entertainment with cultural • mixed-use complex 	<ul style="list-style-type: none"> • Demolishing • No interest shown by owners and municipality
AlAmayrah Building	<ul style="list-style-type: none"> • Cultural heritage building • Historical site along the wall of Citadel 	<ul style="list-style-type: none"> • Deteriorated/abandoned • Negative scene next to tourist site 	<ul style="list-style-type: none"> • Cultural archive • Archeologist zone • Stay/study 	<ul style="list-style-type: none"> • Not officially listed as a heritage building • Not a stable structure
Halawa Farm	<ul style="list-style-type: none"> • Vibrant location • Accessibility • Diverse users 	<ul style="list-style-type: none"> • Deteriorated • Ownership (heirs) • Environmental contamination 	<ul style="list-style-type: none"> • Craft/hobby zone • Employment • Community farm 	<ul style="list-style-type: none"> • Future density • Municipality plans • No interest shown by owners

2. The Delphi technique relied on experts' feedback, using face-to-face interviews, with the objective of involving all stakeholders (governmental institutions, professional developers, nongovernmental organizations (NGOs), and local communities). The interviews were based on a structured questionnaire that consisted of four sections: (1) typology of company, type of development, and undertaken brownfield development; (2) level of interest and familiarity with brownfield projects, benefits, and challenges, along with willingness to be involved in such projects; (3) database availability, remediation technologies, regulations, and building codes; and (4) recommendations for developing guidelines to facilitate implementation toward sustainability. Data collection was performed in Arabic (the mother language of research settings) from August 10 to October 25, 2018. The interview lasted between 25 and 40 minutes, depending on the respondents' collaboration. A total of 40 respondents agreed to participate; they were distributed as follows: 10 employees from GAM, 10 architects, 3 urban designers, 12 developers, and 5 employees from NGOs. Two iterations of participatory workshops (cooperative design) were undertaken: The first workshop

involved a brainstorming session trying to get various points of view on good practice. The second workshop was conducted with local community participation (owners and residents from surroundings) for the selected case studies to gather feedback on proposed design guidelines in terms of function and image, as well as the suitability of strategies.

3. Results and Discussion

The collected data from the participating stakeholders showed that more than 80% of the total sample were aware of the typology of the project and scope of work, were passionate about it, and agreed with its significance. This reflected positively in their willingness to cooperate with governmental institutions in order to propose strategies and regulations to facilitate practice. Using the respondents' feedback, brownfield sites can be described as vulnerable because of natural and human hazards, such as weathering and aging, functional misuse, and lack of maintenance. About 70% of the respondents referred to brownfield sites as infill projects with vacant and damaged facilities. Only 20% of the respondents discussed contamination levels and pointed out that the pollution level and cleanup process are not complicated. In general, they agreed that limited effort has been invested in preserving these buildings and reusing them as luxurious antique shops, galleries, and restaurants, which marginalizes the local community and favors income-generating users.

The stakeholders emphasized that brownfield regeneration is a crucial issue required to highlight opportunities and challenges. The developers discussed opportunities in terms of locations represented by proximity to public transportation and thriving zones along with existing infrastructure, which helps expedite sales and positively affect profit. This was applicable in Amman, where most brownfield sites are concentrated in the city center. On the contrary, the developers underlined that the challenges associated with real estate in terms of the liability of environmental contamination and assessment of cleanup cost and timelines are complex and hard to determine. This requires an innovative strategy for financing, not a standard insufficient one. The architects' feedback was centered on those brownfield sites in Amman that have low contamination levels on the basis of their original use, which may facilitate redevelopment. The employees from NGOs pointed out that ownership is the most problematic issue, as most of the buildings constructed between the 1930s and 1950s are now owned by heirs, which could explain the poor maintenance of these properties. In general, the stakeholders' focus was on economic dimension; however, there is currently a serious need for a comprehensive evaluation including environmental, social, and cultural aspects.

According to the GAM employees' feedback, there is a growing interest in brownfield regeneration. However, there is no official database or statistics, except for a few initiatives and academic trials aiming to revitalize brownfield sites by documenting buildings, organizing workshops, and making initial proposals for decision-makers. So, interest in brownfield regeneration can be considered an individualistic mission and fragmented effort with little practical attention, which is mainly fruitless. Compared globally, there are several programs, guidelines, and regulations initiated to stimulate regeneration. Consequently, several schemes have been planned, implemented, and evaluated within the sustainability theme. Therefore, it is necessary to conduct research into this field in Jordan from different aspects, which may facilitate the development of a database including location, area, construction date, ownership status, connected infrastructure, original use, nature of hazardous substances, proposed plan, and estimated remediation cost. Such a database requires cooperation between different agencies, such as the Environmental Agency and

local government, along with support from several institutes, such as urban planning institutes, development departments, sustainable management programs, and land record authorities.

Brownfield regeneration in Jordan is still in a primitive stage that lacks technical regulations. Therefore, participatory workshops (cooperative design) are useful in setting up a guidance framework for improving practice at different levels, which is as follows:

1. Proposed strategies for municipality involve the following: (a) Initiate a provincial policy to limit greenfield investments and redirect them to brownfield sites. This may control the sprawl and activate the growth management plan within the sustainable theme. (b) Develop evaluation criteria to identify the priorities of brownfield sites on the basis of municipal leadership strategy, where the database may facilitate the selection process for developers. (c) Expedite the timelines of city approval for brownfield projects by hiring a coordinator-led team working with the advisory groups of such projects.
2. Proposed strategies for developers include (a) improving public awareness of opportunities between developers and providing them with a risk analysis model to increase the demand and enhance market for redevelopment and (b) initiating several alternatives of incentives and assistance fund programs, such as permit fees refund and tax-based development.
3. Proposed strategies for designers cover (a) improving several alternatives of remediation technologies using diverse scenarios; (b) utilizing innovative strategies, considering community needs and financial pressure, such as interim use and incremental design; (c) encouraging designers to adopt sustainable building principles, such as Energy Star and LEED standards (e.g., effective utilization of renewable resources could add value because of the scarcity of energy resources in Jordan); and (d) applying the concept of sustainability into brownfield regeneration by supporting intensification and mixed-use development, mixing of housing options, preserving cultural heritage resources, integrating green infrastructure, and supporting the competitive local economy.
4. Proposed strategies for the local community include (a) educating and informing the public about the importance of brownfield redevelopment by showcasing pilot projects, where the cleanup and regeneration of “stigmatized” sites would act as a catalyst for community improvement and (b) involving the local community from the beginning, which can help reach mature decisions. Moreover, transparency in informing the public about the vision and future development can help avoid possible conflicting issues.
5. Proposed strategies for stakeholder engagement involve (a) the increasing level of communication and collaboration between all stakeholders through different stages, starting from studies, planning, and design strategies to implementation and management; (b) aligning development strategy with other municipal priorities, such as downtown revitalization or infrastructure renewal may help ensure sufficient resources are devoted to project programs; and (c) engaging knowledgeable stakeholders in municipal development requirements, development process, finding programs, and remediation technologies. The more knowledgeable the stakeholders, the more useful the consultation.

These recommended strategies can be considered a starting point for a chain of integrated investigations that aim to propose an optimal solution for brownfield sites. We hope this would raise awareness about the possibilities of brownfield regeneration and encourage stakeholders in moving toward implementation within the context of Amman.

4. Conclusions

Brownfield regeneration is considered a successful strategy in developed countries, with growing attention to the last decade. Several sites were redeveloped in attractive sustainable themes to serve as catalysts for economic growth. Unfortunately, in Jordan, there has been no actual action taken on the cleanup policy and lack of available databases. Therefore, this study aims to develop a sustainable strategy for brownfield regeneration using an interdisciplinary approach. This would require an inclusive understanding of the context to maximize opportunities and minimize threats. Hence, a better vision for the revitalization process that implies synergy of theory, professional practice, and community is a must. Also, there is a need for collaboration between all stakeholders. There is also a need for entirely governmental levels to adopt management strategy to expedite sustainable development of brownfield sites. The finance dilemma needs to be relieved in order to attract local and global investors. Local communities need to be involved and informed about the project vision, which can play a key role in implementing strategies. All of this would encourage the stakeholders to move toward implementation within a flexible framework that is subject to continuous evaluation. In conclusion, this study serves as a starting point for broader dialogues with the stakeholders who need to discuss “brownfield regeneration” thoroughly in a series of workshops.

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